16,22,01

MarineScience SYMPOSIUM

Program of Events

January 21-24, 2007 Anchorage Hilton, Anchorage, Alaska

Sponsored by:

Alaska Fisheries Science Center Alaska Ocean Observing System Alaska Pacific University Alaska Sea Grant Alaska SeaLife Center Alliance for Coastal Technologies Exxon Valdez Oil Spill Trustee Council Kachemak Bay Research Reserve Minerals Management Service National Ocean Service National Park Service North Pacific Fishery Management Council North Pacific Research Board North Slope Science Initiative Oceans Alaska Science and Learning Center Oil Spill Recovery Institute Pollock Conservation Cooperative Research Center Prince William Sound Science Center University of Alaska Fairbanks US Arctic Research Commission **USGS Alaska Science Center**

Sunday, January 21: Workshops and Welcoming Reception

1000-1600

» Workshop: Communicating Ocean Science (Birch/Willow Rooms)

1300-1600

» Workshop: Gulf of Alaska Integrated Ecosystem Research Program (Denali Room)

1800-2100

» Posters: Evening Reception (Bristol Bay Ballroom)



January 22: Arctic Ocean

Morning Emcee: Denis Wiesenburg, School of Fisheries and Ocean Sciences, University of Alaska Fairbanks

Note: The Cook Inlet Room on the lobby level is available for speakers to use for presentation checks and rehearsals.

830-900

» Welcoming Remarks

900-945

» Keynote: Steve Amstrup Polar Bears and Climate Change

Session 1: Climate, Ocean and Lower Trophics

945-1000

» Stephen Okkonen, Session Chair: Intro and Poster Review

1000-1015

» Carin Ashjian: Environmental Variability Relative to Bowhead Whale Distribution and Prey Availability Near Barrow, Alaska

1015-1030

» Stephen Okkonen: Exchange Between Elson Lagoon and the Nearshore Beaufort Sea

1030-1045

» Break (Refreshments in Bristol Bay Ballroom)

1045-1100

» Rachel Potter: Using HF Radar to Map Surface Currents in the Beaufort Sea

1100-1115

Seth Danielson: Results from the Collection of Oceanographic Measurements from Three Nearshore Acoustic Doppler Current Meter Profilers (ADCPs) Along the Inner Beaufort Sea Shelf from Smith Bay to Camden Bay, Alaska

1115-1130

» Jia Wang: Simulating 20th Century Arctic Sea Ice and Ocean Circulation Variability Using a Global Coupled Atmosphere-Ice-Ocean-Land Mode

1130-1145

» Gleb Panteleev: Variational Reconstruction of the Quasistationary Bering Sea Circulation and Reanalysis of the Fall 1990 Circulation in the Chukchi Sea

1145-1200

» Nora Foster: Old Wine, New Bottles: Archiving George MacGinitie's Arctic Marine Invertebrate Data

1200-1215

» Kohei Mizobata: Recent Summer Chlorophyll Reduction Affected by the Warm Pacific Summer Water in the Chukchi Sea – Observation and Modeling

1215-1345

- » Lunch (provided in Alaska Ballroom)
- » Keynote: Thomas Litwin (Smith College) May You Live in Exciting Times: Climate Change, Public Understanding and Lessons from The Harriman Expedition Retraced

Afternoon Emcee: Michele Eder, North Pacific Research Board and US Arctic Research Commission

Session 2: Living Marine Resources

1345-1400

» Brendan Kelly, Session Chair: Intro and Poster Review

1400-1415

» Stephen Murphy: Factors Affecting the Subsistence Harvest of Arctic Cisco in the Colville River

1415-1430

» Nate Bickford: Fish Habitat and Otolith Chemistry

1430-1445

IAY

» David Roseneau: Monitoring Murres and Kittiwakes at Cape Lisburne, Alaska, 1976-2006

1445-1500

» **Dave Rugh:** Identifying Individual Bowhead Whales Through Aerial Photography

1500-1515

» Lori Quakenbush: Satellite Tracking of Western Arctic Bowhead Whales

1515-1530

» Break (Refreshments in Bristol Bay Ballroom)

1530-1545

» Ryan Huebinger: Microsatellite Analysis of Bowhead Whales from the Bering-Chukchi-Beaufort Seas with Regard to Population Stock Structure and Genetic Bottlenecks

1545-1600

» **Chadwick Jay:** Preliminary Identification of Pacific Walrus Subpopulations from Whole Tooth Elemental Analysis

1600-1615

» Michael Cameron: Diving Behavior, Habitat Use, and Movements of Bearded Seal Pups in the Bering and Chukchi Seas

1615-1630

» Brendan Kelly: Evidence of Philopatry in Ringed Seals

1630-1645

» Anthony Fischbach: Landward Shift in Polar Bear Denning Determined from Satellite Telemetry in Alaska

1645-1700

» **George Durner:** A Model for Autumn Pelagic Distribution of Adult Female Polar Bears in the Chukchi Sea, 1987-1994

1700-1715

 Cliff Ryer: Moving Toward a Process-Based Understanding of Essential Fish Habitat in Juvenile Flatfish Nurseries

Evening Activities

1800-1930

THEARCTIC

» Poster Reception: Bristol Bay Ballroom

1930-2100

» NPRB Contaminants Panel: Aleutian Ballroom



January 23: Bering Sea & Aleutian Islands

Morning Emcee: Kris Holderied, NOAA National Ocean Service

Note: The Cook Inlet Room on the lobby level is available for speakers to use for presentation checks and rehearsals.

Session 1: Climate, Ocean and Lower Trophics

800-815

» Phyllis Stabeno, Session Chair: Intro and Poster Review

815-830

» Phyllis Stabeno: Was 2006 An Anomalous Cold Year in a Warming Trend or a Shift in Decadal Climate Patterns?

830-845

» James Overland: What Will the Bering Sea Look Like in the Next 30 Years?

845-900

» Don Atwood: Monitoring Alaskan Marine Ecosystems with Synthetic Aperture Radar

900-915

» Mike Litzow: Warming Climate Alters the Biogeography of the Southern Bering Sea

915-930

» Meibing Jin: Late Ice Retreat and Ice-Associated Phytoplankton Blooms in the Southeastern Bering Sea

930-945

» Carolina Parada: Settlement Patterns of Snow Crab Associated with Warm (1979) and Cold (1990) Years in the Eastern Bering Sea

945-1000

» Break (Refreshments in Bristol Bay Ballroom)



Session 2: Fish and Fish Habitat

1000-1015

Kimberly Rand, Session Chair: Intro and Poster Review

1015-1030

» Paige Drobny: Squid Overload in the Bering Sea

1030-1045

Robert Walker: Information from Archival Tags on Salmon in the Bering Sea, 2003-2006

1045-1100

» Nicola Hillgruber: Distribution, Condition, and Age of Chum Salmon Juveniles in Western Alaska

1100-1115

Sara Miller: Estimation of Migration in an Age-Structured Population Dynamics Model of Eastern Bering Sea Walleye Pollock

1115-1130

» **Kimberly Rand:** Food Habits and Small-Scale Habitat Utilization of Atka Mackerel in the Aleutian Islands

1130-1145

» Daniel Cooper: Spatial and Temporal Variability in Atka Mackerel Female Maturity

1145-1200

» Jesus Jurado-Molina: Developing a Statistical-Multispecies Framework for a Predator-Prey System in the Eastern Bering Sea

1200-1300

- » Lunch (provided in Alaska Ballroom)
- » Keynote: Paula Keener-Chavis (NOAA Office of Ocean Exploration) Enhancing Ocean Science Literacy through NOAA Ocean Exploration

Afternoon Emcee: Leslie Cornick, Alaska Pacific University

Session 3: Seabirds

1300-1315

» Alan Springer, Session Chair: Intro and Poster Review

1315-1330

» Alan Springer: Hot Oceanography? A Seabird Story from the Pribilofs

TUESDAY | JANUARY 23

1330-1345

» Alexander Kitaysky: Early Ice Retreat Has Opposite Effects on Planktivorous and Piscivorous Top-Predators

1345-1400

» Ian Jones: The Meaning of Annual Variation in Auklet Demographic Parameters and Chick Diets

1400-1415

» Steffen Oppel: King Eider Winter Movements in the Bering Sea Tracked by Satellite Telemetry

1415-1430

» Greg Balogh: Inter-Specific Differences in Marine Habitat Use by Albatrosses in Alaska

Session 4: Marine Mammals

1430-1445

» Andrew Trites, Session Chair: Intro and Poster Review

1445-1500

» **Tom Gelatt:** On Their Own: Migrations of Northern Fur Seal Pups from Increasing and Decreasing Populations

1500-1515

» Break (Refreshments in Bristol Bay Ballroom)

1515-1530

» Alison Banks: Consequences of Fur Seal Foraging Strategies (COFFS) – Interannual Variability

1530-1545

» Vladimir Burkanov: Overview of Abundance and Trends of Northern Fur Seals in the Commander Islands, 1958-2006 – Caveats and Conclusions

1545-1600

» Brian Battaile: The Decline and Fall of the Alaskan Pinniped Empire

1600-1615

» John Bickham: Population and Evolutionary Genetic Analyses Using Multiple Nuclear and Mitochondrial Loci in Steller Sea Lions

1615-1630

» Kelly Newman: Killer Whales Do It In The Dark: Nocturnal Activity By Transients At St. Paul Island

1630-1645

» David Mellinger: An Acoustic Survey for Right and Other Endangered Whales in the Bering Sea



Session 5: Human and Community Impacts

1645-1700

Steve MacLean, Session Chair: Intro and Poster Review

1700-1715

» **Randy Hagenstein:** The Pribilof Island Collaborative: Complex Problems, Collaborative Solutions

1715-1730

» Sarah Kruse: The Pribilof Islands: Establishing a Socioeconomic Baseline

1730-1745

» Ellen Lance: Evaluation of Three Techniques for Baseline Monitoring of Petroleum Hydrocarbon Contamination in Nelson Lagoon, Alaska

Evening Activities

1800-1930

» Poster Reception: Bristol Bay Ballroom

1930-2100

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BERING SEA AND A

» Evening Town Hall Meeting on Arctic Research: US Arctic Research Commission (Aleutian Room)



January 24: Gulf of Alaska

Emcee: Michael Baffrey, EVOS Trustee Council

Note: The Cook Inlet Room on the lobby level is available for speakers to use for presentation checks and rehearsals.

Session 1: Climate and Oceanography

745-800

» Scott Pegau, Session Chair: Intro and Poster Review

800-815

» Scott Pegau: Connecting Oceanography and Fisheries in the Offshore Test Fishing Program

815-830

» **William Sydeman:** Meso-Marine Ecosystems of the North Pacific: Seasonal and Interannual Variability

830-845

» Tal Ezer: Modeling and Satellite Observations of Tidally-Driven Currents and Mud Flats Flooding in Cook Inlet, Alaska

845-900

» Lisa Etherington: Oceanography of Glacier Bay: Implications for Biological Patterns and Productivity in a Temperate Glacial Fjord

900-915

» Mario Tamburri: ACT and Integrated Sensor Systems for Vessels of Opportunity

915-930

» Molly McCammon: Special Poster Review: Ecosystem Perspectives and Human/Community Impacts

Session 2: Lower Trophic Levels

930-945

» K.O. Coyle, Session Chair: Intro and Poster Review

945-1000

» K.O. Coyle: Calibration of an NPZ Model for Use with a Three-Dimensional Physical Model to Simulate Ecological Mechanisms on the Northern GOA Shelf



1000-1015

» Break (Refreshments in Bristol Bay Ballroom)

1015-1030

» **Jon Houghton:** Intertidal Benthos in Iniskin/Iliamna Bay: A 28-Year Baseline and Hints of Climate Change?

1030-1045

» Nick Harman: Role of Grazers in the Recolonization of Hard Bottom Communities in Kachemak Bay, Alaska

1045-1100

» Dennis Lees: Clams and Armor: Were They Casualties of The War on the Beaches?

Session 3: Fish and Fish Habitat

1100-1115

» Brenda Norcross, Session Chair: Intro and Poster Review

1115-1130

» Brenda Norcross: A Model of Early Life History Survival for Pacific Herring in Prince William Sound

1130-1145

» **Elizabeth Logerwell:** Distribution and Feeding Ecology of Juvenile Walleye Pollock and Capelin in the GOA

1145-1200

» Sean Powers: Assessing Residence Time and Habitat Use of Coho and Sockeye Salmon in Alaska Estuaries

1200-1300

- » Lunch (provided in Alaska Ballroom)
- » Keynote: Jan Straley (University of Alaska Southeast) Swimming in the Lunch Line: Underwater Footage of Sperm Whales near Longline Fishing Gear

1300-1315

» **Bruce Finney:** Effects of Marine-Derived Nutrients on Biological Production in Sockeye Salmon Systems

1315-1330

» Gregg Rosenkranz: Machine Vision Benthic Imaging in the GOA

1330-1345

» **Julie Nielson:** Using synthetic aperture acoustic telemetry to determine location, timing and spatial aggregation of female Tanner crabs during reproductive events

1345-1400

» **John Harper:** The ShoreZone Coastal Dataset as a Research Tool

GULF OF ALASKA

WEDNESDAY | JANUARY 24

1400-1415

» Matthew Berman: Spatial Fisheries Values in the GOA

Session 4: Seabirds and Marine Mammals

1415-1430

» Peter Boveng, Session Chair: Intro and Poster Review

1430-1445

» Briana Witteveen: Investigation of Foraging Habits and Prey Selection by Humpback Whales Using Acoustic Tags and Concurrent Fish Surveys

1445-1500

» Edward Gregr: Multi-Scale Predictions of Right Whale Habitat in the North Pacific and Bering Sea

1500-1515

» Craig Matkin: Killer Whales in the Northern GOA: Status, Trends, and Tagging

1515-1530

» Break (Refreshments in Bristol Bay Ballroom)

1530-1545

» Greg O'Corry-Crowe: Genetic Indicators of Metapopulation Boundaries and Dynamics in Steller sea Lions: Implications for Recovery

1545-1600

» Andreas Fahlman: Open-Water Steller Sea Lion Research Station Provides New Insights into the Real Costs of Diving for Food

1600-1615

» Jamie Womble: Linking Seasonal Distribution Patterns with Prey Availability in Steller Sea Lions

1615-1630

» Elizabeth Mathews: The Role of Predation by Steller Sea Lions in the Population Decline of Harbor Seals in Glacier Bay National Park, Alaska

1630-1645

» Peter Boveng: Strong Seasonal Dynamics of Harbor Seals, an Upper-Trophic Predator in Cook Inlet

1645-1700

» Caroline Jezierski: Impact of Ecotourism on Harbor Seal Behavior in Pedersen Lake, Kenai Fjords National Park

1700

» Symposium Closing Remarks





The 2007 Alaska Marine Science Symposium was sponsored by:

Alaska Fisheries Science Center Alaska Ocean Observing System Alaska Pacific University Alaska Sea Grant Alaska SeaLife Center Alliance for Coastal Technologies Exxon Valdez Oil Spill Trustee Council Kachemak Bay Research Reserve Minerals Management Service National Ocean Service National Park Service North Pacific Fishery Management Council North Pacific Research Board North Slope Science Initiative Oceans Alaska Science and Learning Center Oil Spill Recovery Institute Pollock Conservation Cooperative Research Center Prince William Sound Science Center University of Alaska Fairbanks

US Arctic Research Commission

USGS Alaska Science Center

www.alaskamarinescience.org









photography Contest















2007 NPRB Photography Contest The North Pacific Research Board invites you to

enter your images in our first annual photography competition.

We welcome images of coastal seascapes or sea life within U.S. waters from the Gulf of Alaska, Prince William Sound, Aleutian Islands, Bering Sea, Bering Strait or Beaufort/Chukchi Seas.

The deadline for entry is March 15, 2007 Winners will be announced May 1, 2007

Prizes will be awarded in two age categories:

Youth (ages 18 and younger): \$600 First Prize; \$400 Second Prize; \$200 Third Prize Adult (over 18): \$1,200 First Prize; \$600 Second Prize; \$300 Third Prize

Please see the NPRB website for official rules and regulations before entering images.

www.nprb.org

Photos top to bottom, left to right- NPRB; Randall Davis, Texas A&M; Karna McKinney, NOAA; C. Loren Buck, NPRB PI; Karna McKinney, NOAA



United States Arctic Research Commission

Town Hall Meeting

at the Alaska Marine Science Symposium Anchorage Hilton, Aleutian Room Tuesday, 23 January 2007, 7:30-9:00 PM

Please join the U.S. Arctic Research Commission for an evening 'Town Hall Meeting' regarding our upcoming *Report on Goals and Objectives for Arctic Research*. The Commission will first present a short overview of the major topics of our report. Next, and most importantly, we will facilitate a conversation with the audience seeking your ideas and views for inclusion in this key strategic guide. All participants will be provided an opportunity to make a brief statement (1-2 minutes maximum) about a key issue or point regarding U.S. Arctic research. We will endeavor to capture these key points throughout the evening and use them in the preparation of our final report.

We invite all participants in the Symposium to join us and contribute to this conversation with the Commission.

Mead Treadwell Chairman, U.S. Arctic Research Commission

John Farrell, PhD Executive Director, Arlington, VA

Lawson Brigham, PhD Alaska Office Director, Anchorage, AK



NORTH PACIFIC RESEARCH BOARD

"Building a clear understanding of the North Pacific, Bering Sea, and Arctic Ocean ecosystems that enables effective management and sustainable use of marine resources."

Tylan Schrock, Chairman Stephanie Madsen, Vice-Chairman Clarence Pautzke, Executive Director 1007 West 3rd Avenue, Suite 100 Anchorage, AK 99501 Phone: (907) 644-6700 Fax: 644-6780

NPRB Contaminants Panel

2007 Alaska Marine Science Symposium Aleutian Room, Anchorage Hilton Hotel Monday, January 22nd: 7:30 – 9:00 pm

1. Panel Members

- Clarence Pautzke (Facilitator)
- Shannon Atkinson
- Jim Berner
- Patricia Cochran
- Doug Dasher
- Larry Duffy
- Jesse Ford
- Michael Smolen

2. Agenda

- a. Introduction and Overview (Pautzke)
 - i. Introduce panel members and recognize audience members who are leaders of contaminants labs in or outside Alaska

North Pacific Research Board

Alaska Native Tribal Health Consortium

Alaska Native Science Commission

University of Alaska Fairbanks Oregon State University

University of Alaska Fairbanks, Alaska SeaLife Center

Alaska Department of Environmental Conservation

- ii. Explain purpose of panel
 - 1. Better communicate NPRB needs with goal of receiving better proposals
 - 2. Increase communication between contaminants researchers

Purdue University

- 3. Raise awareness about contaminants programs and issues in Alaska marine ecosystems and how they may impact humans and resources.
- iii. Summarize contaminants section of NPRB Science Plan and describe results of RFPs
- b. Individual panelist presentations (5-7 min each) on current research interests
- c. Panel roundtable discussion:
 - i. Current major contaminants programs and agency activities in Alaska
 - ii. New directions for contaminants research and how NPRB can make a difference
 - iii. Identify specific high priority contaminants topics for NPRB 2008 RFP
- d. Audience interaction and input as appropriate
- e. Concluding remarks

Deliverable: Refined selection of contaminants research priorities for 2008 RFP and future RFPs, as well as summary of major programs currently supporting contaminants research off Alaska.



2008 National Ocean Sciences Bowl

www.sfos.uaf.edu/nosb

www.nosb.org

NATIONAL OCEAN SCIENCES BOWL

The University of Alaska Fairbanks will host the National Ocean Sciences Bowl (NOSB) Final Competition in **Seward, Alaska on April 25-27, 2008**.

The NOSB is a "quiz bowl" style academic competition for high school students in topics related to the study of the oceans. It provides an educational forum for students who excel in math and science to receive national recognition for their diligence and talents. 2008 will be the 10th anniversary of the NOSB.



Cordova high school team members put their heads together during the 2005 Tsunami Bowl. Photo credit: Hank Pennington.

High school students compete in 26 regional NOSB competitions across the United States, including Alaska. The winning five-member team from each region attends the National Ocean Sciences Bowl competition.

The national competition has been held in various locations across the contiguous United States, but never in Alaska.







The Unalaska high school team competes at the 2005 Tsunami Bowl, Alaska's regional NOSB competition. Photo credit: Hank Pennington.

The 2008 NOSB national finals will bring over 250 volunteers, students, judges, and family members to Seward.

The additional cost of bringing this national competition to Alaska requires the support of Alaska's tourism industry, marine community and industry leaders.

Your support for the NOSB finals in Alaska will allow talented high school students from around the nation compete for the national title in the state with half of the U.S. coastline and the largest fishery in the world.



For more information, please contact: Denis Wiesenburg, Dean School of Fisheries and Ocean Sciences University of Alaska Fairbanks Tel: 907-474-7210 E-mail: wiesenburg@sfos.uaf.edu

UAF is an AA/EO employer and educational institution. NOSB is a registered trademark of the Consortium for Oceanographic Research and Education.

SFOS School of Fisheries and Ocean Sciences



www.sfos.uaf.edu

MISSION

The School of Fisheries and Ocean Sciences is dedicated to the pursuit of excellence in education, research and public service concerning marine and freshwater ecosystems, and to fostering sustainable use of these resources for the benefit of Alaska, the nation and the world.

ABOUT US

The School of Fisheries and Ocean Sciences is one of the most diverse schools in the University of Alaska Fairbanks both in geographic distribution and academic mission, with faculty in twelve locations.

SFOS offers programs leading to baccalaureate degrees in Fisheries and master's and doctoral degrees in Oceanography, Fisheries, and Marine Biology. We are educating the next generation of leaders for the fisheries and ocean related industries in Alaska and the Northwest.

Faculty research at the School of Fisheries and Ocean Sciences extends from the rivers of Alaska to the fisheries of the Bering Sea and from Arctic Ocean oceanography to marine mammals in the Antarctic.



Rock Greenling near Amchitka Island, Alaska. Photo courtesy of Stephen Jewett, SFOS Scientific Diving Program.

FACTS

- Over \$16 million in research funding each year
- 55 faculty in five major locations across Alaska
- 155 students in M.S. and Ph.D. programs
- SFOS faculty and research staff collaborate with over 60 state, national, international and private agencies.
- Marine Advisory Program (MAP) agents are located in Unalaska, Homer, Kodiak, Bethel, Cordova, Dillingham, Anchorage, Petersburg and Ketchikan.



The R/V Alpha Helix in Prince William Sound. Photo credit: Tom Kline.

SELECTED RESEARCH PROGRAMS Census of Marine Life (CoML)

SFOS faculty have a leadership role in this 70-nation, tenyear initiative. Funded by the Sloan Foundation, CoML strives to assess and explain the diversity, distribution and abundance of marine life in the world's oceans. www.coml.org

West Coast & Polar Regions Undersea Research Center WCPRURC supports highly-rated, peer-reviewed proposals to conduct in situ research in the region offshore California, Oregon, Washington, Alaska, and the Arctic and Antarctic. www.westnurc.uaf.edu



The SFOS divisions are located in five Alaska communities.

Alaska Ocean Observing System (AOOS)

SFOS faculty are leading the effort to construct an expanded ocean observing system in waters off Alaska. This program will combine data collection and modeling to provide real time information on oceanographic conditions in the Gulf of Alaska, Bering Sea and Arctic Ocean. www.aoos.org

Pollock Conservation Cooperative Research Center The PCCRC focuses on the commercial fisheries of the Bering Sea and Aleutian Islands and funds SFOS faculty to investigate problems important to the seafood industry. www.sfos.uaf.edu/pcc

UAF is an AA/EO employer and educational institution.

SFOS School of Fisheries and Ocean Sciences



www.sfos.uaf.edu

SFOS DIVISIONS

Institute of Marine Science

IMS is active in research and graduate training at the master's and doctoral levels. IMS conducts marine science studies in the world's oceans, with special emphasis on arctic and Pacific subarctic waters.

Fishery Industrial Technology Center

Our Kodiak faculty work to increase the value of the Alaska fishing industry through academic and research programs in sustainable harvesting and seafood technology.

Fisheries Division

Through collaborative efforts with state, national and international organizations, our fisheries faculty study how to develop and maintain sustainable fisheries programs in Alaska and global waters.

Alaska Sea Grant/Marine Advisory Program

Alaska Sea Grant funds marine research, provides education and advisory services and distributes information about Alaska's seas and coasts.

Global Undersea Research Unit

GURU's faculty and graduate students emphasize seafloor research in marine biology and geology. GURU provides access to undersea technologies and operates NOAA's Kasitsna Bay Laboratory near Seldovia.

Seward Marine Center

SMC provides access to saltwater laboratories and the coastal environment with excellent laboratories, constant temperature chambers and a running seawater system.



SFOS oceanographers at work on the R/V Alpha Helix. Photo credit: Sarah Thornton.



A jellyfish in the Aleutian Islands. Photo courtesy of Stephen Jewett, SFOS Scientific Diving Program.

2006 ACCOMPLISHMENTS

- Secured \$5,000,000 Rasmuson Foundation grant to enhance SFOS academic programs
- Broke ground on new Lena Point fisheries facility in Juneau
- Established Dr. Keith Criddle as the first Ted Stevens Distinguished Professor of Marine Policy
- Hired two new fisheries faculty, including a new program coordinator for the undergraduate fisheries degree
- Selected to host the 2008 National Ocean Sciences Bowl finals competition in Seward, Alaska
- Alaska Sea Grant rated among the nation's best Sea Grant programs
- Awarded three International Polar Year post-doctoral fellowships by the University of Alaska

2007 GOALS

- Secure the Alaska Region Research Vessel for UAF
- Increase ecosystem-based research activities in the Bering Sea
- Improve education and research facilities for SFOS faculty and students
- Add new oceanography faculty in Fairbanks
- Update our distance delivery systems to high-definition systems at all locations

CONTACT US

Dr. Denis Wiesenburg, Dean School of Fisheries and Ocean Sciences University of Alaska Fairbanks P.O. Box 757220 Fairbanks, AK 99775-7220

Tel: (907) 474-7210 Fax: (907) 474-7204 E-mail: info@sfos.uaf.edu

www.sfos.uaf.edu



January 21-24, 2007 Anchorage Hilton Anchorage, AK

Additional Abstracts

Brian Allee

UAF Sea Grant

Unifying the Vision: Advancing an Alaska Regional Marine Research Plan

While much research has and is being done, Alaska has the opportunity to create a statewide mechanism through which management entities and stakeholders can collaborate, plan, prioritize, communicate, and advance an ecosystem- based, interdisciplinary (ecological, economic, and social) research approach to address management-critical coastal and marine resource needs.

A framework for creating such a mechanism lies within the 2004 U.S. Commission on Ocean Policy report, An Ocean Blueprint for the 21st Century. This watershed document urges federal and state agencies, regional fishery councils, and other relevant stakeholders collaborate to craft regional marine research plans that advance the concept of ecosystem-based management. To facilitate this planning effort, NOAA's National Sea Grant College Program designated eleven regional marine ecosystems around the country. Alaska is identified as a distinct region. The Alaska Sea Grant College Program recently received an award of \$250,000 over two years to assist Alaska Regional Research planning efforts, and will receive up to \$50,000 in each of the following three years to sustain the effort.

Following consultation with state and federal managers and stakeholders, Alaska Sea Grant is leading efforts to facilitate the crafting of an Alaska regional plan that as a first step focuses on the Aleutian Islands. Chief among the outcomes of the plan would be an assessment of research and information needs, with the overall goal to develop a comprehensive plan that focuses ecosystem-based research, technology transfer, and outreach efforts on the highest priority issues within the Aleutian Island region. A key partner in this effort is the Alaska Marine Ecosystem Forum (AMEF). The primary role of the AMEF is to enhance coordination in support of the sustainable management of Alaska's marine ecosystems.



Pamela M. Lestenkof Andrew Trites

Marine Mammal Research Unit, University of British Columbia

Fine scale foraging behavior of female northern fur seals (Callorhinus ursinus)

The decline of the Pribilof Island population of northern fur seals (Callorhinus ursinus) since the late 1970s is not well understood. It has been suggested that commercial fisheries may be affecting the abundance of fur seals' key prey, contributing to their decline and (or) impeding their recovery. Previous studies have identified the at-sea locations, movement patterns and two-dimensional plots of time and depth of fur seals, but the resolution of data has been too coarse to assess critical habitat and the spatial overlap with fisheries. With the advent of new data loggers, more dive parameters can be collected allowing dives to be depicted in three dimensions. Information collected by a 12-channel deadreckoner was used to determine the pelagic habitat of fur seals during the breeding season on a finer spatial scale than is currently available. A total of 16 lactating fur seals were tracked from St. Paul Island in 2005 and 2006. We obtained detailed information on fur seal diving patterns and movements in the Bering Sea. These results provide a better understanding of fur seal foraging behavior and ultimately provide an improved assessment of critical habitat and the degree of spatial overlap with fisheries. Studying fur seal foraging behavior at a fine scale is a necessary step towards addressing the question of potential interactions between northern fur seals and commercial fisheries operating in the vicinity of the Pribilof Islands.



Sheryl Salasky

Chugach School District

Mapping and Surveying of Mineral Creek State Park

This year the Valdez Youth Area Watch group will be continuing an ongoing project of mapping and surveying Mineral Creek State Park. The purpose of this project is to gather information regarding the species in this area for the Alaska Department of Fish and Game and the City of Valdez, because of the interest to further develop this area. Our group had the opportunity to look at a number of different plans that The City of Valdez Planning and Zoning Commission had created. We used earlier observations and our own data to evaluate the effects each individual plan had on the ecosystem. We have been using G.P.S. to map the various ecological zones and note the locations of bald eagle nesting sites, bear trails, and anadromous streams. We will also continue to monitor life in the Mineral Creek area by performing random and maximum density counts on a few species of intertidal life with the aid of mud-core, quadrat sampling, and monitoring of invasive species (European Green crab).

Maximum density testing was done on barnacles and mussels present in the area in April 2005 and 2006. By taking the count in three different quadrants we had designated, we averaged the maximum density of barnacles (760) and mussels (83). We also took the random density, again selecting three quadrants and averaging the random densities of barnacles (130) and mussels (49). The number of eagle nests in the area (2) was also recorded, along with the G.P.S. location. After observing the activity of the nests, we evaluated the potential effects development could have on this area and the current natural inhabitants.

Until more data are collected again this year in the Mineral Creek State Park area, and until the Mineral Creek State Park development begins, there is little to conclude concerning what effect extensive human use could have on the area's ecosystem. Water quality testing will also be introduced into our surveying data this year, to evaluate what effects future development of the Mineral Creek area has on the water quality. The baseline data we collect this year will be compared with previous year's data to help project the impact of increased human usage as development looms on the horizon.



Janet Hall Schempf

Alaska Department of Fish and Game

ADF&G Refuges, Critical Habitat Areas, and Sanctuaries

Twenty-four legislatively designated refuges, sanctuaries, and critical habitat areas managed by the Alaska Department of Fish and Game (ADF&G) encompass estuarine and marine habitats. These areas, collectively known as "Special Areas," were established to protect unique or exceptional habitats supporting a broad diversity of species, for the conservation of fish and wildlife populations, and for the public use and enjoyment of high quality environments. These areas also have other societal uses and values, including commercial fishing, subsistence and game hunting, oil and gas exploration and development, recreation, and tourism.

The poster presentation is a map showing the locations of ADF&G's Special Areas and Alaska's Coastal Boundaries. The accompanying PowerPoint show presents information about management objectives and the indicators used for evaluating success of particular ADF&G Special Areas. Specific biological, socio-economic, and governance indicators used to measure the effectiveness of management actions in achieving goals and objectives will be detailed.

Mike Turek, SRSIII

Alaska Department of Fish and Game

Subsistence Harvests and Local Knowledge of Alaska Rockfish

This project will collect and analyze local traditional knowledge (LTK) about rockfish to augment the information available through conventional management approaches. Are subsistence fishers significant contributors to rockfish harvests? Does LTK contribute to sustainable harvest practices, and if so how? We expect to find that LTK is applied to reduce incidental rockfish harvests in the subsistence halibut fishery. The research will employ a combination of social science methods: participant observation, systematic household surveys, and structured key respondent interviews in order to document local knowledge and observations regarding rockfish populations, describe the contemporary subsistence harvest strategies for rockfish (how LTK is applied by its practitioners), and to define the relationship between the subsistence halibut fishery and rockfish harvests to assist in subsistence fisheries management.



Frank A. Whitney

Institute of Ocean Sciences, Fisheries and Oceans Canada

Decreasing oxygen levels in the interior waters of the subarctic Pacific

To understand the 50 year record of oxygen decline at Ocean Station P (OSP, 50° N, 145° W), the transport of ventilated waters throughout the interior of the subarctic Pacific is assessed. A slightly modified NO parameter (Broecker, 1974) shows that the highest nitrate-oxygen signature in intermediate waters of the North Pacific is found in the Bering Sea Gyre and East Kamchatka Current. Through mixing with low NO waters found in the Sea of Okhotsk and the subtropics, this signature is diluted as waters flow south to the Japanese coast, then eastward across the Pacific. Evidence of northward flow from California is seen along the coasts of British Columbia and Alaska. Subsurface waters of the Alaskan Gyre region are estimated on average to be an equal mixture of western subarctic and subtropical waters. At OSP on the 26.5, 26.7 and 26.9 density surfaces, oxygen is declining at 0.74, 0.69 and 0.59 μ mol kg-1 y-1 as temperatures increase by 0.009, 0.012 and 0.011 C r^{-1} . Other features are discernible in these data, including periods of increased ventilation on an \sim 18 year cycle and strong variability caused by passing mesoscale eddies. The long record of measurements at OSP removes most of the bias created by bi-decadal oscillations, providing a more reliable estimate of oxygen declines in eastern subarctic waters than those estimated from repeat ocean surveys.

Stephani G. Zador*, André E. Punt, and Julia K. Parrish University of Washington, School of Aquatic and Fishery Sciences

Population impacts of endangered short-tailed albatross bycatch in the alaskan trawl fishery

We conducted a decision analysis that explores the effects of trawl-related fisheries mortality on achieving the population recovery goals for the U.S. federally-endangered shorttailed albatross (*Phoebastria albatrus*), proposed by the U.S. Fish and Wildlife Service. A population model was constructed and its parameters estimated by fitting it to counts of the numbers of albatross chicks and eggs at Torishima Island, Japan, where 83% of the world's population of this species is found. Bayesian inference was used to assign probabilities to alternative plausible rates of fishing mortality and to conduct population projections with different levels of trawl mortality to determine their effects on achieving the population recovery goals. The analyses of the impact of trawl mortality on the Torishima short-tailed albatross population suggest that exceeding the current expected incidental take in the Alaska groundfish trawl fishery, two in any five year period, by as much as a factor of 10 would have little impact on when the proposed recovery goals for the species are achieved. A quantitative approach that addresses uncertainty such as that outlined in this study could aid the process to evaluate allowable limits in light of species recovery goals by addressing both take limits and recovery goals within the same framework.

Alaska MarineScience SYMPOSIUM

Participant List

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Sponsored by:

Alaska Fisheries Science Center Alaska Ocean Observing System Alaska Pacific University Alaska Sea Grant Alaska SeaLife Center Alliance for Coastal Technologies Exxon Valdez Oil Spill Trustee Council Kachemak Bay Research Reserve Minerals Management Service National Ocean Service National Park Service North Pacific Fishery Management Council North Pacific Research Board North Slope Science Initiative Oceans Alaska Science and Learning Center Oil Spill Recovery Institute Pollock Conservation Cooperative Research Center Prince William Sound Science Center University of Alaska Fairbanks US Arctic Research Commission USGS Alaska Science Center

Adams, Kenneth Kenneth Adams Prince William Sound Fisheries Research Application and Planning kadams@gci.net box 1855 Cordova, AK, 99574, usa Phone: 907-424-5456

Alexander, Vera Vera Alexander University of Alaska Fairbanks vera@sfos.uaf.edu School of Fisheries and Ocean Sciences University of Alaska Fairbanks Fairbanks, AK, 99775-7220, usa Phone: 907-474-5071 Fax: 907-474-7386

Allee, Brian Brian Allee, Ph.D NOAA Alaska Sea Grant College Program allee@sfos.uaf.edu University of Alaska Fairbanks Fairbanks, AK, 99775-5040, usa Phone: 907-474-7949

Ammann, Erika Erika Ammann NOAA erika.ammann@noaa.gov NOAA Fisheries 222 West 7th Ave Anchorage, AK, 99501, usa Phone: 907 271 5118 Fax: 907 271 3030

Anderson, Donald Don Anderson Woods Hole Oceanographic Institution danderson@whoi.edu Biology Department, MS #32 266 Woods Hole Road . Woods Hole, MA, 02543, usa Phone: (508) 289-2351 Fax: (508) 457-2027

Andrews, Elizabeth Elizabeth Andrews Alaska Dept. of Fish and Game elizabeth_andrews@fishgame.state.ak.us P.O. Box 115526 Juneau, AK, 99811-5526, usa Phone: 907-465-4146

Andrews, Russel Russ Andrews UAF and Alaska SeaLife Center russ_andrews@alaskasealife.org Alaska SeaLife Center P.O. Box 1329 Seward, AK, 99664, usa Phone: 907-224-6344 Fax: 907-224-6371 Apeti, Dennis Dennis Apeti National Oceanic and Atmospheric Administration dennis.apeti@noaa.gov 1305 East West Highway Room 9111 Silver Spring, MD, 20910, usa Phone: (301) 713 3028 Fax: (301) 713 4388

Arimitsu, Mayumi Yumi Arimitsu USGS - Alaska Science Center marimitsu@usgs.gov USGS-Glacier Bay Field Station 3100 National Park Rd Juneau, AK, 99801, usa Phone: 907-364-1593 Fax: 907-364-1540

Ashjian, Carin Carin Ashjian Woods Hole Oceanographic Institution cashjian@whoi.edu MS #33 WHOI Woods Hole, MA, 02543, usa Phone: 508-289-3457

Atkinson, Shannon Shannon Atkinson, Ph.D. University of Alaska Fairbanks/Alaska SeaLife Center shannon_atkinson@alaskasealife.org 301 Railway Ave. POB 1329 Seward, AK, 99664-1329, usa Phone: 907-224-6346 Fax: 907-224-6360

Atwood, Don Don Atwood Alaska Satellite Facility datwood@asf.alaska.edu PO Box 757320 Fairbanks, AK, 99775-7320, usa Phone: 907 474 7380 Fax: 907 474 6441

Baffrey, Michael Michael Baffrey Exxon Valdez Oil Spill Trustee Council michael_baffrey@evostc.state.ak.us 441 West 5th Avenue, Suite 500 Anchorage, AK, 99501, usa Phone: 907-278-8012 Fax: 907-276-7178 Baird, Steve Steve Baird Kachemak Bay Research Reserve steve_baird@fishgame.state.ak.us Kachemak Bay Research Reserve 95 Sterling Highway, Suite 2 Homer, AK, 99603, usa Phone: 907-226-4655

Baker, Laura Laura Baker The Nature Conservancy Ibaker@tnc.org 119 Seward St. #2 Juneau, AK, 99801, usa Phone: (907) 586-8623

Baker, Torie Torie Baker Alaska Sea Grant/EVOS PAC torie@sfos.uaf.edu PO Box 830 Cordova, AK, 99574, usa Phone: 9074243820

Ban, Su Sue Ban Entrix Environmental Consultants sban@entrix.com 1600 A Street Suite 304 Anchorage , AK, 99501, usa Phone: 907-261-7703 Fax: 907-563-0439

Banks, Alison Alison Banks University of Alaska, Fairbanks banks@sfos.uaf.edu University of Alaska Fairbanks 905 N. Koyukuk Dr., Suite 245 Fairbanks, AK, 99775, usa Phone: 907-474-2456

Baraff, Lisa Lisa Baraff University of Alaska Fairbanks fslsb1@uaf.edu P.O. Box 85314 Fairbanks, AK, 99708, usa Phone: (907)479-0747

Batten, Sonia Sonia Batten Sir Alister Hardy Foundation for Ocean Science soba@sahfos.ac.uk 4737 Vista View Crescent Nanaimo, BC, V9V 1N8, can Phone: 1-250-756-7747 Battiale, Brian Brian Battaile ,Marine Mammal Research Unit, UBC Marine Mammal Research Unit b.battaile@fisheries.ubc.ca MMRU Room 247, AERL, 2202 Main Mall Vancouver, BC, V6T 1Z4, can Phone: 6048229890

Bechtol, William Bill Bechtol University of Alaska Fairbanks ftwrb2@uaf.edu 11120 Glacier Hwy Juneau, AK, 99801, usa Phone: 907/796-2054

Becker, Paul Paul Becker National Institute of Standards and Technology paul.becker@nist.gov NIST, Hollings Marine Laboratory 331 Fort Johnson Road Charleston, SC, 29412, usa Phone: 843-762-8861 Fax: 843-762-8742

Belanger, Claude Claude Belanger Prince William Sound Science Center belanger@pwssc.gen.ak.us P.O. Box 705 Cordova, AK, 99574, usa Phone: 907-242-5800 ext.235

Bennett, Alan Alan Bennett National Park Service alan_bennett@nps.gov Southwest Alaska Network-NPS 240 West 5th Ave Anchorage, AK, 99501, usa Phone: 907/644-3681

Bennett, Barbara Barbara Bennett, American Cetacean Society American Cetacean Society aknaturalist@aol.com 7201 South Park Drive Anchorage, AK, 99516, usa Phone: 907-345-6205

Benowitz-Fredericks, Morgan Morgan Benowitz-Fredericks University of Alaska Fairbanks ffzmb@uaf.edu 311 Irving I University of Alaska Fairbanks Fairbanks, AK, 99775, usa Phone: (907) 474-5179 Benson, David Dave Benson Pollock Conservation Cooperative dwbenson@comcast.net 5303 Shilshole Ave. NW Seattle, WA, 98107, usa Phone: 206-297-6442

Benter, Robert Brad Benter USFWS brad_benter@fws.gov 1011 E Tudor Road Anchorage, AK, 99503, usa Phone: (907) 786 3980

Fax: (907) 786 3816

Berman, Matthew Matt Berman University of Alaska Anchorage matt.berman@uaa.alaska.edu 4218 W. 11th Ave. Vancouver, BC, V6R 2L7, can Phone: (604) 822-5602

Bickford, Nate Nate Bickford UAF nate@sfos.uaf.edu P.O. Box 757220 Fairbanks, AK, 99701, usa Phone: 907-474-6469

Bickham, John John W. Bickham, Center for the Environment, Purdue University Purdue University bickham@purdue.edu Center for the Environment, Purdue University 503 Northwestern Ave. West Lafayette, IN, 47907-2699, usa Phone: 1-765-494-1369

Bird, Nancy Nancy Bird Prince William Sound Science Center & Oil Spill Recovery Institute bird@pwssc.gen.ak.us P.O. Box 705 Cordova, AK, 99574, usa Phone: 9074245800 Fax: 9074245820

Bishop, Mary Anne Mary Anne Bishop Prince William Sound Science Center mbishop@pwssc.gen.ak.us PO Box 705 Cordova, AK, 99574, usa Phone: 907-424-5800 x 228 Fax: 907-424-5820 Bizzarro, Joseph Joseph J. Bizzarro Moss Landing Marine Laboratories jbizzarro@mlml.calstate.edu 8272 Moss Landing Rd. Moss Landing, CA, 95039, usa Phone: 831-771-4438 Fax: 831-632-4403

Blakeslee, Mark Mark Blakeslee / AquaLife Engineering / Kodiak Aqualife Engineering klcmark@gci.net PO Box 3696 Kodiak, AK, 99615, usa Phone: 907 486-4995

Blundell, Gail Gail Blundell Alaska Dept. of Fish and Game gail_blundell@fishgame.state.ak.us ADF&G/DWC PO Box 240020 Douglas, AK, 99824, usa Phone: (907) 465-4345 Fax: (907) 465-4272 /

Bochenek, Robert Rob Bochenek Axiom Consulting and Design rob@axiomdms.com 2554 Glacier Anchorage, AK, 99508, usa Phone: 907-677-5930

Bodkin, James Jim Bodkin US Geological Survey james_bodkin@usgs.gov 1011 E. Tudor Rd. Anchorage, AK, 99503, usa Phone: 907 786 3550

Boerner, Catherine Catherine Boerner Exxon Valdez Oil Spill Trustee Council catherine_boerner@evostc.state.ak.us 500 W. 5th Avenue Suite 500 Anchorage, AK, 99501, usa Phone: 265-9328

Bohn, Dede Dede Bohn USGS dbohn@usgs.gov 1011 E. Tudor Rd. Anchorage, AK, 99503, usa Phone: 907-786-3685 Fax: 907-786-3636

Boudreau, Susan

Susan L Boudreau Department of Interior susan_boudreau@nps.gov Glacier Bay National Park and Preserve PO Box 140 Gustavus, AK, 99826, usa Phone: 907-796-2397 Fax: 907-697-2654

Boveng, Peter Peter Boveng NOAA Alaska Fisheries Science Center peter.boveng@noaa.gov 7600 Sand point Way NE Seattle, WA, 98115, usa Phone: 206-526-4244

Brewer, Jennifer Jennifer Brewer Kachemak Bay Research Reserve jennifer_brewer@fishgame.state.ak.us KBRR 95 Sterling Hwy Suite 2 Homer, AK, 99603, usa Phone: 907-226-4657

Brewer, Michael Casey Brewer Aleut Community of St. Paul Island-Tribal Government mcbrewer@tribaleco.com 2050 Venia Minor Road St. Paul Island, AK, 99660, usa Phone: 907-546-3232 Fax: 907-546-3253

Brewer, Reid Reid Brewer University of Alaska Fairbanks brewer@ims.uaf.edu PO Box 526 Unalaska, AK, 99685, usa Phone: 9075814589

Brock, Mathew Mathew Brock Alaska Department of Fish and Game mathew_brock@fishgame.state.ak.us 1255 W. 8th Street PO Box 115526 Juneau, AK, 99811-5526, usa Phone: 907-465-2747

Bromaghin, Jeff Jeff Bromaghin US Fish and Wildlife Service jeffrey_bromaghin@fws.gov 1011 E. Tudor Road Mail Stop 331 Anchorage, AK, 99503, usa Phone: 907-786-3559 Fax: 907-786-3350 Brown, Evelyn Evelyn Brown, Flying Fish Ltd. Flying Fish Ltd. husumbandb@earthlink.net P.O. Box 169 866 Hwy 141 Husum, WA, 98623, usa Phone: 509-493-8900

Brown, Liz Liz Brown University of Alaska Fairbanks bfeab@uaf.edu PO Box 1549 Dillilngham, AK, 99576, usa Phone: 907-842-1265

Bryant, Joni Joni R. Bryant Alaska Native Harbor Seal Commission jonibryant@harborsealcommission.org 800 East Dimond Blvd #3-590 Anchorage, AK, 99516, usa Phone: 907-345-0554 Fax: 907-345-0566

Buckley, Mark Mark K. Buckley Digital Observer Inc. mkbuckley@alaska.com Box 649 Kodiak, AK, 99615, usa Phone: 907 486-4684

Bue, Brian Brian Bue Bue Consulting bbue@mtaonline.net P.O. Box 641 Palmer, AK, 99645, usa Phone: 907-745-0182

Burkanov, Vladimir Vladimir Burkanov, NRC Inc., NMML/AFSC/NMFS/NOAA Natural Resources Consultants, Inc.; NMML/AFSC/NMFS/NOAA vladimir.burkanov@noaa.gov 7600 Sand Piont Way, NE Building 4 Seattle, WA, 98119, usa Phone: 206-526-4298

Burns, Jennifer Jennifer Burns University of Alaska Anchorage afjmb4@uaa.alaska.edu Dept Biology, EBL 123 3211 Providence Dr Anchorage, AK, 99508, usa Phone: 907-786-1527 Fax: 907-786-1314 Bychkov, Alexander Alexander Bychkov PICES (North Pacific Marine Science Organization) bychkov@pices.int 9860 West Saanich Road, P.O. Box 6000 Sidney, BC, V8L 4B2, can Phone: 1-250-363-6364 Fax: 1-250-363-6827

Byerly, Mike Mike Byerly Alaska Dept. of Fish and Game mike_byerly@fishgame.state.ak.us 3298 Douglas Place Homer, AK, 99603, usa Phone: 907-235-1745

Byrd, Vernon Vernon Byrd Alaska Maritime National Wildlife Refuge vernon_byrd@fws.gov 95 Sterling Hwy Homer, AK, 99603, usa Phone: 907-235-6546

Calkins, Donald Don Calkins Alaska SeaLife Center don_calkins@alaskasealife.org 301 Railway Ave. POB 1329 Seward, AK, 99664-1329, usa Phone: 907-224-6325 Fax: 907-224-6360

Call, Katherine Kate Call NOAA/NMFS/NMML Kate.Call@noaa.gov National Marine Mammal Laboratory 7600 Sand Point Way NE Seattle, WA, 98115, usa Phone: 206-526-6868 Fax: 206-526-6615

Cameron, Michael. Michael Cameron NOAA/NMFS michael.cameron@noaa.gov 7600 Sand point Way NE Seattle, WA, 98115, usa Phone: (206) 526-6396 Fax: (206) 526-6615

Campbell, Rob Rob Campbell PWS Science Center, Cordova Prince William Sound Science Center rob.campbell@uni-hamburg.de P.O. Box 705 Cordova, AK, 99574, usa Phone: 9074245800 Fax: 9074245820 Canino, Michael Michael Canino Alaska Fisheries Science Center Mike.Canino@noaa.gov 7600 Sand point Way NE Seattle, WA, 98115, usa Phone: 206.302.2477 Fax: 206.526.6723

Carlile, David Dave Carlile State of Alaska dave_carlile@fishgame.state.ak.us 1255 W. 8th St. PO Box 115526 Juneau, AK, 99811-5526, usa Phone: 907-465-4216

Carter, Brian

Brian Carter Alaska Pacific University bcarter@alaskapacific.edu 3711 Casper Ct. Apt 3 Anchorage, AK, 99502, usa Phone: 907-646-1102

Cermak, Rob Rob Cermak Alaska Ocean Observing System cermak@sfos.uaf.edu School of Fisheries and Ocean Sciences Suite 245 905 N. Koyukuk Dr. Fairbanks, AK, 99775-7220, usa Phone: 1-907-474-7048 Fax: 1-907-474-7204

Childs, Jefferson Jeff Childs University of Alaska Oceanauts@gci.net POB 111406 Anchorage, AK, 99511, usa Phone: 907-770-0562

Christie, David David Christie University of Alaska Fairbanks dchristie@guru.uaf.edu PO Box 757220 Fairbanks, AK, 99775-7220, usa Phone: 907-474-7836 Fax: 907-474-5804

Chythlook, Helen Helen Chythlook, BBNA Marine Mammal Coordinator Bristol Bay Native Association hchythlook@bbna.com P.O. Box 310 Dillingham, AK, 99576, usa Phone: (907)-842-5257, ext. 340 Fax: (907)-842-5932 Clark, Cheryl Cheryl Clark Alaska Department of Fish and Game cheryl_clark@fishgame.state.ak.us 525 West 67th Ave Anchorage, AK, 99518, usa Phone: (907) 267-2888

Clark, Robert Bob Clark Alaska Department of Fish and Game bob_clark@fishgame.state.ak.us 333 Raspberry Rd Anchorage, AK, 99518, usa Phone: 907 267-2222

Cochran, Patricia Patricia Cochran Alaska Native Science Commission/Inuit Circumpolar Council pcochran@aknsc.org 429 L Street Anchorage, AK, 99501, usa Phone: 9072582672

Cokelet, Edward Dr. Ned Cokelet NOAA Pacific Marine Environmental Laboratory edward.d.cokelet@noaa.gov 7600 Sand Point Way NE Seattle, WA, 98115-6439, usa Phone: (206) 526-6820 Fax: (206) 526-6485

Colonell, Jack JACK COLONELL Entrix Environmental Consultants jcolonell@entrix.com Entrix Inc. 1600 A St., Suite 304 Anchorage, AK, 99501, usa Phone: 907.261.7709 Fax: 907.563.0439

Connor, Joseph Joseph Connor Arctic Slope Regional Corporation joseph.connor@asrcenergy.com 3900 C Street, Suite 601 Anchorage, AK, 99503, usa Phone: 907-339-5455 Fax: 907-339-6758

Coon, Cathy Cathy Coon North Pacific Fishery Management Council cathy.coon@noaa.gov 605 W 4th Ave Suite 306 Anchorage, AK, 99501, usa Phone: 9072711503 Cooper, Daniel Dan Cooper AFSC dan.cooper@noaa.gov 7600 Sand Point Way F/AKC-2 Seattle, WA, 98115, usa Phone: 206-526-4330

Corin, Lenny Lenny Corin U.S. Fish and Wildlife Service leonard_corin@fws.gov MS 361, 1011 E. Tudor Road Anchorage, AK, 99503, usa Phone: 907-786-3619 Fax: 907-786-3350

Cornick, Leslie Leslie Cornick Alaska Pacific University Icornick@alaskapacific.edu 4101 University Drive Anchorage, AK, 99508, usa Phone: 907-564-8885 Fax: 907-562-4276

Couvillion, Amalie Amalie Couvillion The Nature Conservancy acouvillion@tnc.org 715 L Street Anchorage, AK, 99501, usa Phone: 907 276 3133

Cowles, Cleve Cleve Cowles Minerals Management Service Cleveland.Cowles@mms.gov 3801 Centerpoint Dr. Anchorage, AK, 99503-5823, usa Phone: 907-334-5281

Cox, Marlin Keith Cox Sheldon Jackson College kcox@sj-alaska.edu 801 Lincoln Street Sitka, AK, 99835, usa Phone: 907 747 5296

Coyle, Kenneth Ken Coyle University of Alaska coyle@ims.uaf.edu Institute of Marine Science University of Alaska Fairbanks, AK, 99775-7220, usa Phone: 907 474 7705 Fax: 907 474 7204 Crawford, Richard

Dr. Rick Crawford - Prince William Sound Science Center Prince William Sound Science Center rcrawford@pwssc.gen.ak.us PO Box 705 Cordova, AK, 99574, usa Phone: 907-424-5800

Criddle, Keith Keith Criddle University of Alaska Fairbanks ffkrc@uaf.eud 11120 Glaceir Hwy Juneau, AK, 99821, usa Phone: 907-796-6449

Csepp, David David Csepp NOAA/NMFS/ Auke Bay Lab NOAA/NMFS/AFSC/Auke Bay Lab dave.csepp@noaa.gov Auke Bay Lab 11305 Glacier Hwy Juneau, AK, 99801, usa Phone: 907-789-6075

Cullen, Kirsten Kirsten Cullen YAW Jenny_Heckathorn@valdez.cc Phone: 835-4767

Cullenberg, Paula Paula Cullenberg, Marine Advisory Program, Alaska Sea Grant Marine Advisory Program, Alaska Sea Grant pcullenberg @uaa.alaska.edu 1007 W 3rd Suite 100 Anchorage, AK, 99516, usa Phone: 907 274-9691

Daly, Benjamin Ben Daly University of Alaska Fairbanks daly@sfos.uaf.edu PO Box 3191 Homer, AK, 99603, usa Phone: 802-779-1549

Daly, Imoge Imogen J. Daly *** imodaly@care2.com 326 W11th AVe Anchorage, AK, 99501, usa Phone: 907 277-4396 Fax: 907 277-4396 Danielson, Seth Seth Danielson UAF seth@ims.uaf.edu UAF-SFOS Rm. 126 O'Neill Bldg Fairbanks, AK, 99775-7220, usa Phone: 907 474 7834 Fax: 907 474 7204

Dasher, Douglas Douglas Dasger State of Alaska doug_dasher@dec.state.ak.us 610 University Ave. Fairbanks, AK, 99709, usa Phone: 907-451-2172 Fax: 907-451-5146

DaSilva Lage, Jana Jana DaSilva Lage Fugro Pelagos jlage@fugro.com 615 East 82nd. Ave. Suite 304 Anchorage, AK, 99518, usa Phone: 907-258-1799 Fax: 907-258-3422

Davis, Randall Randall Davis Texas A&M University davisr@tamug.edu Texas A&M University 5007 Avenue U League City, TX, 77551, usa Phone: 281-250-7839 Fax: 281-334-5065

Deans, Nora Nora L. Deans Alaska SeaLife Center norad@alaskasealife.org 1007 West Third Avenue Suite 100 Anchorage, AK, 99501, usa Phone: 907.644.6707 Fax: 907.644.6780

Dehn, Larissa Lara Dehn University of Alaska Fairbanks ftld@uaf.edu Institute of Arctic Biology University of Alaska Fairbanks Fairbanks, AK, 99775-7000, usa Phone: 907-474-5799 Fax: 907-474-6967 Denlinger, Lynn Lyndi Denlinger U.S. Fish and Wildlife Service Lynn_Denlinger@fws.gov 1011 E. Tudor Rd Anchorage, AK, 99503, usa Phone: (907) 786-3945

Dillon, Tim Tim Dillon, Alaska SeaLife Center Alaska SeaLife Center jotimazdad@hotmail.com 1007 W 3rd Avenue Suite 100 Anchorage, AK, 99577, usa Phone: 907-242-9709 Fax: 907-644-6780

Dizard, Jesse Dr. Jesse Dizard Division of Subsistence jesse_dizard@fishgame.state.ak.us ADF&G Division of Subsistence P.O. Box 115526 Juneau, AK, 99811-5526, usa Phone: 907-465-6292 Fax: 907-465-2066

Dong, Changming Changming Dong Institute of Geophysical and Planetary Physics, UCLA cdong@atmos.ucla.edu 3637 Geology Bldg IGPP/UCLA Los Angeles, CA, 90098, usa Phone: 310-825-5402 Fax: 310-206-3051

Douglas, David David Douglas USGS Alaska Science Center ddouglas@usgs.gov 3100 National Park Road Juneau, AK, 99801, usa Phone: 907-364-1576

Dragoo, Don Don Dragoo Alaska Maritime National Wildlife Refuge don_dragoo@fws.gov 95 Sterling Hwy. Suite 1 Homer, AK, 99603, usa Phone: 907-226-4626

Driskell, William William Driskell Consultant bdriskell@comcast.net 6536 20th ave ne seattle, WA, 98115, usa Phone: 206-522-5930 Drobny, Susan Paige Drobny UAF fsspd@uaf.edu po box 83209 fairbanks, AK, 99708, usa Phone: 9074747918

Dugan, Larry

Larry Dugan Arctic Slope Regional Corporation lawrence.dugan@asrcenergy.com 3900 C Street, Suite 601 Anchorage, AK, 99053, usa Phone: 907-339-5463 Fax: 907-339-6758

Eagleton, Matthew Matthew Eagleton NOAA Fisheries NOAA Fisheries matthew.eagleton@noaa.gov 222 West 7th Ave., #43 Rm 517 Anchorage, AK, 99513, usa Phone: 9072716354

Ebert, David David Ebert Pacific Shark Research Center/Moss Landing Marine Laboratories debert@mlml.calstate.edu 8272 Moss Landing Road Moss Landing, CA, 95039, usa Phone: 831-771-4427 Fax: 831-632-4403

Eder, Michele Michele Longo Eder U.S. Arctic Research Commission michele@michelelongoeder.com P O Box 1530 Newport, OR, 97365, usa Phone: 541-265-3337 Fax: 541-265-6633

Eidam, Dona Dona Eidam USGS AK Science Center eidam.d@alaska.com 18036 Misty Falls Circle Eagle River, AK, 99577, usa Phone: 694-7143

Eischens, Carrie Carrie Beck Eischens Alaska Department of Fish & Game charlotte_eischens@fishgame.state.ak.us 525 W. 67th Avenue Anchorage, AK, 99518, usa Phone: 907-267-2887 Fax: 907-267-2859 Eisner, Lisa Lisa Eisner NOAA/NMFS/AFSC lisa.eisner@noaa.gov 11305 Glacier Highway Juneau, AK, 99801, usa Phone: 907-789-6602 Fax: 907-789-6094

Esler, Dan Dan Esler Centre for Wildlife Ecology desler@sfu.ca Centre for Wildlife Ecology - SFU 5421 Robertson Road Delta, BC, V4K 3N2, can Phone: 604 940-4652

Esslinger, George George Esslinger U.S. Geological Survey george_esslinger@usgs.gov 1011 East Tudor Rd Anchorage, AK, 99503, usa Phone: 907-786-3606

Etherington, Lisa Lisa Etherington NOAA, Cordell Bank National Marine Sanctuary lisa.etherington@noaa.gov P.O. Box 159 Olema, CA, 94950, usa Phone: 415-663-1443 Fax: 415-663-0315

Evanoff, Larry Larry Evanoff EVOS Trustee Council Imevanoff@hotmail.com PO Box 8003 Chenega Bay, AK, 99574, usa Phone: 907/573-5317

Ezer, Tal Tal Ezer Princeton University ezer@splash.princeton.edu AOS Program, Sayre Hall P.O.Box CN710 Princeton, NJ, 08544-0710, usa Phone: 609-2581318

Fadely, Brian Brian Fadely NOAA Fisheries Alaska Fisheries Science Center brian.fadely@noaa.gov National Marine Mammal Lab 7600 Sand Point Way, NE Seattle, WA, 98115, usa Phone: 206-526-6173 Fax: 206-526-6615 Fahlman, Andreas Andreas Fahlman UBC fahlman@zoology.ubc.ca UBC Marine Mammal Research Unit Room 247, AERL, 2202 Main Mall Vancouver, BC, V6T 1Z4, can Phone: +1-604-827-3166

Farrell, John John Farrell U.S. Arctic Research Commission jfarrell@arctic.gov 4350 N. Fairfax Drive Suite 510 Arlington, VA, 22203, usa Phone: (703) 525-0111 Fax: (703) 525-0114

Farrow, Kathy Kathy Farrow US Arctic Research Commssion k.farrow@arctic.gov 4350 N. Fairfax Drive Suite 510 Arlington, VA, 22203, usa Phone: 703-525-0111 Fax: 703-525-0114

Finney, Bruce Bruce Finney University of Alaska Fairbanks finney@ims.uaf.edu Institute of Marine Science Univ. Alaska Fairbanks Fairbanks, AK, 99775, usa Phone: 907-474-7724 Fax: 907-474-7204

Fischbach, Anthony Anthony Fischbach USGS Alaska Science Center afischbach@usgs.gov 4230 University Dr. Anchorage, AK, 99508, usa Phone: 907.786.7145 Fax: 786.786.7150

Flinn, Rowenna Rowenna Flinn University of British Columbia r.flinn@fisheries.ubc.ca Marine Mammal Research Unit, AERL, 2202 Main Mall University of British Columbia Vancouver, BC, V6T 1Z4, can Phone: (604)822-8181 Fluharty, David David Fluharty, School of Marine Affairs, University of Washington University of Washington fluharty@u.washington.edu 3707 Brooklyn Ave. NE Seattle, WA, 98105, usa Phone: 206-685-2518 Fax: 206-543-1417

Follmann, Erich Erich Follmann University of Alaska Fairbanks ffehf@uaf.edu P. O. Box 757000 Fairbanks, AK, 99775-7000, usa Phone: 907-474-7338 Fax: 907-474-6967

Foster, Nora Nora R. Foster University of Alaska Museum swamprat@mosquitonet.com 2998 Gold Hill Road Fairbanks, AK, 99709, usa Phone: 907 474 9557

Foy, Catherine Cathy Foy Aleutians East Borough catherinefoy@ak.net 301 Research Ct Kodiak, AK, 99615, usa Phone: 907-486-1541

Foy, Robert Robert Foy University of Alaska Fairbanks foy@sfos.uaf.edu 118 Trident Way Kodiak, AK, 99615, usa Phone: 907-486-1514

Fruzza, Emily Emily Fruzza The Alaska Sea Otter and Steller Sea Lion Commission efruzza@seaotter-sealion.org 6239 B Street, Suite #204 Anchorage, AK, 99518, usa Phone: 907-274-9799

Fuller, Philip phil fuller norseman maritime charters llc norsemanchtr@comcast.net 15 pinecrest dr york, ME, 03909, usa Phone: 207 636 7958 Gallager, Scott Scott Gallager Woods Hole Oceanographic Institution sgallager@whoi.edu MS50 Woods Hole , MA, 02543, usa Phone: 508 289 2783

Gallucci, Vincent Vince Gallucci University of Washington vgallucc@u.washington.edu SAFS University of Washington Box 355020 Seattle, WA, 98195-5020, usa Phone: 206-525-3842 Fax: 206-517-4137

Gardner, Lee Ann Lee Ann Gardner RWJ Consulting rwjconsulting@ak.net PO Box 672302 Chugiak, AK, 99567-2302, usa Phone: 907-688-1400

Gauvin, John John Gauvin Marine Conservation Alliance Foundation gauvin@seanet.com 2104 SW 170th Street Burien, WA, 98166, usa Phone: 206 660 0359 Fax: 206 243 7686

Gay, Shelton Shelton Gay Prince William Sound Science Center/ Texas A&M University smg3ak@earthlink.net 628 O&M Building 3146 TAMU College Station, TX, 77843-3146, usa Phone: 979-220-3574

Geiselman, Joy Joy Geiselman USGS Alaska Science Center joy_geiselman@usgs.gov 1011 E. Tudor Road Anchorage, AK, 99503-6199, usa Phone: (907)786-3668 Fax: (907)7863636

Gelatt, Tom Tom Gelatt Alaska Fisheries Science Center/ National Marine Fisheries Service Tom.Gelatt@noaa.gov National Marine Fisheries Service, Alaska Fisheries Science Center, Bldng 4 7600 Sand Point Way NE Seattle, WA, 98115, usa Phone: 206 526 4040 Gende, Scott Scott Gende National Park Service Scott_Gende@nps.gov 3100 National Park Road Juneau, AK, 99801, usa Phone: 907-364-2622 Fax: 907-364-1540

Gerster, John Dr. John Gerster, NPRB North Pacific Research Board (NPRB) jgerster@alaska.net 10014 Main Tree Anchorage, AK, 99507, usa Phone: 907-346-3370 Fax: 907-346-3297

Gharrett, Anthony A.J. Gharrett University of Alaska Fairbanks ffajg@uaf.edu JCSFOS, UAF 11120 Glacier Highway Juneau, AK, 99801, usa Phone: 9077966445

Gibson, Georgina Georgina Gibson University of Alaska Fairbanks george@ims.uaf.edu Institute of Marine Science, 107 O'Neill Building University of Alaska Fairbanks Fairbanks, AK, 99775-7220, usa Phone: 907 474 5963

Gill, Verena Verena A. Gill Fish and Wildlife Service verena_gill@fws.gov USFWS-MMM 1011 East Tudor Road, MS 341 Anchorage, AK, 99577, usa Phone: 907-786-3584

Gish, Robert Skip Gish Alaska Department of Fish and Game robert_gish@fishgame.state.ak.us Alaska Department of Fish and Game 211 Mission Road Kodiak, AK, 99615, usa Phone: 907-486-1825 Fax: 907-486-1841

Gnath, Dennis Dennis Gnath Joint Pipeline Office dgnath@jpo.doi.gov 411 West 4th Ave Anchorage, AK, 99501, usa Phone: 907-257-1307 Fax: 907-272-0690 Goldman, Kenneth Kenneth J. Goldman Alaska Department of Fish and Game ken_goldman@fishgame.state.ak.us 3298 Douglas Place Homer, AK, 99603, usa Phone: 907-235-8191 Fax: 907-235-2448

Greene, Ben Ben A. Greene State of Alaska - Department of Natural Resources ben_greene@dnr.state.ak.us Phone: 907-269-7474 Fax: 907-269-3981

Gregr, Edward Edward Gregr SciTech Consulting ed@scitechconsulting.com 2136 Napier Street Vancouver, BC, V5L 2N9, can Phone: 604-612-8324

Gustafson, Richard Richard L. Gustafson Alaska Department of Fish and Game richard_gustafson@fishgame.state.ak.us Alaska Department of Fish and Game 3298 Douglas Place Homer, AK, 99603, usa Phone: (907) 235-8191 Fax: (907) 235-2448

Guthridge, Jared Jared Guthridge Alaska SeaLife Center / University of Alaska Fairbanks jared_guthridge@alaskasealife.org Box 1329 Seward, AK, 99664-1329, usa Phone: 907-224-6886

Hagenstein, Randall Randy Hagenstein The Nature Conservancy rhagenstein@TNC.ORG 715 L Street; Suite 100 Anchorage, AK, 99501, usa Phone: (907) 276-3133 ext. 119

Hanns, Cyd Cyd Hanns North Slope Borough cyd.hanns@north-slope.org PO Box 69 Barrow, AK, 99723, usa Phone: 907-852-0350 Fax: 907-852-0351 Harman, Nicholas Nick Harman University of Alaska Fairbanks ftnwh@sfos.uaf.edu 6620 Stella Pl. #3 Anchorage, AK, 99507, usa Phone: 9073501936

Harney, Jodi Jodi Harney Coastal and Ocean Resources jodi@coastalandoceans.com 214-9865 West Saanich Road Sidney, BC, V8L 5K6, can Phone: 2506554035 Fax: 2506551290

Harper, John John Harper Coastal & Ocean Resources Inc. john@coastalandoceans.com 214 - 9865 W. Saanich Rd Sidney, BC, V8L 5Y8, can Phone: 250 655 4035 Fax: 250 655 1290

Harper, Shawn Shawn Harper University of Alaska Fairbanks fssth@uaf.edu 1287 Gull Rd Fairbanks, AK, 99712, usa Phone: 907-474-5243

Harrell, Kelly Kelly Harrell Alaska Marine Conservation Council kelly@akmarine.org P.O. Box 101145 Anchorage, AK, 99510, usa Phone: 9072775357 Fax: 9072775975

Hartleben, Goetz Goetz Hartleben University of Alaska, Fairbanks goetz.hartleben@gmx.de P.O. Box 757220 Fairbanks, AK, 99775, usa Phone: 907-474-7074

Hasbrouck, James James J. Hasbrouck Division of Sport Fish james_hasbrouck@fishgame.state.ak.us 333 Raspberry Road Anchorage, AK, 99518, usa Phone: 907-267-2124 Fax: 907-267-2401 Hatch, Scott Scott Hatch U.S. Geological Survey shatch@usgs.gov 1011 East Tudor Rd. Anchorage, AK, 99503, usa Phone: 907-786-3529 Fax: 907-786-3636

Heckathorn, Jenny Jenny Heckathorn Youth Area Watch Jenny_Heckathorn@valdez.cc Phone: 907 835-4767

Heintz, Ron Ron Heintz NOAA Fisheries ron.heintz@noaa.gov Auk Bay Laboratory 11305 Glacier Hwy Juneau, AK, 99801, usa Phone: 907-789-6058 Fax: 907-789-6094

Hershberger, Paul Paul Hershberger United States Geological Survey phershberger@usgs.gov Marrowstone Marine Field Station 616 Marrowstone Point Road Nordland, WA, 98358, usa Phone: 3603851007 Fax: 3603857207

Hillgruber, Nicola Nicola Hillgruber University of Alaska Fairbanks n.hillgruber@uaf.edu 11120 Glacier Highway SFOS, UAF Juneau, AK, 99801, usa Phone: (907) 796-6288 Fax: (907) 796-6447

Hinckley, Sarah Sarah Hinckley NOAA/NMFS/Alaska Fisheries Science Center Sarah.Hinckley@noaa.gov 7600 Sand Point Way, NE Seattle, WA, 98115, usa Phone: 206-526-4109 Fax: 206-526-6723

Hoferkamp, Lisa L. Hoferkamp University of Alaska Southeast jflh@uas.alaska.edu University of Alaska Southeast 11120 Glacier Hwy Juneau, AK, 99801, usa Phone: 907 796 6538 Fax: 907 796 6441 Hoffman, Chris Chris Hoffman USACE choffman@mtaonline.net PO Box 596 Palmer, AK, 99645, usa Phone: 907-357-8970

Holba, Carrie Carrie Holba ARLIS - Alaska Resources Library & Information Services carrie @arlis.org Suite 111 Library Building 3211 Providence Drive Anchorage, AK, 99508, usa Phone: 907-786-7660 Fax: 907-786-7652

Holderied, Kris Kris Holderied NOAA Kasitsna Bay Lab NOAA Kasitsna Bay Laboratory kris.holderied@noaa.gov 2181 Kachemak Drive Homer, AK, 99603, usa Phone: 907-235-2400 Fax: 907-235-1528

Holladay, Brenda Brenda Holladay, Institute of Marine Science, UAF Institute of Marine Science, UAF holladay@ims.uaf.edu IMS/SFOS/UAF P.O. Box 757220 Fairbanks, AK, 99775-7220, usa Phone: 907-474-7938 Fax: 907-474-1943

Hollowed, Anne Anne Hollowed Alaska Fisheries Science Center Anne.Hollowed@noaa.gov 7600 Sand point Way NE Seattle, WA, 98115, usa Phone: 206-232-4638 Fax: 206-232-6723

Holmes, L.A. L.A. Holmes APU Graduate Student Iholmes@alaskapacific.edu Box 230 Homer, AK, 99603, usa Phone: 907.299.1380

Hoover-Miller, Anne Anne Hoover-Miller Alaska SeaLife Center anneh@alaskasealife.org P.O. Box 1329 Seward, AK, 99664-1329, usa Phone: (907) 224-6331 Hopcroft, Russell Russ Hopcroft University of Alaska hopcroft@ims.uaf.edu 245 O'Neill Bldg Fairbanks, AK, 99775-7220, usa Phone: 907-474-7842

Horowitz, Warren Warren Horowitz U.S. Minerals Management Service warren.horowitz@mms.gov 3801 Centerpoint Drive Suite 500 Anchorage, AK, 99503-5823, usa Phone: 907-334-5285

Houghton, Jon Jon Houghton Pentec Environmental/Hart Crowser, Inc. jon@pentecenv.com 120 Third Ave. South Edmonds, WA, 98020, usa Phone: (425) 329-1150 Fax: (425) 778-9417

Howard, Kerry Kerry Howard, OHMP, DNR Office of Habitat Management and Permitting Kerry_Howard@dnr.state.ak.us 400 Willoughby Ave. Suite 400 Juneau, AK, 99801, usa Phone: 907 465-3176

Hu, Haoguo Haoguo Hu University of Alaska Fairbanks hhu@iarc.uaf.edu 930 Koyukuk Dr. Fairbanks, AK, 99775, usa Phone: 907-474-7059

Huebinger, Ryan Ryan Huebinger Texas A&M University rhuebinger@yahoo.com 2913 Montana Ave Bryan, TX, 77803, usa Phone: 979-324-0965

Hufford, Gary Gary Hufford NOAA gary.hufford@noaa.gov 222 W. 7th Ave. #23 Anchorage , AK, 99513, usa Phone: 907-271-3886 Fax: 907-271-3711 Hulson, Peter-John Peter Hulson University of Alaska, Fairbanks p.hulson@uaf.edu P.O. Box 210685 Auke Bay, AK, 99821, usa Phone: 907-463-1253

Hunt, George George Hunt University of Washington geohunt2@u.washington.edu School of Aquatic and Fishery Sciences U. Washington Seattle, WA, 98195, usa Phone: 206-441-6109

Hyrenbach, K. David Hyrenbach University of Washington khyrenba@u.washington.edu School of Aquatic and Fishery Sciences, University of Washington Box 355020 Seattle, WA, 98195, usa Phone: (206) 221-4494

Insley, Stephen Steve Insley UCSC sinsley@ucsc.edu 1070 Llanfair Cres. Brentwood Bay, BC, V8M 1G2, can Phone: (250) 652-0717

Irvine, Gail Gail Irvine U.S. Geological Survey gail_irvine@usgs.gov USGS, Alaska Science Center 1011 E. Tudor Rd. Anchorage, AK, 99503, usa Phone: 907-786-3653 Fax: 907-786-3636

Irvine, Gail Gail V. Irvine US Geological Survey gail_irvine@usgs.gov 1011 E. Tudor Rd. Anchorage, AK, 99503, usa Phone: 907-786-3653 Fax: 907-786-3636

Jackson, Dave Dave Jackson State of Alaska david_jackson@fishgame.state.ak.us 211 Mission Rd. Kodiak, AK, 99615, usa Phone: 907.486.1846 Janka, David David Janka Auklet Charter Services info@auklet.com P.O. Box 498 Cordova, AK, 99574-0498, usa Phone: 907-424-3428

Jay, Chadwick Chad Jay USGS, Alaska Science Center chad_jay@usgs.gov 4230 University Drive Anchorage, AK, 99508, usa Phone: 907-786-7414

Jenski, Dana Dana Jenski US Fish and Wildlife Service dana_jenski@fws.gov 1011 E. Tudor Road, MS 341 Anchorage, AK, 99503, usa Phone: 907-786-3808 Fax: 907-786-3816

Jewett, Stephen Stephen Jewett University of Alaska Fairbanks jewett@ims.uaf.edu School of Fisheries and Ocean Sciences University of Alaska Fairbanks Fairbanks, AK, 99775, usa Phone: 907-474-7841 Fax: 907-474-7204

Jezierski, Caroline Caroline Jezierski University of Alaska, Fairbanks caroline_jezierski@alaskasealife.org 201 Railway Rd. Seward, AK, 99664, usa Phone: 907-224-4310

Jin, Meibing Meibing Jin University of Alaska Fairbanks ffjm@uaf.edu 930 Koyukuk Dr Fairbanks, AK, 99775-7340, usa Phone: 9074742442 Fax: 9074742643

Johnson, Scott Scott Johnson NOAA Fisherie's scott.johnson@noaa.gov Auke Bay Laboratory 11305 Glacier Hwy. Juneau, AK, 99801, usa Phone: 907-789-6063 Fax: 907-789-6094 Johnson, Terry Terry Johnson Sea Grant Marine Advisory Program rttlj@uaf.edu Marine Advisory Program 3734 Ben Walters Lane #205 Homer, AK, 99603, usa Phone: 907-235-5643

Jones, Benjamin Benjamin Jones U.S. Geological Survey bjones@usgs.gov 4230 University Drive Anchorage, AK, 99508, usa Phone: 907-786-7033

Jones, Ian Ian L. Jones Memorial University of Newfoundland iljones@mun.ca Biology Memorial University of Newfoundland St. John's, NL, A1B 3X9, can Phone: 709 737-7666

Jones, Matthew Matthew Jones UAF m.jones@sfos.uaf.edu PO BOX 750692 Fairbanks, AK, 99775, usa Phone: 9074742456

Jones, Peter Pete Jones NOAA Fisheries peter.d.jones@noaa.gov NMFS POBox 21668 Juneau, AK, 99802-1668, usa Phone: 907-586-7280 Fax: 907-586-7249

Jurado-Molina, Jesus Jesús Jurado-Molina University of Washington University of Washington jjurado@u.washington.edu Alaska Fisheries Science Center 7600 Sand Point Way NE Seattle, WA, 98115, usa Phone: (206) 526-4226 Fax: (206) 526-6723

Karpovich, Shawna Shawna Karpovich Alaska Department of Fish and Game shawna_karpovich@fishgame.state.ak.us Alaska Department of Fish and Game 1300 College Rd Fairbanks, AK, 99701, usa Phone: 907 459 7239 Katrayev, Igor Igor Katrayev North Pacific Research Board ikatraev@gmail.com 1007 W. 3rd Ave Ste 100 Anchorage, AK, 99501, usa Phone: 907-644-6711

Kaufman, Mette Mette Kaufman UAF nielson@sfos.uaf.edu 1701 Army Road Fairbanks, AK, 99709, usa Phone: 907-456-1199

KELLY, BRENDAN BRENDAN KELLY National Science Foundation brendan.kelly@uas.alaska.edu School of Arts and Sciences 11120 Glacier Hwy Juneau, AK, 99801, usa Phone: 907-796-6510 Fax: 907-796-6406

Kettle, Arthur Arthur Kettle Alaska Maritime National Wildlife Refuge Arthur_Kettle@fws.gov 95 Sterling Hwy #1 Homer, AK, 99603, usa Phone: 907-235-6546

Keyse, Matthew Matthew Keyse University of Alaska Fairbanks fnmdk@uaf.edu Po Box 83807 Fairbanks, AK, 99708, usa Phone: 907-474-7938

Kibbe, Justine BJ Kibbe KUHB-FM St. Paul Island waltgregg@kuhb.org KUHB PO Box 905 St. Paul Island, AK, 99660, usa Phone: 907-546-2254

Kiefer, Dale Dale Kiefer (Univ. Southern California) University of Southern California kiefer@usc.edu Department of Biological Sciences, University of Southern California 3616 Trousdale Parkway, AHF M-235 Los Angeles, CA, 90089-0371, usa Phone: 1-213-7405814 Fax: 1-213-7408123 Kirkwood, Willia Bill Kirkwood Monterey Bay Aquarium Research Institute kiwi@mbari.org 7700 Sandholdt Moss Landing , CA, 95039, usa Phone: 831-775-1707 Fax: 831-775-1646

Kitaysky, Alexander Alexander Kitaysky University of Alaska Fairbanks ffask@uaf.edu IAB Univeristy of Alaska Fairbanks 311 Irving I Fairbanks, AK, 99775, usa Phone: 907-474-5179 Fax: 907-474-6967

Kleinleder, Rich

Rich Kleinleder URS Corp. richard_kleinleder@urscorp.com P.O. Box 367 Homer, AK, 99603, usa Phone: 907-235-8702

Kline, Thomas Tom Kline Prince William Sound Science Center tckline@gci.net PO Box 705 Cordova, AK, 99574, usa Phone: 907-424-5800 x233

Kloecker, Kimberly Kim USGS Alaska Science Center kkloecker@usgs.gov 1011 East Tudor Road Anchorage, AK, 99503, usa Phone: 907-786-3480

Knoth, Brian Brian Knoth NOAA/NMFS/AFSC brian.knoth@noaa.gov 301 Research Ct. Kodiak, AK, 99615, usa Phone: 907-481-1731

Kohout, Jenifer Jenifer Kohout U.S. Fish & Wildlife Service Jenifer_Kohout@fws.gov 1011 E. Tudor Rd. Anchorage, AK, 99503, usa Phone: 907-786-3687 Konar, Brenda Brenda Konar University of Alaska Fairbanks bkonar@guru.uaf.edu School of Fisheries and Ocean Sciences/UAF PO Box 757220 Fairbanks, AK, 99775, usa Phone: 907-474-5028

Kopchak, Robert RJ Kopchak Exxon Valdez Oil Spill Trustee Council ecotrust@ak.net po box 1126 Cordova, AK, 99574, usa Phone: 907 424-3541

Kruse, Gordon Gordon H. Krus University of Alaska Fairbanks gordon.kruse@uaf.edu UAF/School of Fisheries and Ocean Sciences, Juneau Center 11120 Glacier Highway Juneau, AK, 99801, usa Phone: 907-796-2052 Fax: 907-796-2050

Kruse, Sarah Sarah Kruse Ecotrust skruse@ecotrust.org 721 NW 9th Avenue, Suite 200 Portland, OR, 97209, usa Phone: 503.467.0785

Krygier, Earl Earl Krygier - ADF&G NPRB Board Member State of Alaska earl_krygier@fishgame.state.ak.us ADF&G Com. Fish 333 Raspberry Road Anchorage, AK, 99518-1599, usa Phone: 907-267-2111

Labunski, Elizabeth Liz Labunski U.S. Fish and Wildlife Service elizabeth_Labunski@fws.gov 1011 E. Tudor Rd MS-201 Anchorage, AK, 99503, usa Phone: (907)-786-3865 Fax: (907)-786-3641

Ladd, Carol Carol Ladd NOAA/PMEL carol.ladd@noaa.gov 7600 Sand Point Way Bldg 3 Seattle, WA, 98115, usa Phone: 206-526-6024 Fax: 206-526-6485 Laing, Karen Karen Laing U.S. Fish and Wildlife Service karen_laing@fws.gov U.S. Fish and Wildlife Service 1011 E. Tudor Road Anchorage, AK, 99503, usa Phone: 907-786-3459

Lance, Brian Brian Lance NOAA Fisheries NOAA Fisheries brian.lance@noaa.gov NMFS, 222 West 7th Ave Room 517 Anchorage, AK, 99577, usa Phone: 907 271-1301 Fax: 907 271-3030

Lance, Ellen Ellen W. Lance US Fish and Wildlife Service ellen_lance@fws.gov Anchorage Fish and Wildlife Field Office 605 West 4th Ave., Rm G61 Anchorage, AK, 99501, usa Phone: 907 271-1467 Fax: 907 271-2786

Lander, Michelle Michelle Lander NOAA Fisheries michelle.lander@noaa.gov NMML/NMFS/NOAA 7600 SandPoint Way NE Seattle, WA, 98115, usa Phone: 206-526-4012 Fax: 206-526-6615

Lane, Donald Don Lane F/V Predator drl@xyz.net POB 2921 Homer, AK, 99603, usa Phone: 907-235-7898 Fax: 907-235-7898

LaPorte, Barat Barat LaPorte Patton Boggs LLP blaporte@pattonboggs.com 601 W. 5th Avenue, Suite 700 Anchorage, AK, 99501, usa Phone: 263 6315

Lea, Mary-Anne Mary-Anne Lea Alaska Fisheries Science Center, NOAA Mary-Anne.Lea@noaa.gov NMML, AFSC-NOAA Bldg 4, 7600 Sand Point Way NE Seattle, WA, 98115, usa Phone: 206-526 4015
Lees, Dennis DENNIS LEES, LITTORAL ECOLOGICAL & ENVIRONMENTAL SERVICES Littoral Ecological & Environmental Services dennislees@earthlink.net 1075 Urania Ave. Leucadia, CA, 92024, usa Phone: 760 635-7998 Fax: 760 635-7998

Lestenkof, Aquilina Aquilina D. Lestenkof Aleut Community of St. Paul Island-Tribal Government adlestenkof@tribaleco.com 2050 Venia Minor Road St. Paul Island, AK, 99660, usa Phone: 907-546-3229 Fax: 907-546-3253

Lestenkof, Pamela

Pamela Lestenkof University of British Columbia lestenko@zoology.ubc.ca Rm. 247, AERL, 2202 Main Mall Vancouver, BC, V6T 1Z4, can Phone: 604-822-8181

Lestyk, Keri

Keri Lestyk University of Alaska Anchorage kclestyk@gmail.com 3211 Providence Dr. EBL 130 Anchorage, AK, 99508, usa Phone: 907-786-1534

Li, Qing

Qing Li University of Hawaii qingl@hawaii.edu 1955 East_west Rd Ag Sci Bldg Rm 218 Honolulu, HI, 96822, usa Phone: +1 (808) 956-2011 Fax: +1 (808) 956-3542

Lindeberg, Mandy Mandy Lindeberg NOAA/NMFS mandy.lindeberg@noaa.gov 11305 Glacier Hwy Juneau, AK, 99801, usa Phone: 907-789-6616

Lindstrom, Sandra Sandra Lindstrom University of British Columbia sandracl@interchange.ubc.ca Dept of Botany, #3529 - 6270 University Blvd. University of British Columbia Vancouver, BC, V6T 1Z4, can Phone: 604-822-3349 Fax: 604-822-6089 Litwin, Thomas Tom Litwin Smith College Smith College Tlitwin@smith.edu Clark Science Center Smith College Northampton, MA, 01063, usa Phone: 413-585-3801

Litzow, Mike Mike Litzow National Marine Fisheries Service Mike.Litzow@noaa.gov Kodiak Fisheries Research Center 301 Research Ct. Kodiak, AK, 99615, usa Phone: 907-481-1723

Livingston, Patricia Pat Livingston Alaska Fisheries Science Center pat.livingston@noaa.gov 7600 Sand point Way NE Seattle, WA, 98115, usa Phone: 206-526-4172

Logerwell, Elizabeth

Libby Logerwell NOAA National Marine Fisheries Service libby.logerwell@noaa.gov F/AKC2 P.O. Box 15700 Seattle, WA, 98115, usa Phone: 206-526-4231 Fax: 206-526-673

Lyons, Courtney

Courtney Lyons Alaska Pacific University courtney lyons@gmail.com 4301 Wisconsin St Apt 2 Anchorage, AK, 99517, usa Phone: 360 333 4855

MacGregor, Paul Paul MacGregor North Pacific Research Board pmacgregor@mundtmac.com 999 Third Avenue, Suite 4200 Seattle, WA, 98104-4082, usa

Phone: 206-624-5950 Fax: 206-624-5469

MacLean, Steve Steve MacLean The Nature Conservancy smaclean@tnc.org 715 L Street, Suite 100 Anchorage, AK, 99501, usa Phone: 9072763133 Fax: 9072762584 Markis, Joel Joel Markis University of Alaska Fairbanks markis@sfos.uaf.edu P.O. Box 3191 Homer, AK, 99603, usa Phone: (907)299-0760

Marguette, Allen

Allen Marquette - Prince William Sound Science Center Prince William Sound Science Center allen@pwssc.gen.ak.us P. O. Box 705 Cordova, AK, 99574, usa Phone: 907 424 5800 ext 237 Fax: 907 424 5820

Martinez. Dan

Dan Martinez, TASSC The Alaska Sea Otter and Steller Sea Lion Commission dmartinez@seaotter-sealion.org 6239 B St. Ste. 204 Anchorage, AK, 99518, usa Phone: 9072749799 Fax: 9072749022

Mathews, Elizabeth Beth Mathews University of Alaska Southeast Beth.Mathews@uas.alaska.edu UAS, Natural Sciences, Anderson Bldg 11120 Glacier Hwy Juneau, AK, 99801, usa Phone: 907 796 6027 Fax: 907 796 6447

Matkin, Craig Craig O. Matkin, NGOS North Gulf Oceanic Society cmatkin@acsalaska.net 3430 Main St. Suite B1 Homer, AK, 99603, usa Phone: 907 235-6590 Fax: 907 235-6590

McCall Valentine, Erica Erica McCall Valentine Partners for Fisheries Monitoring Program -Native Village of Eyak erica@nveyak.org PO Box 868 Talkeetna, AK, 99676, usa Phone: 9072301169

McCammon, Molly Molly McCammon Alaska Ocean Observing System mccammon@aoos.org 1007 W Third Avenue, Suite 100 Anchorage, AK, 99501, usa Phone: 907-644-6703

McCorkle, Vern

Vern McCorkle Alaska Business Monthly Magazine publisher@akbizmag.com P.O. Box 241288 Anchorage, AK, 99524, usa Phone: 907-276-4373 Fax: 907-279-2900

McCrea, Mauree Maureen McCrea U.S. Army Corps of Engineers icecube@alaska.net 6906 Big Mountain Drive Anchorage, AK, 99516, usa Phone: 907-230-6910

McDermott, Susanne Susanne McDermott NOAA Alaska Fisheries Science Center susanne.mcdermott@noaa.gov 7600 Sandpoint Way NE F.AKC2 Seattle, WA, 98115-6349, usa Phone: 206 526 4417 Fax: 206 526 6723

McKenzie, Jane Jane McKenzie University of Alaska Fairbanks janemckenzie@malpage.com 118 Trident Way Kodiak, AK, 99615, usa Phone: 907 4851513

McKinney, Holly Holly J. McKinne University of Alaska, Fairbanks happyinak@hotmail.com PO Box 751075 Fairbanks, AK, 99775, usa Phone: 907-455-4298

McLaughlin, Kate Kate McLaughlin - McLaughlin Environmental Services McLaughlin Environmental Services mclenvironmental@yahoo.com PO Box 8043 Chenega Bay, AK, 99574, usa Phone: 907-573-5092

McRoy, Peter Peter McRoy University of Alaska Fairbanks ffcpm@uaf.edu Institute of Marine Science University of Alaska Fairbanks Fairbanks, AK, 99775, usa Phone: 907-474-7783 Fax: 907-479-2707

Meehan, Joe Joe Meehan, Alaska Department of Fish and Game Alaska Department of Fish and Game joe_meehan@fishgame.state.ak.us 333 Raspberry Road Anchorage, AK, 99518, usa Phone: 907-267-2281 Fax: 907-267-2433

Meehan, Rosa Rosa Meehan USFWS rosa_meehan@fws.gov USFWS MMM MS341 1011 E Tudor Road Anchorage, AK, 99503, usa Phone: (907) 786-3800

Meeks, William Will Meeks USFWS - Alaska Maritime NWR will_meeks@fws.gov 95 Sterling Hwy Suite #1 Homer, AK, 99603, usa Phone: 907-235-6546

Mellinger, David Dave Mellinger Oregon State University david.mellinger@oregonstate.edu 2030 SE Marine Science Dr. Newport, OR, 97365, usa Phone: 541-867-0372 Fax: 541-867-3907

Mellish, Jo-Ann Jo-Ann Mellish University of Alaska Fairbanks joannM@alaskasealife.org PO Box 1329, 301 Railway Avenue Alaska SeaLife Center Seward, AK, 99664-1329, usa Phone: 907 224-6324

Metcalf, Vera Vera K. Metcalf U.S. Arctic Research Commission ewc.pd@kawerak.org 907 Ivan Johnson Way PO Box 1144 Nome, AK, 99762, usa Phone: 907/443-4380 (wk) Fax: 907/443-4484 Meuret-Woody, Heather Heather Meuret-Woody Sitka Tribe of Alaska hwoody@sitkatribe.org 456 Katlian Street Sitka, AK, 99835, usa Phone: 907-747-7501

Miller, Jessica Jessica Miller Nova Southeastern University/UAA swangirl22@yahoo.com 8220 Nordale St Anchorage, AK, 99502, usa Phone: 907-831-0622

Miller, Sara Sara E. Miller University of Alaska, Fairbanks fssem1@uaf.edu P.O. Box 35244 Juneau, AK, 99803, usa Phone: 907-463-1262

Mills, Tamara Tamara Mills U.S. Fish and Wildlife Service Tamara_Mills@usfws.gov 1011 E. Tudor Rd., MS 201 Anchorage, AK, 99503, usa Phone: 907-786-3517

Mizobata, Kohei Kohei Mizobata University of Alaska Fairbanks kmizobata@iarc.uaf.edu 930 Koyukuk Drive Fairbanks, AK, 99775, usa Phone: 907-474-2444 Fax: 907-474-2691

Moffitt, Steve Steve Moffitt Alaska Department of Fish and Game State of Alaska steve_moffitt@fishgame.state.ak.us P.O. Box 669 Cordova, AK, 99574, usa Phone: 907-424-3212 Fax: 907-424-3235

Moore, Sue Sue Moore NOAA/Alaska Fisheries Science Center sue.moore@noaa.gov APL-UW 1013 NE 40th Street Seattle, WA, 98105-6698, usa Phone: 206-685-2125 Moran, John John Moran NOAA Fisheries john.moran@noaa.gov 11305 Glacier Highway Juneau, AK, 99801-8626, usa Phone: 907-789-6014

Morris, Mary

Mary Morris Archipelago Marine Research Ltd. marym@archipelago.ca 525 Head St. Victoria, BC, V9A 5S1, can Phone: 2503831463

Mueter, Franz Franz Mueter Sigma Plus fmueter@alaska.net 697 Fordham Drive Fairbanks, AK, 99709, usa Phone: 907-479-8815 Fax: 907-479-8815

Mullins, C. Ross Mullins -- PWSFRAP PWS Fishery Research, Application and Planning group rmullins@gci.net PO Box 1249 Cordova, AK, 99674, usa Phone: 907 424-3664

Mundy, Phil Phillip Mundy AK Fisheries Science Ctr/NMFS phil.mundy@noaa.gov Auke Bay Laboratories 11305 Glacier Hwy Juneau, AK, 99801, usa Phone: 907-789-6001

Munger, Lisa Lisa Munger Scripps Institution of Oceanography Imunger@ucsd.edu Scripps Inst of Oceanog, UC San Diego 9500 Gilman Dr. mailcode 0205 La Jolla, CA, 92093-0205, usa Phone: (858)534-5755

Murphy, Stephen Steve Murphy ABR, Inc. smurphy@abrinc.com P.O. Box 80410 Fairbanks, AK, 99708, usa Phone: 907-455-6777 Fax: 907-455-6781 Mutter, Douglas Doug Mutter U.S. Department of the Interior douglas_mutter@ios.doi.gov 1689 C Street Room 119 Anchorage, AK, 99501, usa Phone: 907-271-5011 Fax: 907-271-4102

Myers, Matthew Matt

Alaska SeaLife Center and the University of Alaska Fairbanks matthew_myers@alaskasealife.org 301 Railway Ave. Seward, AK, 99664, usa Phone: (907) 224-6374 Fax: (907) 224-6360

Napp, Jeffrey Jeffrey Napp NOAA -- Fisheries jeff.napp@noaa.gov 7600 Sand Point Way., NE Bldg. 4, F/AKC1 Seattle, WA, 98115, usa Phone: 206.526.4148

Neidetcher, Sandi Sandi Neidetcher Alaska Fisheries Science Center Sandi.Neidetcher@noaa.gov NOAA/NMFS/AFSC F/AK2 7600 Sand Point Way NE Seattle, WA, 98115, usa Phone: 206-526-4521 Fax: 206-526-6723

Nelson, Bonita Bonita Nelson NOAA Auke Bay Laboratory bonita.nelson@noaa.gov Auke Bay Laboratory 11305 Glacier Highway Juneau, AK, 99801, usa Phone: 9077896071

Neufeld, Gayle Gayle Neufeld University of Alaska Fairbanks gneufeld@sfos.uaf.edu PO Box 80125 Fairbanks, AK, 99708, usa Phone: 907-474-7839

Newbury, Thomas Tom Dunning Newbury Minerals Management Service thomas.newbury@mms.gov 3801 Centerpoint Drive, Suite 500 Anchorage, AK, 99503-5823, usa Phone: 907-334-5263 Newman, Kelly Kelly Newman University of Alaska Fairbanks k.newman@sfos.uaf.edu 245 O'Neill PO Box 757220 Fairbanks, AK, 99775-7220, usa Phone: 907-474-7931 Fax: 474-7204

Nielsen, Julie Julie Nielsen University of Alaska j.nielsen@uaf.edu 11120 Glacier Highway Juneau, AK, 99801, usa Phone: (907) 364-1579 Fax: (907) 364-1540

Noel, Jim Jim Noel Jim Noel Data Consulting jnoel@gci.net 17430 Andreanoff Way Juneau, AK, 99801, usa Phone: 907-789-4656

Norberg, Sarah Sarah Norberg Alaska SeaLife Center sarah_norberg@alaskasealife.org Alaska SeaLife Center P.O. Box 1329 Seward, AK, 99664, usa Phone: 907-224-6376 Fax: 907-224-6371

Norcross, Brenda Brenda Norcross University of Alaska Fairbanks norcross@ims.uaf.edu PO Box 757220 Fairbanks, AK, 99775-7220, usa Phone: 907-474-7990 Fax: 907-474-1943

Oakley, Karen Karen Oakley U.S. Geological Survey, Alaska Science Center koakley@usgs.gov USGS Alaska Science Center 1011 E. Tudor Rd. MS 701 Anchorage, AK, 99503, usa Phone: 907-786-3579

O'Corry-Crowe, Greg Greg O'Corry-Crowe Southwest Fisheries Science Center greg.o'corry-crowe@noaa.gov 8604 La Jolla Shores Drive La Jolla, CA, 92037, usa Phone: (858) 546-7091 Fax: (858) 546-7003 Okkonen, Stephen Stephen Okkonen, Head Barnacle University of Alaska Fairbanks okkonen@alaska.net Box 1025 Kasilof, AK, 99610, usa Phone: 907-283-3234 Fax: 907-283-3234

Okonek, Brian Brian Okonek Diane Okonek okonek@mtaonline.net P.O. Box 583 Talkeetna, AK, 99676, usa Phone: 907 733-2111 Fax: 907 733-2111

Okonek, Diane Diane Calamar Okonek Diane Okonek okonek@mtaonline.net P.O. Box 583 Talkeetna, AK, 99676, usa Phone: 907 733-2111 Fax: 907 733-2111

Olsen, Myra Myra J. Olsen, Chairman, Bristol Bay Marine Mammal Council Bristol Bay Marine Mammal Council hchythlook@bbna.com P.O. Box 74 Egegik, AK, 99579, usa Phone: (907)-233-2424

Oppel, Steffen Steffen Oppel University of Alaska Fairbanks fssjo3@uaf.edu Dept of Biology and Wildlife 211 Irving 1 Fairbanks, AK, 99775-6100, usa Phone: 907 474-1949

Osterback, Peggy Peggy N. Osterback Aleut Marine Mammal Commission ammc@arctic.net P.O. Box 920045 Dutch Harbor, AK, 99692, usa Phone: (907) 581-5324 Fax: (907) 581-5325

Otis, Ted Ted Otis Alaska Dept. of Fish and Game ted_otis@fishgame.state.ak.us 3298 Douglas Place Homer, AK, 99603, usa Phone: (907) 235-8191 Overland, James James Overland NOAA/Pacific Marine Environmental Laboratory james.e.overland@noaa.gov 7600 Sand point Way NE Seattle, WA, 98115, usa Phone: 1.206.526.6795 Fax: 1.206.526.6485

Panteleev, Gleb Gleb Panteleev, IARC, UAF. IARC, UAF, gleb@iarc.uaf.edu 930 Kiyukuk Dr. Fairbanks, AK, 99775, usa Phone: 907-4742680

Parada Veliz, Carolina Carolina E. Parada NOAA carolina.parada@noaa.gov 7600 Sand point Way NE Seattle, WA, 98115, usa Phone: 206 526 4794

Parker, Pamela Pam Parker Alaska SeaLife Center pamela_parker@alaskasealife.org Alaska SeaLife Center P.O. Box 1329 Seward, AK, 99664, usa Phone: 907-224-6387 Fax: 907-224-6320

Parrish, Julia Julia Parrish University of Washington jparrish@u.washington.edu Box 355020 1122 NE Boat St. Seattle, WA, 98195, usa Phone: 206-221-5787

Pautzke, Clarence Clarence Pautzke North Pacific Research Board cpautzke@nprb.org 1007 W. 3rd Ave, Suite 100 Anchorage, AK, 99501, usa Phone: 907-644-6702 Fax: 907-644-6780

Pawlowski, Robert Bob Pawlowski Alaska Fisheries Development Foundation rpawlowski@afdf.org 431 West 7th Avenue Suite 201 Anchorage, AK, 99501, usa Phone: 907-276-7315 Fax: 907-276-7311 Pegau, William W. Scott Pegau Kachemak Bay Research Reserve scott_pegau@fishgame.state.ak.us 95 Sterling Hwy, Suite 2 Homer, AK, 99603, usa Phone: 907-226-4654 Fax: 907-235-4794

Pendergast, Mike Mike Pendergast Alaska SeaLife Center mikep@alaskasealife.org PO Box 1329 Seward, AK, 99664, usa Phone: 9072246335

Perry, Alison Alison Perry Alaska SeaLife Center alisonp@alaskasealife.org 1007 W. 3rd Ave. Suite 100 Anchorage, AK, 99501, usa Phone: (907) 644-6714

Pinchuk, Alexei Alexei Pinchuk University of Alaska Fairbanks ftaip1@uaf.edu P.O.Box 2561 Seward, AK, 99664, usa Phone: (907)224-4313

Pletnikoff, George George Pletnikoff Greenpeace george.pletnikoff@wdc.greenpeace.org 125 Christensen Drive, Suite 200 Anchorage, AK, 99501, usa Phone: 907-277-8234

Polasek, Lori Lori Polasek Alaska SeaLife Center & University of Alaska Fairbanks Iori_polasek@alaskasealife.org Alaska SeaLife Center PO Box 1329 Seward, AK, 99664, usa Phone: 907-224-6893

Poston, Jacqueline Jacqueline (Jackie) Poston U.S. EPA poston.jacqueline@epa.gov 7711 Our Own Lane Anchorage, AK, 99516, usa Phone: (907)271-3541 Fax: (907)271-3424 Potter, Rachel Rachel A Potter UAF - SFOS / AOOS rpotter@ims.uaf.edu 245 O'Neill Bldg Fairbanks, AK, 99775-7220, usa Phone: 907-474-5709

Powers, Sean Sean P. Powers

University of South Alabama spowers@disl.org Dauphin Island Sea Lab 101 Bienville Blvd. Dauphin Island, AL, 36528, usa Phone: 251-861-3802

Prentki, Richard Dick Prentki USDOI MMS richard.prentki@mms.gov MMS 3801 Centerpoint Drive Suite 500 Anchorage, AK, 99503-5823, usa Phone: 907-334-5277

Prewitt, Jill

Jill Prewitt University of Alaska Anchorage jsprewitt@gmail.com 3211 Providence Dr. EBL 130 Anchorage, AK, 99508, usa Phone: 907-786-1534

Punt, Andre

Andre Punt University of Washingron aepunt@u.washington.edu 1122 NE Boat St Seattle, WA, 98195, usa Phone: 1-206-221-6319 Fax: 1-206-685-7471

Quakenbush, Lori

Lori Quakenbush Alaska Department of Fish and Game lori_quakenbush@fishgame.state.ak.us 1300 College Rd Fairbanks, AK, 99701, usa Phone: (907) 459-7214 Fax: (907) 452-6410

Quinn, Terrance Terrance Quinn University of Alaska Fairbanks terry.quinn@uaf.edu 11120 Glacier Hwy Juneau, AK, 99801, usa Phone: 907-796-2051 Fax: 907-796-2050 Ralonde, Raymond Raymond RaLonde Alaska Sea Grant afrir@uaa.alaska.edu 1007 W. 3rd Ave #100 Anchorage, AK, 99501, usa Phone: 907-274-9697

Rand, Kimberly Kimberly Rand University of Washington - Alaska Fisheries Science Center kimberly.rand@noaa.gov 7600 Sandpoint Way NE Seattle, WA, 98103, usa Phone: 206-526-6303

Rea, Lorrie Lorrie Rea Alaska Department of Fish and Game Iorrie_rea@fishgame.state.ak.us 245 O'Neill Building, University of Alaska Fairbanks Fairbanks, AK, 99775-7220, usa Phone: (907)474-5079 Fax: (907)474-5080

Ream, Rolf

Rolf Ream, National Marine Mammal Laboratory National Marine Fisheries Service rolf.ream@noaa.gov 7600 Sand Point Way NE, Bldg. 4 Seattle, WA, 98115, usa Phone: 206 526-4328 Fax: 206 526-6615

Rearden, Spencer

Spencer Rearden ASRC Energy Services spencer.rearden@asrcenergy.com ASRC Energy Services 3900 C St., Suite 601 Anchorage, AK, 99503, usa Phone: 907-339-5459 Fax: 907-993-5475

Reifenstuhl, Steve

Steve Reifenstuhl Northern S.E. Regional Aquaculture Assoc. steve_reifenstuhl@nsraa.org 1308 SMC Rd sitka, AK, 99835, usa Phone: 907-747-6850

Reynolds, Jennifer Jennifer Reynolds University of Alaska Fairbanks jreynolds@guru.uaf.edu P.O. Box 757220 UAF-SFOS Fairbanks, AK, 99775-7220, usa Phone: 907-474-5871 Fax: 907-474-5804 Rice, Joel Joel S. Rice University of Washington joelrice@u.washington.edu Box 355020 Seattle, WA, 98195-5020, usa Phone: (206) 221-6776

Rice, Stanley Jeep Rice Auke Bay Lab jeep.rice@noaa.gov Auke Bay Lab 11305 Glacier Highway Juneau, AK, 99801, usa Phone: 907 789 6020 Fax: 907 789 6094

Rich, Cecil Cecil Rich

Alaska Department of Fish and Game cecil_rich@fishgame.state.ak.us 333 Raspberry Rd Anchorage, AK, 99518, usa Phone: 907-267-2333 Fax: 907-267-2464

Richardson, Edward Edward Richardson

Atsea Processors Association erichardson@atsea.org Atsea Processors Association 4039 21st Avenue West, Suite 400 Seattle, WA, 98199, usa Phone: (206) 285-5139

Ridgway, Michelle

Michelle Ridgway Oceanus Alaska michelleridgway@acsalaska.net 119 Seward Street Suite 9 Juneau, AK, 99801-1268, usa Phone: (907) 463-6782 Fax: (907) 463-6781

Riedel, Monica

Monica Riedel Alaska Native Harbor Seal Commission monicariedel@gci.net 800 E. Dimond Blvd. #3-590 Anchorage, AK, 99504, usa Phone: 907-345-0555 Fax: 907-345-0566 Robards, Martin Martin Robards University of Alaska, Fairbanks ftmdr@uaf.edu 144 Roxie Road Fairbanks, AK, 99709, usa Phone: 907-474-7603

Robbins Gisclair, Rebecca Becca Robbins Gisclair Yukon River Drainage Fisheries Association becca@yukonsalmon.org 725 Christensen Dr., Ste. 3-B Anchorage, AK, 99501, usa Phone: (907)272-3141x106 Fax: (907)272-3142

Robilliard, Gordon Gordon A. Robilliard Entrix Inc. grobilliard@entrix.com 715 121st ST NW Gig Harbor, WA, 98332, usa Phone: 253 209 4908

Robilliard, Gordon Gordon Robilliard Entrix Inc. grobilliard@entrix.com 715 121st ST NW Gig Harbor, WA, 98332, usa Phone: 253 209 4908

Robson, Bruce Bruce Robson Community and Ecology Resources mandybruce@co-eco.com 1413 26th Ave Seattle, WA, 98122, usa Phone: 206 782 8273

Rode, Karyn Karyn Rode US Fish and Wildlife Service karyn_rode@fws.gov 1011 E Tudor Road Anchorage, AK, 99503, usa Phone: 907-786-3801

Romberg, Bill Bill Romberg Alaska Department of Fish and Game william_romberg@fishgame.state.ak.us 333 Raspberry Rd Anchorage, AK, 99518, usa Phone: 907-267-2366 Rooper, Chris Chris Rooper RACE Division, Alaska Fisheries Science Center chris.rooper@noaa.gov 7600 Sand Point Way NE, Bldg. 4 Seattle, WA, 98115, usa Phone: 206-526-4689 Fax: 206-526-6723

Roseneau, David Dave Roseneau, Alaska Maritime NWR U.S. Fish and Wildlife Service dave_roseneau@fws.gov USFWS 95 Sterling Highway #1 Homer, AK, 99603-7472, usa Phone: (907) 226-4613 Fax: (907) 235-7783

Rosenkranz, Gregg Gregg Rosenkranz Alaska Department of Fish and Game gregg_rosenkranz@fishgame.state.ak.us Alaska Dept. of Fish and Game 211 Mission Road Kodiak, AK, 99615, usa Phone: 907 486-1858

Rosner, Carolyn Carolyn Rosner North Pacific Research Board Carolyn.Rosner@nprb.org 1007 w 3rd avenue suite 100 anchorage, AK, 99501, usa Phone: 9076446701

Royer, Thomas Tom Royer OldDominion University royer@ccpo.odu.edu Center for Coastal Physical Oceanography 768 W. 52 nd St. Norfolk, VA, 23508, usa Phone: 757 683 5547

Rugh, David Dave Rugh Natl. Marine Mammal Lab, Alaska Fisheries Science Center, NOAA Fisheries Service dave.rugh@noaa.gov Natl. Marine Mammal Lab, NOAA Fisheries Service 7600 Sand Pt Way, NE Seattle, WA, 98115, usa Phone: 206 526 4018 Fax: 206 526 6615 Ryer, Clifford Cliff Ryer, Fish Behavior, AFSC RACE Division/AFSC/NOAA Fisheries cliff.ryer@noaa.gov Hatfield Marine Science Ctr 2030 Marine Science Drive Newport, OR, 97365, usa Phone: 541 867-0267

Salasky, Sheryl Shoo Salasky Chugach School District salasky@alaska.net Phone: (907) 522-7400

Schempf, Janet Janet Hall Schempf State of Alaska janet_schempf@fishgame.state.ak.us PO Box 110024 Juneau, AK, 99824-0024, usa Phone: 907-465-6061 Fax: 907-465-8170

Schmale, Christine Christine Schmale State of Alaska christine_schmale@fishgame.state.ak.us P.O. Box 20881 Juneau, AK, 99802, usa Phone: 907-586-0543

Schoch, Carl Carl Schoch Alaska Ocean Observing System cschoch@nprb.org 1007 W 3rd Ave, Suite 100 Anchorage, AK, 99501, usa Phone: 907-644-6712

Schrock, Tylan Tylan Schrock Alaska SeaLife Center tylan_schrock@alaskasealife.org P.O. Box 1329 Seward, AK, 99664, usa Phone: 907-224-6349 Fax: 907-224-6360

Schroeder, Kercia Kercia Schroeder Alaska Department of Fish and Game kercia_schroeder@fishgame.state.ak.us PO Box 110024 Douglas, AK, 99811-0024, usa Phone: 907-465-8546 Fax: 907-465-2034 Seitz, Andrew Andy Seitz University of Alaska Fairbanks aseitz@ims.uaf.edu School of Fisheries and Ocean Sciences - UAF PO Box 757220 Fairbanks, AK, 99775-7220, usa Phone: 907-474-7918 Fax: 907-474-1943

Shen, Haixue Haixue Shen University of Alaska Fairbanks h.shen@uaf.edu PO BOX 34431 Juneau, AK, 99803, usa Phone: 907-586-2492

Shevchenko, Ilya Ilya Federal Russian Institute of Fisheries and Oceanography shevchenko@gol.ru Verkhnie Polya St., 6-138 Moscow, null, 109382, rus Phone: +7(495)3494445 Fax: +7(495)3494445

Siekaniec, Greg Greg Siekaniec, Alaska Maritime National Wildlife Refuge Alaska Maritime National Wildlife Refuge gregory_siekaniec@fws.gov 95 Sterling Highway Homer, AK, 99603, usa Phone: 907-235-6546 Fax: 907-235-7783

Sigler, Michael Mike Sigler NOAA Alaska Fisheries Science Center Mike.Sigler@noaa.gov 11305 Glacier Highway Juneau, AK, 99801, usa Phone: 907 789 6037 Fax: 907 789 6094

Sigman, Marilyn Marilyn Sigman Center for Alaskan Coastal Studies cacs@xyz.net P.O. Box 2225 Homer, AK, 99603, usa Phone: 907-235-6667 Fax: 907-235-6668

Simpkins, Michael Mike Simpkins Marine Mammal Commission / NPRB Science Panel msimpkins@mmc.gov 4340 East-West Highway, Suite 905 Bethesda, MD, 20814, usa Phone: 301-504-0087 Fax: 301-504-0099

continued

Skinner, John John Skinner Alaska SeaLife Center johns@alaskasealife.org 301 Railway Ave. Seward, AK, 99664, usa Phone: 9072246888 Fax: 9072246320

Skinner, Rebecca Rebecca Skinner

Sun'aq Tribe of Kodiak rskinner@ak.net 312 West Marine Way Kodiak, AK, 99615, usa Phone: 907-486-4449 Fax: 907-486-3361

Smith, Caryn Caryn Smith USDOI Minerals Management Service caryn.smith@mms.gov 3801 Centerpoint Drive, Suite 500 Anchorage, AK, 99503, usa Phone: 9073345248

Smith, Orson Orson Smith - University of Alaska Anchorage University of Alaska Anchorage afops @uaa.alaska.edu 3211 Providence Dr. School of Engineering Anchorage, AK, 99508, usa Phone: 907-632-0343 Fax: 907-786-1079

Smith, Wade Wade Smith Oregon State University wsmith@mlml.calstate.edu Pacific Shark Research Center, Moss Landing Marine Labs 8272 Moss Landing Road Moss Landing, CA, 95039, usa Phone: 831 771 4419

Smoker, Bill Bill Smoker School of Fisheries and Ocean Sciences, University of Alaska Fairbanks bill.smoker@uaf.edu 11120 Glacier Hwy Juneau, AK, 99801, usa Phone: 9077966444 Smolen, Michael Mike Smolen Purdue University msmolen@tds.net 39559 Mathews Lane Paonia, CO, 81428, usa Phone: (970) 527-4054

Smolen, Michael Michael Smolen Purdue University msmolen@tds.net 39559 Mathews Lane Paonia, CO, 81428, usa Phone: 970 527-4054

Sorum, Elise Elise Sorum YAW Ruthie_knight@valdez.cc Phone: 835-4767

Southam, Anne Anne Southam URS Corporation Anne_Southam@urscorp.com 2700 Gambell Street Suite 200 Anchorage, AK, 99503, usa Phone: 907-562-3366 Fax: 907-562-1297

Spies, Ingrid Ingrid Spies Alaska Fisheries Science Center ingrid.spies@noaa.gov 7600 Sand Point Way NE Seattle, WA, 98125, usa Phone: (206)526-4786 Fax: (206)526-6723

Springer, Alan Alan Springer University of Alaska Fairbanks ams@ims.uaf.edu PO Box 757220 University of Alaska Fairbanks Fairbanks, AK, 99775-7220, usa Phone: 907 474-6213 Fax: 907 474-7204

Springer, Emilie Emilie Springer University of Washington emilie1@u.washington.edu 4826 36th Ave NE Seattle, WA, 98109, usa Phone: 206-963-7385 Spurkland, Tania Tania Spurkland University of Alaska Fairbanks tspurk@sfos.uaf.edu P. O. Box 82 Ester, AK, 99725, usa Phone: 907-474-7074

Stabeno, Phyllis Phyllis J. Stabeno NOAA phyllis.stabeno@noaa.gov Bldg 3 7600 Sand Point Way NE Seattle, WA, 98115, usa Phone: 206-526-6453 Fax: 206-526-6485

Stauffer, Gary Gary Stauffer Trident Seafoods Corp garystauffer47@msn.com 1724 214th St SW Lynnwood, WA, 98036, usa Phone: 425-776-9470

Stephens, Carol Carol Stephens Alaska SeaLife Center carols@alaskasealife.org 301 Railway Avenue PO Box 1329 Seward, AK, 99664, usa Phone: 907-224-6351 Fax: 907-224-7901

Straley, Jan Jan Straley University of Alaska Southeast Sitka Campus jan.straley@uas.alaska.edu 1332 Seward Ave. Sitka, AK, 99835, usa Phone: 907747779 Fax: 9077477741

Strathe, Cody Cody Strathe University of Alaska Fairbanks ftcjs@uaf.edu 310 Eielson Building PO Box 757720 Fairbanks, AK, 99775-7720, usa Phone: 907-474-5885

Sugai, Susan Susan Sugai UAF fnsfs@uaf.edu PO Box 757740 305 IARC Fairbanks, AK, 99775-7740, usa Phone: (907) 474-5415 Fax: 474-6722 Suryan, Robert Rob Suryan Oregon State University rob.suryan@oregonstate.edu 2030 S.E. Marine Science Dr. Newport, OR, 97365, usa Phone: 541-867-0223 Fax: 541-867-0138

Swanson, Lori Lori Swanson - Groundfish Forum Groundfish Forum Ioriswanson@seanet.com 4241 21st Avenue W, Suite 200 Seattle, WA, 98199, usa Phone: 206-909-5959

Sydeman, William Bill Sydeman PRBO Conservation Science wsydeman@prbo.org 3820 Cypress Drive, No. 11 Petaluma, CA, 94954, usa Phone: 707-781-2555 x. 319

Talbot, Vickie Vickie Talbot Alaska Pacific University vtalbot@alaskapacific.edu 5960 Camborne Dr Palmer, AK, 99645, usa Phone: 357-4574

Tallmon, David Dave Tallmon University of Alaska Southeast david.tallmon@uas.alaska.edu 11120 Glacier Hwy Juneau, AK, 99801, usa Phone: 907-796-6330 Fax: 907-796-6447

Tamburri, Mario Mario Tamburri Alliance for Coastal Technologies tamburri@cbl.umces.edu ACT/CBL One Williams Street Solomons, MD, 20688, usa Phone: 410 326 7440 Fax: 410 326 7428

Tate, Paul Paul Tate Norseman Maritime Charters captpst@aol.com PO Box 1448 Seward, AK, 99664, usa Phone: 907-224-6767 Taylor, Ken Ken Taylor North Slope Science Initiative kenton_taylor@ak.blm.gov 222 W. 7th Ave., #13 Anchorage, AK, 99513, usa Phone: 907 271-3131 Fax: 907 271-4596

Taylor, Kevin Kevin Taylor University of Alaska Fairbanks fskdt3@uaf.edu Institute of Marine Science University of Alaska Fairbanks Fairbanks, AK, 99775, usa Phone: 907-474-7993 Fax: 907-474-7204

Testa, James Ward Testa Alaska Fisheries Science Center ward.testa@noaa.gov Biological Sciences Department - UAA 3211 Providence Drive Anchorage, AK, 99508, usa Phone: (907)786-1350 Fax: (907)786-4607

Tester, Patricia Pat Tester National Ocean Service pat.tester@noaa.gov 101 Pivers Island Roda Beaufort, NC, 28516, usa Phone: 252 728 8792 Fax: 252 728 8784

Thomson, Arni ARNI THOMSON EXECUTIVE DIRECTOR ALASKA CRAB COALITIO Alaska Crab Coalition acccrabak@earthlink.net 3901 LEARY WAY NW SUITE 6 SEATTLE, WA, 98107, usa Phone: 206 547 7560 Fax: 206 547 0130

Thomton, Jamie Jamie Thomton Alaska SeaLife Center jamie T@alaskasealife.org PO Box 1329, 301 Railway Avenue Alaska SeaLife Center Seward, AK, 99664-1329, usa Phone: 907 224-6390 Thorne, Richard Dick Thorne Prince William Sound Science Center thorne@pwssc.gen.ak.us P.O. Box 705 Cordova, AK, 99574, usa Phone: 9074245800 Fax: 9074245820

Timm, Katriina Katriina M Timm ASRC katriina.timm@asrcenergy.com 3900 C Street Suite 601 Anchorage, AK, 99503, usa Phone: 907.339.5468 Fax: 907.339.5475

Torsen, Carol Carol Torsen IPCoMM caroltorsen@gci.net 800 E. Dimond Blvd. #3-590 Anchorage, AK, 99516, usa Phone: 907-644-1047 Fax: 907-345-0566

Treadwell, Mead Mead Treadwell U.S. Arctic Research Commission meadwell@alaska.net 1007 West Third Ave. Ste. 200 Anchorage, AK, 99501, usa Phone: 907 278 4801 Fax: 907 278 4807

Trent, John John Trent, USFWS U.S. Fish and Wildlife Service john_trent@fws.gov USFWS, Matrine Mammals Management 1011 East Tudor Road Anchorage , AK, 99503, usa Phone: (907)-786-3815 Fax: (907)-786-3816

Tribuzio, Cindy Cindy A Tribuzio University of Alaska Fairbanks ftcat@uaf.edu Phone: 907-463-3522 Fax: 907-796-6447 Trites, Andrew Andrew Trites North Pacific Universities Marine Mammal Research Consortium trites@zoology.ubc.ca Marine Mammal Research Unit, Room 247, AERL, 2202 Main Mall Vancouver, BC, V6T 2G6, can Phone: 604 822-8181

Trust, Kimberly Kimberly Trust Exxon Valdez Oil Spill Trustee Council kim_trust@evostc.state.ak.us 441 West 5th Avenue, Suite 500 Anchorage, AK, 99501, usa Phone: 907-278-8012 Fax: 907-276-7178

Tsontos, Vardis Vardis TSONTOS (Univ. Southern California) University of Southern California tsontos@usc.edu Department of Biological Sciences, University of Southern California 3616 Trousdale Parkway, AHF M-235 Los Angeles, CA, 90089-0371, usa Phone: 1-213-7401810 Fax: 1-213-7408123

Turek, Michael Mike Turek Alaska Department of Fish and Game mike_turek@fishgame.state.ak.us P.O. Box 115526 Juneau, AK, 99811-5526, usa Phone: 907-46503617 Fax: 907-465-2600

Turne, Juli Juli University of Alaska Fairbanks fsjat4@uaf.edu 2001 Cowles St. Apt. 5 Fairbanks, AK, 99701, usa Phone: (907)451-0119

Tutiakoff, Anfesia Anfesia Tutiakoff Aleut Marine Mammal Commission ammcsent@arctic.net P.O. Box 920045 Dutch Harbor, AK, 99692, usa Phone: (907) 581-5324 Fax: (907) 581-5325 Udevitz, Mark Mark Udevitz USGS Alaska Science Center mudevitz@usgs.gov USGS Alaska Science Center 1011 E. Tudor Rd., MS 701 Anchorage, AK, 99503, usa Phone: 907-786-3365

Ulmer, Fran Fran Ulmer University of Alaska Anchorage affau@uaa.alaska.edu 3211 Providence Drive Anchorage, AK, 99508, usa Phone: 907-786-5402 Fax: 907-786-7739

Urban, Dan Dan Urban Alaska Dept. of Fish and Game dan_urban@fishgame.state.ak.us 211 Mission Road Kodiak, AK, 99615, usa Phone: 907-486-1849

van den Broek, Keith Keith van den Broek Native Village of Eyak keith@nveyak.org PO Box 1388 Cordova, AK, 99574, usa Phone: 907 424 7867

Vlasof, Marth Martha Vlasoff - PAC EVOSTC - Subsistence Public Advisory Committee - Subsistence unungangirl@yahoo.com 724 O Street Apt 6 Anchorage, AK, 99501, usa Phone: 907-929-2964

Vollenweider, JJ JJ Vollenweider NOAA Fisheries, Auke Bay Lab Johanna.Vollenweider@noaa.gov NOAA Fisheries, Auke Bay Lab 11305 Glacier Hwy Juneau, AK, 99801, usa Phone: 907-789-6612 Fax: 907-789-6094

von Biela, Vanessa Vanessa von Biela University of Alaska Anchorage vanessavb@gmail.com 3221 Providence Dr. EBL 130 Anchorage, AK, 99508, usa Phone: 907-786-1534 Vorosmarty, Charles Charles Vorosmarty University of New Hampshire charles.vorosmarty@unh.edu Institute for the Study of Earth, Oceans, and Space Morse Hall, 39 College Road Durham, NH, 03824, usa Phone: 603-862-0850 Fax: 603-862-0587

Vukelic, Heather Heather Vukelic, University of Alaska Fairbanks University of Alaska Fairbanks hevcoastal@hotmail.com Phone: 907-388-8716

Waddell, James James Waddell Bristol Environmental & Engineering Services Corporation jwaddell@bristol-companies.com 1150 S. Colony Way Suite #3, PMB 127 Palmer, AK, 99645, usa Phone: 907-743-9370

Wagner, Jennifer Jennifer Wagner Arctic Slope Regional Corporation jennifer.wagner@asrcenergy.com 3005 Barbara Street Anchorage, AK, 99517, usa Phone: 907-339-5469

Walker, Robert Trey Walker University of Washington rvwalker@u.washington.edu University of Washington Box 355020 Seattle, WA, 98195-5020, usa Phone: 206-543-7281 Fax: 206-685-7471

Walker, Susan Sue Walker National Marine Fisheries Service susan.walker@noaa.gov P.O. Box 21668 Juneau, AK, 99801, usa Phone: 907-586-7646 Fax: 907-586-7358

Wang, Jia Jia Wang University of Alaska Fairbanks jwang@iarc.uaf.edu 930 Koyukuk Dr Fairbanks, AK, 99775, usa Phone: 9074742685 Fax: 9074742643 Wang, Shiway Shiway Wang USGS - Alaska Science Center shiway@gmail.com PO Box 2495 Seward, AK, 99664, usa Phone: 9073622494

Warrenchuk, Jon Jon Warrenchuk Oceana jwarrenchuk@oceana.org Suite 418, 175 South Franklin Juneau, AK, 99801, usa Phone: 9075866744

Waschak, Emily Emily Waschak Oregon State University emily.waschak@oregonstate.edu 104 Nash Hall Department of Fisheries and Wildlife Corvallis, OR, 97331, usa Phone: 5412315742

Wedemeyer, Kate Kate Wedemeyer Enivronmental Studies kate.wedemeyer@mms.gov 3708 Centerpoint Drive Anchorage, AK, 99508-5823, usa Phone: 334-5278 Fax: 334-5242

Weltz, Fred Fred Weltz Alice Cove Research weltzfred@ctcak.net PO Box 982 Cordova, AK, 99574, usa Phone: 907 424=7506

Wenzel, Melanie Melanie Wenzel University of Alaska, Fairbanks melanie.wenzel@web.de School of Fisheries and Ocean Science, 245 O' Neill Bldg University of Alaska Fairbanks, AK, 99775, usa Phone: 907-474-7074

Whalen, Mary Mary E. Whalen U.S. Geological Survey mwhalen@usgs.gov 1011 E. Tudor Rd., MS 701 Anchorage, AK, 99503, usa Phone: 907-786-3496 Fax: 907-786-3636 Whitney, Frank Frank Whitney Fisheries and Oceans Canada whitneyf@pac.dfo-mpo.gc.ca Institute of Ocean Sciences 9860 W. Saanich Rd Sidney, BC, V8L 4B2, can Phone: 250 363-6346

Wiese, Francis Francis Wiese North Pacific Research Board francis.wiese@nprb.org 1007W 3rd Ave Suite 100 Anchorage, AK, 99501, usa Phone: 907 6446713

Wiesenburg, Denis Denis Wiesenburg University of Alaska Fairbanks University of Alaska Fairbanks wiesenburg@sfos.uaf.edu University of Alaska Fairbanks P. O. Box 757220 Fairbanks, AK, 99775-7220, usa Phone: 907-474-7210 Fax: 907-474-7204

Willette, Mark Mark Willette State of Alaska mark_willette@fishgame.state.ak.us 43961 Kalifornsky Beach Rd, Ste B Soldotna, AK, 99669, usa Phone: 907-260-2911

Williams, Michael Mike Williams National Marine Fisheries Service michael.williams@noaa.gov 222 W. 7th Avenue Box 43 Anchorage, AK, 99513, usa Phone: 907-271-5117 Fax: 907-271-3030

Willoya, Donn Donna Willoya The Alaska Sea Otter and Steller Sea Lion Commission dwilloya@seaotter-sealion.org 6239 B Street, Suite 204 Anchorage, AK, 99518, usa Phone: 907-274-9799

Wilson, Bill Bill Wilson No. Pacific Fishery Mgt. Council bill.wilson@noaa.gov 605 West 4th Avenue Suite 306 Anchorage, AK, 99501, usa Phone: 907-271-2809 Fax: 907-271-2817 Wilson, Kenneth Ken Wilson Alyeska wilsonk@alyeska-pipeline.com PO Box 60469 Fairbanks, AK, 99701, usa Phone: 907-450-5732 Fax: 907-450-5534

Winter, Andreas

.

Andreas Winter University of Alaska - Fairbanks ffagw@uaf.edu Fishery Industrial Technology Center 118 Trident Way Kodiak, AK, 99615, usa Phone: 907 486 1534

Witherell, David David Witherell

North Pacific Fishery Management Council david.witherell@noaa.gov 605 West 4th Ave, Suite 306 Anchorage, AK, 99501, usa Phone: 2712809

Witteveen, Briana Bree Witteveen University of Alaska Fairbanks bwitteveen@sfos.uaf.edu UAF/FITC 118 Trident Way Kodiak, AK, 99615, usa Phone: 907-486-1532

Wolf, Elise Elise Wolf AK OCS Project alaskawatch@acsalaska.net PO Box 15303 Fritz Creek, AK, 99603, usa Phone: 541-549-6045

Wolfe, Jim Jim Wolfe University of Alaska afjrw@uaa.alaska.edu PO Box 210090 Anchorage, AK, 99521, usa Phone: 907 337-4407

Wolfe, Megan Megan Wolfe University of Alaska Fairbanks m.wolfe@sfos.uaf.edu PO Box 210090 Anchorage, AK, 99521, usa Phone: 907-978-8837 Womble, Jamie Jamie Womble National Park Service Jamie_Womble@nps.gov National Park Service-Glacier Bay Field Station 3100 National Park Road Juneau, AK, 99801, usa Phone: 907-364-1591 Fax: 907-364-1540

Woodby, Doug Doug Woodby Alaska Department of Fish and Game doug_woodby@fishgame.state.ak.us P.O. Box 115526 Juneau, AK, 99801, usa Phone: 907-465-6115

Wright, Bruce Bruce Wright, Aleut International Association Aleut International Association brucew@apiai.org 201 East 3rd Avenue Anchorage, AK, 99501, usa Phone: 907-222-4260 Fax: 907-279-4351

Wynne, Kate Kate Wynne UAF /SFOS ffkmw@uaf.edu FITC 118 Trident Way Kodiak, AK, 99615, usa Phone: 907-486-1517 Fax: 907-486-1540

Zador, Stephani Stephani Zador University of Washington szador@u.washington.edu UW-SAFS Box 355020 Seattle, WA, 98195, usa Phone: 206-221-6904

Zavadil, Phillip

Phillip A. Zavadil Aleut Community of St. Paul Island-Tribal Government pazavadil@tribaleco.com 2050 Venia Minor Road St. Paul Island, AK, 99660, usa Phone: 907-546-3230 Fax: 907-546-3253

Zeppelin, Tony Tonya Zeppelin NOAA/NMFS/NMML Tonya.Zeppelin@noaa.gov National Marine Mammal Laboratory 7600 Sand Point Way NE Seattle, WA, 98115, usa Phone: 206-526-4036 Fax: 206-526-6615 Zhang, Sheng Sheng Zhang University of Alaska Fairbanks szhang@iarc.uaf.edu International Arctic Research Center University of Alaska Fairbanks Fairbanks, AK, 99775-7340, usa Phone: 907-474-2684 Fax: 907-474-2643

Zheng, Ji Jie Zheng Alaska Department of Fish and Game jie_zheng@fishgame.state.ak.us Alaska Department of Fish and Game, Comm. Fish. P.O. Box 115526 Juneau, AK, 99811-5526, usa Phone: 907-465-6102

Zimenko, Nadezhda Nadezhda Russian Federal Institute of Fisheries and Oceanography n_zimenko@vniro.ru Verkhnie Polya St., 6-138 Moscow, null, 109382, rus Phone: +7(495)3494445 Fax: +7(495)3494445

Monitoring, Mapping and Surveying of the New Mineral Creek State Park Area

Valdez Youth Area Watch Students Valdez High School Valdez, Alaska 99686

> ·Average Count April 2006)

> > .260

Average Count

6 due to

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Introduction

The Valdez Youth Area Watch group will be continuing the ongoing project of mapping and surveying Mineral Creek State Park. The purpose of this project is to gather information for the Alaska Department of Fish and Game and the the city of Valdez, because of the interest for further development.











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Green Crab Survey:

As part of our studies on marine life of the region, we took over a monitoring project from Regional Citizen's Advisory Council for monitoring the Green Crab (Carcinus maenas), an invasive and potentially harmful species. This involved setting live

traps along the beach during spring, the season in which these crabs reproduce in the inter-tidal zone. So far, none of this species have been discovered.

•Date •Alyeska •Hatcher •Contain •M.Cree y .Docks k •N/A •N/A •N/A •0 •April 1-2 +2 •N/A •2cm Hermit Crab, •April 17-18 Sculpin Sculpin 14- 6.3-18cm, 13.5cm



Mineral Creek State Park Development Plans



S OF YOU

Development Plan B





ng lot is too close to

Conclusions

Until more data is collected again this year in the Mineral Creek State Park area, and until the Mineral Creek State Park development begins, there is little to conclude concerning what effect extensive human use could have on the area's consystem. In addition to our continued mapping and surveying of the area and monitoring for invasive species, water quality testing and mud-core sampling will also be used to gather data in 2007. The data collected will be used to help project the impact of increased human usage as development looms on the horizon.

Membership Application

Join US! Become a member today! Renew for 2 years and help ANROE save on the cost of mailing!

Types: Fees for 1 year / 2 years

Individual	\$35 / \$70
Student/Retired/Fixed Income	\$25 / \$50
Agency/Small Business/Tribal Gov	\$160 / \$320
Agency/Large Business/Tribal Gov	\$275 / \$550
Discovering Salmon Coloring Book	\$5.00
Targeting Excellence	\$3.00
Status Report: EE in AK	\$5.00
Shipping and Handling	FREE
Total:	

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Mail applications and payments to:

ANROE: Membership 200 West 34th Avenue, Suite 1007 Anchorage, AK 99503





The ANROE logo is inspired by a Western Alaska Eskimo mask.

Radiating from the moon's face ringed with mountains and water are Alaska life forms. The hand symbolizes excapement allowing them to remain.

Design by Joann Popham







ALASKA NATURAL RESOURCE & OUTDOOR EDUCATION ASSOCIATION

"PROMOTING AND IMPLEMENTING NATURAL RESOURCE, OUTDOOR AND ENVIRONMENTAL EDUCATION"

MISSION STATEMENT

VISIT ANROE'S WEBSITE AT www.anroe.org

About ANROE

The Alaska National Resource and Outdoor Education Association is a statewide, non-profit organization that promotes and implements natural resource, outdoor and environmental education among Alaska's communities and beyond. ANROE collaborates with organizations, agencies, school districts and tribes to provide educational resources and materials, training, and networking opportunities about Alaska resources and the environment.

Creating CONNECTIONS

A NROE members create networks and develop partnership oppotunities across the state. Through the newsletter, list serve and web conference site members share information about environmental educational tools, techniques, employment, statewide conferences and professional developmental opportunities.

The ANROE newletter, *Flyways, Pathways & Waterways,* is published tri-annually and keeps you up to date on new resources, training opportunities, and statewide events. It's also a great resource for learning about Alaska's natural history.



ANROE's website at http://www.anroe.org/ provides links to new educational resources, employment and training opportunities, and the latest EE info in Alaska. ANROE members can add information to our calendar, list serve, and resource guide.





Teaching the TEACHERS

ANROE partners with informed and qualified Alaskan professionals to conduct locally relevant workshops, week long institutes and graduate courses throughout the state.



Working TOGETHER toward common goals

A NROE collaborates with its many partnerships to provide an information clearinghouse of books, audiovisual and other educational materials. ANROE publishes several educational resources including:

- Discovering Alaska's Salmon Coloring Book.
- Targeting Excellence -

Aligning Alaska Environmental Education with Standards.

• The Alaska EE Status Report.



Link Up with ANROE

As a member, you join an ever-growing network of involved educators from all regions of Alaska.

Membership benefits include:

- *Flyways, Pathways, and Waterways* newsletter packed with exciting articles & resources.
- Member only website access to the Guide to Alaska Natural Resource Education.
- Member only access to the ANROE website & bulletin board, monthly email Statewide EE updates, publications, and much more.
- Discounts on conference and workshop fees.



We encourage you to join your regional chapter. You'll find these chapter addresses in NMEA News. If your locality is not listed below, a neighboring state chapter would enjoy having you as a member.

- CARIBWAMEA Caribbean and Western Atlantic Marine Educators
 Association
- FMSEA Florida Marine Science Education Association
- GAME Georgia Association of Marine Education
- GLEAMS Great Lakes Educators of Aquatic and Marine Sciences (Ohio, Indiana, Illinois, Wisconsin, Western Pennsylvania, & Michigan)
- GOMMEA Gulf of Maine Marine Education Association (Maine, New Hampshire, & Vermont)
- MME Massachusetts Marine Educators
- MAMEA Mid-Atlantic Marine Education Association (North Carolina, Virginia, Washington D.C., Maryland, & Delaware)
- NJMEA New Jersey Marine Education Association (New Jersey and Eastern Pennsylvania)

- NYSMEA New York State Marine Education Association
- NAME Northwest Aquatic and Marine Educators (Washington, Oregon, Alaska, & British Columbia)
- OCEANIA (Hawai'i & other Pacific island nations)
- SCMEA South Carolina Marine Educators Association
- SAME Southern Association of Marine Educators (Louisiana, Mississippi, & Alabama)
- SENEME Southeastern New England Marine Educators (Rhode Island & Connecticut)
- SWMEA Southwest Marine/Aquatic Education Association (California, Colorado, New Mexico, Nevada, & Arizona)
- TEAMS Tennessee Educators of Aquatic and Marine Science
- TMEA Texas Marine Education Association



WEA Near begts members up to date with events and activities of its regional chapters, developments and news to mattre and aquific clone and education, and opportunities for confestional development.

National Conference

Each summer a regional chapter routinely horts the rational NMEA conference are local university. Marine and aquatic educators from the Chited States, Canada and other countries gather hi exchapte filtes, experiences and mediane to Insiques, hear the larget research news and make and renew friendahips with colleagues. Members receive a discount on rational coalerence beginniton fees

NMEA INCLUDES PROFESSIONALS IN EDUCATION, SCIENCE, BUSINESS, GOVERNMENT, MUSEUMS, AOURIUMS, AND MARINE RESEARCH

National Marine Educators Association

"... to make known the world of water, both fresh and salt."

National Marine Educators Association

The National Marine Educators Association brings together those interested in the study and enjoyment of the world of water, both fresh and salt. Affiliated with the National Science Teachers Association and the American Association for the Advancement of Science, NMEA provides a valuable focus for marine and aquatic studies all over the world.

MEMBERSHIP BENEFITS

Publications

Current: The Journal of Marine Education features in-depth articles about marine and aquatic, physical, earth and life sciences; maritime history; marine and aquatic education and research; and marine and aquatic literature, songs, and art. NMEA News keeps members up to date with events and activities of its regional chapters, developments and news in marine and aquatic science and education, and opportunities for professional development.

National Conference

Each summer a regional chapter routinely hosts the national NMEA conference at a local university. Marine and aquatic educators from the United States, Canada and other countries gather to exchange ideas, experiences and teaching techniques, hear the latest research news and make and renew friendships with colleagues. Members receive a discount on national conference registration fees.

MEMBERSHIP CATEGORIES

Individual Memberships_

- ACTIVE: Any person who supports the goals of NMEA. 1 year -\$40; 2 years - \$78; 3 years - \$118
- AFFILIATE: Any person who belongs to a regional chapter or affiliate organization. 1 year - \$35; 2 years - \$68; 3 years - \$103
- ASSOCIATE: Any person providing additional support to NMEA. 1 year - \$55
- FAMILY: Active members receiving only one set of mailings per household. 1 year - \$65

This membership allows a husband/wife and /or children living at home to have a joint NMEA membership and attend conferences as though they were individual members.

- LIFE: Any person who wishes to join as an active member for life. \$500 or more
- STUDENT: Any full-time student. 1 year - \$20

Other Types of Memberships

- INSTITUTIONAL: Any active nonprofit organization, including libraries, with goals similar to those of NMEA. This type membership is for a facility not a person. The facility/institution receives one copy of each issue of *Current* and *NMEA News*. 1 year \$40
- CORPORATE: Any company or organization whose business includes the marine and aquatic education market. In addition to basic membership privileges, corporate members receive a 25% discount on advertising rates, a membership rate for the national conference registration fees for three employees, plus recognition as a sponsor in the annual report. 1 year - \$250 or more.

NMEA INCLUDES PROFESSIONALS IN EDUCATION, SCIENCE, BUSINESS, GOVERNMENT, MUSEUMS, AQUARIUMS, AND MARINE RESEARCH.

NATIONAL MARINE EDUCATORS ASSOCIATION MEMBERSHIP CATEGORY

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MAILING ADDRESS	FAMILY CORPORATE	
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CITYSTATEZIP	Credit Card Type: VISA MASTER CARD	
PROVINCE / COUNTRYPC	Name on Credit Card:	
PHONE FAX	Credit Card No.: Expiration Date:	
A CONTRACT OF	Signature:	
EMAIL	 * SEE ABOVE for multiple year costs. FOREIGN MEMBERSHIPS: Please add \$5.00 U.S. or renew only. drawn on bank with U.S. branch. 	

Please make check payable to NMEA and mail to: NATIONAL MARINE EDUCATORS ASSOCIATION • P.O. BOX 1470, OCEAN SPRINGS, MS 39566-1470 Phone: 228-818-8893 • Fax: 228-818-8894 • E-mail: nmea@usm.edu • NMEA Website: http://www.marine-ed.org



National Oceanic and Atmospheric Administration (NOAA) Ocean Exploration Education Program NOAA Ship, Ronald H. Browr



The National

Oceanic and Atmospheric Administration's (NOAA's) **Ocean Exploration Program** is committed to engaging the broadest possible audiences in near-real time ocean exploration to raise America's environmental literacy. This effort includes opportunities for teachers and other educators to engage in learning more about NOAA Ocean Exploration and how they can use the mathematics, science, and technology content associated with exploring the oceans in their classrooms. The offerings listed here are designed to introduce educators to ocean scientists / explorers and their research and explorations, and at the same time, equip educators with exemplary tools and resources that will engage students of all ages in NOAA's ocean exploration efforts.



Ocean Explorer Web Site (http://oceanexplorer.noaa.gov)

An educational Internet offering for all who wish to



Pencil Urchin, Art Howard, NAPRO

learn about, discover, and virtually explore the ocean realm. It provides direct access to current information on NOAA's multidisciplinary ocean exploration expeditions, and contains thousands of pages of content essays, videos and images covering an extensive range of ocean exploration topics. Daily logs for each expedition, written by scientists and educators at sea, reside on the site, and document the activities and findings of the science/education team while at sea. An Education Section provides educators with a variety of resources, including access to lesson plans for students in Grades 5-12.

Lesson Plans for Multidisciplinary Voyages of Discovery

Over 150 lesson plans for students in Grades 5-12, developed by scientists and educators to translate the science behind each NOAA Ocean Exploration expedition to classrooms, reside on the Ocean Explorer Web site. Each handson and inquiry-based lesson plan is correlated to the National Science Education Standards. Many lessons contain adaptations for teachers of deaf students.

Learning Ocean Science through Ocean Exploration Curriculum

Developed as the cornerstone for nationallevel professional development in ocean science content for teachers of Grades 6-12, the curriculum includes lesson plans developed for NOAA voyages of discovery and presents them in a comprehensive scope and sequence through



subject area categories that cut across individual expeditions. Curriculum themes progress from physical science through earth science to biological and environmental science. Through combining the Ocean Explorer Web site with each lesson included in the curriculum, teachers and students have a direct connection to the scientists whose work they are modeling in the classroom and a direct connection to the exciting new discoveries through NOAA ocean exploration. The curriculum is available online at the Ocean Explorer Web site.

Ocean Exploration Education Alliances

NOAA's Ocean Exploration Program is developing alliances with aquariums and science centers to offer professional development to teachers in the use of *Learning Ocean Science through Ocean Exploration*. These one-day long professional development offerings and associated follow-ups help build regional cadres of ocean exploration teacher leaders. Check the Ocean Explorer Web site for an Ocean Exploration Education Alliance in your region.

Professional Development Institutes for NOAA Ocean Expeditions

Offered in regions near locations where expeditions are taking place, Professional Development Institutes provide teachers with opportunities to learn how to use expeditionbased lesson plans and the associated content on the Ocean Explorer Web site. Check the Ocean Exploration Web site for Professional Development Institutes in your region.

Virtual Workshops for Educators

Opportunities to engage in learning more about ocean exploration and how mathematics, science, and technology content associated with exploring the oceans can be used in classrooms to increase awareness and understanding of the ocean. Offerings are designed to introduce premiere ocean scientists/explorers and their research and explorations to educators, and at the same time, provide workshop participants with exemplary tools and resources that engage students in ocean exploration as classrooms are brought closer to the ocean than they have ever been before. Visit the Ocean Exploration Web site for upcoming Virtual Workshops for Educators.

OceanA.G.E. (Another Generation of Explorers)

Developed in collaboration with NASA, and housed on the Ocean Explorer Web site, students are invited through this offering to interact with talented women and men who explore the ocean on NOAA Ocean Exploration expeditions through live interviews, video profiles, biographies, background materials, and mission logs. Live Web Chats, interactive video Web Casts, and text-based Web Forums support the offering. Visit the Ocean Exploration Web site for a schedule of upcoming OceanA.G.E. events.

NOAA Ocean Exploration Education Listserv

Through this listserv, you will receive dates and locations of *Learning Ocean Science through Ocean Exploration* Professional Development Programs; dates and times for Online Professional Development Offerings targeted to specific expeditions; dates, mission objectives, and links to upcoming NOAA Ocean Exploration Expeditions; notifications of new educational offerings posted on the Ocean Explorer web site; and dates, times, and featured speakers in the OceanA.G.E. (Another Generation of Explorers) Web Casts and Web Forums. Visit the Ocean Explorer Web Site for information on how to join the listserv.



Utting-edge tools, such as this Klein 5000 Side Sacn sonar, are being developed by scientists to better explore he depths of the ocean.

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Tube



FOR MORE INFORMATION, PLEASE CONTACT

Paula Keener-Chavis, Director Education Programs NOAA Office of Ocean Exploration Hollings Marine Laboratory 331 Fort Johnson Road, Charleston SC 29412 843.762-8818 843.762-8737 (fax) paula.keener-chavis@noaa.gov

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Marine Science in Alaska: 2007 Symposium Book of Abstracts

Arctic Ocean: Monday, 22 January

• Welcome

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- Keynote Address: Steven C. Amstrup
 - Polar Bears Sentinel of Arctic Change
- Morning: Climate, Oceanography & Lower Trophic Levels
- Lunch: Thomas S. Litwin
 - May You Live in Exciting Times Climate Change, Public Understanding & Lessons from the Harriman Expedition Retraced
- Afternoon: Living Marine Resources and Ecosystem Perspectives

Bering Sea and Aleutian Islands: Tuesday, 23 January

- Morning 1: Climate, Oceanography & Lower Trophic Levels
- Morning 2: Fish & Fish Habitat
- Lunch: Paula Keener-Chavis Communicating Science
- Afternoon 1: Seabirds
- Afternoon 2: Marine Mammals
- Afternoon 3: Human & Community Impacts and Ecosystem Perspectives

• Gulf of Alaska: Wednesday, 24 January

- Morning 1: Climate & Oceanography
- Morning 2: Lower Trophic Levels
- Morning 3: Fish & Fish Habitat
 - Lunch: Jan Straley Behind the scenes: The making of the sperm whale depredation film SEASWAP for NPRB
- Afternoon 1: Fish & Fish Habitat (continued)
- Afternoon 2: Seabirds & Marine Mammals
- Poster Sessions: Human & Community Impacts and Ecosystem Perspectives

Keynote Address

Polar Bears-Sentinel of Arctic Change

Steven C. Amstrup USGS Alaska Science

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Sea ice extent, age, and volume have significantly declined in the past 30 years. These changes are predicted to dramatically alter the entire Arctic Marine Ecosystem. Unfortunately, most biotic changes in this system are difficult to assess because they occur under the sea ice. Polar bears, however, are entirely dependent on the ice surface, and changes in the ice translate directly into changes in their carrying capacity. Also, as the apical member of the ecosystem, the status of polar bears integrates over lower level changes. Because polar bears occur over a broad range of conditions, from perennially to seasonally ice covered seas, they also may forecast changes yet to come. Research has discovered declines in survival, recruitment, and population size near the southern extreme of polar bear range and declining physical stature and recruitment of young in the Beaufort Sea--reflecting climate change effects on biota across a broad swath of the Arctic. Predictions of still greater sea ice declines, therefore, raise concerns regarding long-term conservation of polar bears and their ecosystem. Natural variation, however, guarantees some uncertainty about predictions for the future, and with resolve, we can manage the extent to which humans are contributing to climate trajectories. Further, we know that polar bears survived warm periods in the past. By determining how they respond, spatially and demographically to diminishing ice, we will have our best chance to predict where polar bears may persist and to maximize our opportunity to assure their long-term survival through whatever the future brings.

Monday, 22 January 2007 9:45 AM – 12:30 PM Session Chair and Poster Review: Stephen Okkonen

TALKS

Speaker	Title
Carin Ashjian	Environmental Variability Relative to Bowhead Whale Distribution and
	Prey Availability Near Barrow, Alaska
Stephen Okkonen	Exchange Between Elson Lagoon and the Nearshore Beaufort Sea
Kevin Taylor	Retrospective Analyses of the 1945-2005 Barrow Wind Record
Rachel Potter	Using HF Radar to Map Surface Currents in the Beaufort Sea
Seth Danielson	Results from the collection oceanographic measurements from three
	nearshore acoustic doppler current meter profilers (ADCPs) along the
	inner Beaufort sea shelf from Smith Bay to Camden Bay, Alaska.
Jia Wang	Simulating The 20th Century Arctic Sea Ice and Ocean Circulation
	Variability Using a Global Coupled Atmosphere-Ice-Ocean-Land Mode
Gleb Panteleev	Variational reconstruction of the quasi-stationary Bering Sea circulation
	and reanalysis of the fall 1990 circulation in the Chukchi Sea
Nora Foster	Old wine, new bottles: archiving George MacGinitie's Arctic marine
	invertebrate data
Kohei Mizobata	Recent summer chlorophyll reduction affected by the warm Pacific
	summer water in the Chukchi sea: observation and modeling

POSTERS

First Author	Title
Otina Fox	AOOS and IPY
Jeremy Kasper	Modeling circulation in the landfast ice zone
Jia Wang	Downscaling ice-ocean characteristics in the Beaufort-Chukchi seas
	simulated by an IARC Coupled Ice-Ocean Model (CIOM)
Melanie Wenzel	Changes in benthic community structure in the Chirikov Basin, Bering
	Sea: A comparison between 1986 and 2002
Sheng Zhang	Replacing Ice Code of CIOM model by Las Almos CICE ice model
	version 3.14

Environmental Variability Relative to Bowhead Whale Distribution and Prey Availability near Barrow, Alaska

Carin J. Ashjian, Woods Hole Oceanographic Institution, cashjian@whoi.edu Stephen R. Braund, SR Braund and Associates, srba@alaska.net Robert G. Campbell, University of Rhode Island, Campbell@gso.uri.edu Craig George, North Slope Borough Dept. of Wildlife Management,

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Craig.George@north-slope.org Jack A. Kruse, University of Alaska Anchorage, afjak@uaa.alaska.edu Sue E. Moore, NOAA, Sue.Moore@noaa.gov Craig R. Nicolson, University of Massachusetts, craign@forwild.umass.edu Stephen R. Okkonen, University of Alaska Fairbanks, okkonen@alaska.net Barry F. Sherr, Oregon State University, sherrb@coas.oregonstate.edu Evelyn B. Sherr, Oregon State University, <u>sherre@coas.oregonstate.edu</u>

The annual migration of bowhead whales (Balaena mysticetus) past Barrow, Alaska has provided subsistence hunting to Inupiat whalers for centuries. Bowheads regularly feed near Barrow in autumn, presumably on recurrent aggregations of their zooplankton prev (e.g., copepods, euphausiids). Oceanographic field-sampling and aerial surveys on the shelf near Barrow and in Elson Lagoon were conducted during August and September of 2005 and 2006 to characterize the hydrography and plankton, identify exchange of water and biota between the shelf, lagoon, and offshore, determine biological and physical mechanisms of plankton aggregation, and describe distributions of bowhead whales. The extent of interannual and shorter-term variability in the physical and biological conditions was striking. Multiple water masses were observed, with close coupling between water mass and biological and nutrient characteristics. Short-term variability in hydrography was associated with changes in wind speed and direction that profoundly affected plankton taxonomic composition. Winds from the southwest along Barrow Canyon in early September 2006 apparently pushed Pacific Water and euphausiids onto the shelf that were used by feeding bowhead whales. Sub-tidal fluxes of water in/out of Elson Lagoon were tightly coupled to wind speed and direction; this may fill the lagoon with krill so that the lagoon functions as a krill reservoir. Both mechanisms may contribute to the formation of a favorable feeding environment for bowheads near Barrow. The locations of feeding whales observed in the field sampling corresponded well with longer-term local knowledge and with a 10-year record of whale aggregations on the Alaskan shelf.

Exchange between Elson Lagoon and the nearshore Beaufort Sea

Stephen Okkonen, University of Alaska Fairbanks, okkonen@alaska.net Carin Ashjian, Woods Hole Oceanographic Institution, cashjian @whoi.edu Bob Campbell, University of Rhode Island, <u>campbell@gso.uri.edu</u>

Bottom-mounted moorings, each instrumented with an Aanderaa RCM-11 acoustic current meter and a SeaBird SBE-37 microcat CT sensor, were deployed in Eluitkak Pass (about 5 km southeast of Point Barrow) and in Ekilukruak Entrance (near the west end of Cooper Island) to measure exchange between Elson Lagoon and the nearshore Beaufort Sea during a four week period in August-September 2006. Mean near-bottom currents were directed out of the lagoon at Eluitkak Pass (~7 cm/sec) and into the lagoon at Ekilukruak Entrance (~6 cm/sec). Maximum near-bottom current speeds were ~50 cm/sec (~1 knot). Semi-diurnal tidal currents dominated the flow through both passes. Sub-tidal currents (>25 hr period) responded to changes in wind speed and direction such that there was a net flow of cooler, saltier shelf water into the lagoon, raising the water level in the lagoon when winds were from the west-southwest quadrant. Net flow of warmer, fresher water out of the lagoon, lowering the water level, occurred when winds were from the eastern quadrant. Satellite imagery acquired during the mooring deployment showed that strong outflows from the lagoon established prominent fronts extending seaward from the passes between the barrier islands of Elson Lagoon.

Retrospective Analyses of the 1945-2005 Barrow Wind Record

Kevin Taylor, Thomas Weingartner, and Seth Danielson

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University of Alaska Fairbanks, School of Fisheries and Ocean Sciences, Fairbanks, AK 99775-7220

The circulation over continental shelves depends upon the wind-stress component parallel to the coast. These stresses force along-shelf flows and establish both cross-shelf and vertical motions associated with upwelling and downwelling. The winds also play a critical role in ocean mixing, especially in the Chukchi and Beaufort seas where tidal mixing is negligible. This retrospective analysis of the winds uses the 60-year record of measured winds at Barrow Alaska and applies these measurements to the Northwest coast of Alaska (Chukchi Sea) and along the North Slope (Alaskan Beaufort Sea). Our focus is on: 1) developing a monthly climatology for along-shelf wind stress and the wind speed cubed (which bears directly on the mechanical energy available to the upper ocean for mixing), 2) quantifying interannual variations, including trends in these variables, and 3) relating these variations to larger scale climatic indices.

The analyses use the winds measured by the National Weather Service (NWS) at Barrow Alaska between 1945 and 2005. Since the NWS recording site was moved midway through the measurement period we standardized the measurements by applying corrections to the NWS winds based on overlapping measurements obtained at the NOAA Climate Monitoring and Diagnostics Laboratory in Barrow. We find considerable low-frequency variability in the winds and relate this variability to both the Arctic Oscillation (AO) and Pacific North American (PNA) indices. The AO and PNA are climatological indices that describe the large-scale atmospheric structure of the Artic Ocean and the northern North Pacific Ocean, respectively.

Using HF Radar to Map Surface Currents in the Beaufort Sea

Rachel Potter, University of Alaska Fairbanks, rpotter@ims.uaf.edu David Musgrave, University of Alaska Fairbanks, musgrave@ims.uaf.edu Andrew Bray, University of Alaska Fairbanks, bray@sfos.uaf.edu Tony DAoust, University of Alaska Fairbanks, tonyd@ims.uaf.edu Tom Weingartner, University of Alaska Fairbanks, weingart@ims.uaf.edu

During the open-water season of 2005 and 2006, a High Frequency (HF) Radar system, manufactured by CODAR Ocean Sensors, was deployed on the Beaufort Sea coast, more specifically in Prudhoe Bay. The system continuously mapped surface currents up to 60 km offshore, and real-time data was posted to the web hourly. This project is a field experiment to examine the utility of mapping surface currents in a mixed ice and open water environment and to see how the data obtained can aid general circulation models for oil spill risk analysis. Data analysis includes investigating changes in surface circulation on a seasonal cycle and with varying environmental conditions, thereby aiding researchers in understanding the cause(s) of mesoscale variability in the Beaufort Sea. Results from the study in the form of successes, limitations, and overall utility of the HF Radar in a polar environment, as well as results from preliminary data analysis, will be discussed.

Results from the Collection Oceanographic Measurements from Three Nearshore Acoustic Doppler Current Meter Profilers (ADCPs) along the Inner Beaufort Sea Shelf from Smith Bay to Camden Bay, Alaska

Seth Danielson, UAF-IMS, seth@ims.uaf.edu Tom Weingartner, UAF-IMS, <u>weingart@ims.uaf.edu</u>

We show year-round bottom pressure, velocity, and temperature-salinity-transmissivity data collected from the nearshore (~10 m depth) Alaskan Beaufort Sea shelf. The inner shelf (inshore of the 20 m isobath) encompasses ~25% of Alaska's shelf area and its unique attributes are set by the seasonality of the landfast ice (present from October-June and extending from the coast to the ~25 m isobath) and the pulse-like spring discharge of arctic rivers. The inner shelves are critical in the processing of arctic river runoff, but have received scant attention and are poorly represented in climate models.

When landfast ice is present, currents are along-shore polarized, weak (~5 cm s⁻¹), uncorrelated with winds, and have de-correlation length scales of <100 km. Little crossshore exchange occurs under the landfast ice cover. During the two-week spring freshet highly sheared, strongly stratified and turbid under-ice plumes spread offshore at ~10 cm s⁻¹. After the ice breaks up, currents are swift (>20 cm s⁻¹), wind-driven, and coherent over length scales of ~200 km. Runoff-induced stratification results in a pronounced asymmetry in the velocity profiles under upwelling and downwelling winds. Subtidal currents are also coherent year-round with along-shore sea level slopes of O (10-6). In summer the momentum balance is amongst the wind, bottom friction, and alongshore pressure, while in winter under-ice and bottom friction balance the pressure gradient. We present estimates of the along-shore decorrelation length scales derived from measurements made in Prudhoe Bay, Smith Bay and Camden Bay.

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Arctic Ocean - Climate, Oceanography & Lower Trophic Levels

Simulating the 20th century Arctic sea ice and ocean circulation variability using a global coupled atmosphere-ice-ocean-land mode

Jia Wang, Arctic Modeling Group, International Arctic Research Center University of Alaska Fairbanks jwang@iarc.uaf.edu

The simulations of the Arctic ice-ocean circulation using the high resolution global coupled atmosphere-ice-ocean model with 1/6x1/4 degrees and 48 vertical layers on the "Earth Simulator" supercomputer are evaluated to determine the model performance. physics soundness, and its sensitivity to different process parameterizations. The model climatology (mean over all the model years) and variability were examined and compared with the available observations, such as ice area, temperature and salinity at certain key depths and transects. Several important physical features in the Northern Hemisphere, such as the thermohaline structure in the Arctic Ocean, Atlantic Water, meridional overturning, transports from Bering Strait, Fram Strait, were investigated. An important achievement is that the Atlantic Layer in the Arctic can be reasonably reproduced with no restoring temperature and salinity to observations. An important criterion of reproducing the Atlantic Layer variability is measured by the core (max) temperature of the layer of 500-1500m. The model reproduces reasonably the Atlantic Water core temperature in the 20th century that compares well with the observation by Polyakov et al. (2004). The model catches the 1930s-40s warming and the 1990s warming, similar to the observations. These results indicate that this coupled global model captures most important dynamic and thermodynamic processes in the Arctic Ocean. Further analyses of the model performance are underway.

Variational reconstruction of the quasi-stationary Bering Sea circulation and reanalysis of the fall 1990 circulation in the Chukchi Sea

Gleb Panteleev, International Arctic Research Center, University of Alaska, USA gleb@iarc.uaf.edu

Vladimir Luchin, FEBRAS, Vladivostok, Russia vluchin@poi.dvo.ru Rebecca Woodgate, University of Washington, Applied Physics Laboratory, WA, USA woodgate@apl.washington.edu

Dmitri Nechaev, University of Southern Mississippi, USA dmitri.nechaev@usm.edu Phyllis Stabeno, Pacific Marine Environmental, WA, USA stabeno@pmel.noaa.gov

We present two sets of results of the variational data assimilation applied for the reanalysis and short-range forecast of the currents in the Chukchi and Bering Seas. The model used for the reanalysis is designed specifically for the efficient variational assimilation of long-term observations in ocean regions strongly governed by flow through open boundaries and by atmospheric fluxes.

The circulation in the Chukchi Sea is reconstructed from various sources of observations including 2.0 months of velocity, temperature and salinity records from moorings and CTD observations in autumn 1990

(www.frontier.iarc.uaf.edu/~gleb). Assimilation of mooring velocities allows us to estimate volume, heat and salt transports in the Chukchi Sea. The reconstructed circulation pattern reveals periodical reverse of the East Siberian Current and flow through the Bering Strait, which are the important features of the Chukchi Sea circulation.

The quasi-stationary circulation in the Bering Sea is reconstructed from drifter and mooring observations, climatological temperature and salinity fields, and climatological surface fluxes of momentum, heat and fresh water. As a result of the reconstruction the estimates of volume transports through the Aleutian straits have been derived. Several numerical examples show that the reconstructed climatological sea surface height distribution can be effectively used for operational hind-cast and forecast of the circulation in the Bering Sea.

Old Wine, New Bottles: Archiving George MacGinitie's Arctic Marine Invertebrate Data

Nora R. Foster

In the late 1940s, George McGinitie, a prominent marine ecologist, documented the presence of marine invertebrates in the Beaufort Sea off Point Barrow, Alaska. His notes and photographs record details of the distribution, life history, abundance, feeding habits and parasites of over 200 species in 12 phyla. Much of his observations are recorded and interpreted in the classic Smithsonian publication, Distribution and Ecology of the Marine Invertebrates of Point Barrow, Alaska. In the late 1990s, when the NARL lab closed, several boxes of specimens and other material were donated to the University of Alaska Museum of the North. Among the miscellaneous material were MacGinitie's original notes and approximately 100 original annotated photographs. With finding from the Census of Marine Life's Arctic Ocean Biodiversity Program Arctic mini-grant program, I have begun a project to assure that original notes, and photographs, as well as the ecological information that can be derived from them will remain easily available through the UA Museum's ARCTOS database website and through OBIS, the Ocean Biogeographic Information system.

Recent summer chlorophyll reduction affected by the warm Pacific Summer Water in the Chukchi Sea: Observation and modeling

Kohei Mizobata, International Arctic Research Center, University of Alaska Fairbanks Jia Wang, International Arctic Research Center, University of Alaska Fairbanks

Summer chlorophyll-a (chl-a) distributions in the Chukchi/Beaufort Sea were investigated using satellite ocean color dataset. Since 2002, extremely low chl-a has been observed in the Chukchi Sea. This low chl-a area expands from the northern Hope Valley and Herald Shoal and then reaches southern Hope Valley and Hanna Shoal. The IARC Coupled Ice-Ocean Model (CIOM) suggests that the pathway of the Pacific Water inflow is consistent with this low chl-a area The warm Pacific Summer Water and rapid sea ice retreat have been detected since 2002, implying that phytoplankton blooms tend to be suppressed by the stratification due to warm and low-nutrient Pacific Summer Water. However phytoplankton blooms at sea ice edge occurred in July 2004 indicates that iceedge blooms can not be explained by only Pacific Summer Water. Sensitivity experiments using CIOM are conducted to investigate the mechanisms related to sea icecovered marine ecosystem in the Chukchi Sea.

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AOOS and **IPY**

Otina Fox, otina@sfos.uaf.edu

A website-walk through data and products for IPY.

Modeling circulation in the landfast ice zone

Jeremy Kasper, UAF-SFOS-IMS, ftjlk@uaf.edu Tom Weingartner, UAF-SFOS-IMS, weingart@ims.uaf.edu Seth Danielson, UAF-SFOS-IMS, <u>seth@ims.uaf.edu</u>

Immobile, landfast ice covers the region inshore of the 20 m isobath over arctic shelves and prevents the direct transfer of wind stress to the inner shelf in winter. Thus the outer shelf circulation is directly wind-forced whereas inner shelf dynamics are controlled by remotely-established pressure gradients and frictional coupling of the flow field to the bottom and the under-ice boundaries. To demonstrate the first order effect of landfast ice on the shelf circulation, an analytic description of the mean coastal flow beneath the landfast ice was developed following Csanady's arrested topographic wave model. For comparison, the Regional Ocean Modeling System (ROMS) was used to investigate the 2-D behavior of a mound of water along a straight coast with friction applied at the bottom and at the surface to mimic frictional coupling between the landfast ice and the ocean. The ice-water friction coefficient was varied spatially to examine three cases: constant, linearly increasing offshore, and random. The numerical model was forced with different offshore wind profiles to investigate the response of the inner and outer shelves to offshore winds. The circulation response to winds differs markedly between the inner and outer shelf and there is only limited exchange across the landfast ice edge throughout winter. This implies that dissolved and suspended materials remain trapped to the inner shelf throughout winter. The underice flow field is sensitive to the magnitude of the ice-water friction but is insensitive to the spatial structure of the frictional coupling.

Downscaling ice-ocean characteristics in the Beaufort-Chukchi seas simulated by an IARC Coupled Ice-Ocean Model (CIOM)

Jia Wang, Haogu Hu, Kohei Mizobata, and Meibing Jin Arctic Modeling Group International Arctic Research Center (IARC) University of Alaska Fairbanks jwang@iarc.uaf.edu http://www.frontier.iarc.uaf.edu/!jwang/amg/main.html

We applied an IARC regional CIOM (Coupled Ice-Ocean Model)to simulate the downscaling ice and ocean processes with a 3.7km resolution. The Beaufort CIOM was nested to a global GCM. Simulation of seasonal cycle was conducted. In the Chukchi Sea, the Bering inflow separates into three branches: the first main branch flows along the Alaskaâ€[™]s coast that is the Alaska Coastal Current (ACC); the second branch flows northward and turns to the right, joining the ACC along the Beaufort coast; and the third branch flows toward the Northwind Ridge. The Beaufort Gyre is well reproduced, superimposed by numerous mesoscale eddies, with anticyclones outnumbering cyclones. We also investigated downscaling sea ice dynamics, such as sea ice ridging, rafting, leads and landfast ice, which are not resolved in the previous coarse resolution model. This approach combining the global model for the 20th century climate simulation with the regional downscaling/nesting simulation helps understanding of both large-scale sea ice variability and small-scale sea ice dynamics. Sea ice breaks up offshore piece by piece with landfast ice untouched along the Beaufort Sea coast. Sea ice ridging, rafting, and openings/leads can be well reproduced. Model validation using in situ observations, satellite measurements, and historical datasets is underway.

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Poster: Arctic Ocean – Climate, Oceanography & Lower Trophic Levels

Changes in benthic community structure in the Chirikov Basin, Bering Sea: A comparison between 1986 and 2002

Melanie Wenzel, University of Alaska, Fairbanks, Institute of Marine Science, melanie.wenzel@web.de Katrin Iken, University of Alaska, Fairbanks, iken@ims.uaf.edu

Bodil Bluhm, University of Alaska, Fairbanks, bluhm@ims.uaf.edu

The Chirikov Basin in the northern Bering Sea used to be an important summer feeding area for California gray whales in the 1980s. Here, these whales supposedly predominantly fed on ampeliscid amphipods, whose biomass, however, declined over the last decades as did the use of the area by gray whales. The focus of the present study was to investigate biomass and community structure of the non-ampeliscid infaunal community to identify (1) potential changes between the 1980s and 2000s and (2) if trends were identical to ampeliscid amphipod trends. For this purpose, 3-5 replicate van Veen grabs taken at 15 identical stations were compared between summer cruises in 1986 and 2002. Overall, a trend for higher biomass was observed for 2002 compared to 1986, although differences between years were not always significant. These differences were mainly driven by the major taxa Mollusca (mostly Bivalvia), Polychaeta and Crustacea. Also, infaunal community composition based on biomass was correlated with major water masses in the region, a differentiation that became more distinct in 2002. Our results may suggest that the discussed potential gray whale overharvest of their ampeliscid amphipod food source may have changed infaunal community dynamics and resource availability in a way that enhanced production in these other community components.

Replacing Ice Code of CIOM model by Las Almos CICE ice model version 3.14

Sheng Zhang and Jia Wang International Arctic Research Center University of Alaska Fairbanks 99775 <u>szhang@iarc.uaf.edu</u>

The ice code of IARC regional CIOM (Coupled Ice-Ocean Model, Wang et al., 2005) is being replaced by the CICE ice model version 3.14, released October 2006. The ice model has 4.5 vertical layers and 5 ice thickness categories, as well as the increment remapping advection scheme. The coupling scheme is based on the NCAR Flux Coupler 5, which uses MPI directly, and the ice model and ocean model (based on POM) run as separated programs. This coupling method thus has the advantage as a plug-in type of the code, which will be easily coupling to a different ocean model. We will present the primary comparison of the results from the two versions of the coupled models, as well as comparing with the observed seasonal data.
Monday, 22 January 2007 1:45 – 5:15 PM Session Chair and Poster Review: Brendan Kelly

TALKS

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Speaker	Title
Stephen Murphy	Factors Affecting the Subsistence Harvest of Arctic Cisco in the Colville
	River
Nate Bickford	Fish habitat and otolith chemistry
David Roseneau	Monitoring Murres and Kittiwakes at Cape Lisburne, Alaska, 1976-2006
David Rugh	Identifying Individual Bowhead Whales Through Aerial Photography
Lori Quakenbush	Satellite Tracking of Western Arctic Bowhead Whales
	Microsatellite analysis of Bowhead whales (Baleana mysticetus) from the
Ryan Huebinger	Bering-Chukchi-Beaufort Seas with regards to population stock structure
	and genetic bottlenecks
Chadwick Inv	Preliminary Identification of Pacific Walrus Subpopulations from Whole
	Tooth Elemental Analysis
Michael Cameron	Diving behavior, habitat use, and movements of bearded seal (Erignathus
	barbatus) pups in the Bering and the Chukchi Seas.
Brendan Kelly	Evidence of philopatry in ringed seals
Anthony	Landward shift in polar bear denning determined from satellite telemetry
Fischbach	in Alaska
David Douglas	A Model for Autumn Pelagic Distribution of Adult Female Polar Bears in
	the Chukchi Sea, 1987-1994
Russell Hopcroft	Climate Change impacts in the Chukchi and Beaufort Seas, with strategies
	for future research

POSTERS

First Author	Title
Larissa Dehn	Comparison of stable isotope ratios in muscle and epidermis of bowhead
	whales with reference to ancient whale skin
Mathew Keyse	Patterns in life and environmental histories of Myoxocephalus scorpius in
	the Chukchi Sea

Factors Affecting the Subsistence Harvest of Arctic Cisco in the Colville River

Stephen M. Murphy, ABR, Inc., smurphy@abrinc.com

Franz J. Mueter, Sigma Plus, Statistical Consulting Services; fmueter@alaska.net Stephen R. Braund, Stephen R. Braund & Associates; srba@alaska.net Lawrence L. Moulton, MJM Research; <u>lmoulton@rockisland.com</u>

Low harvest levels of Arctic cisco (Coregonus autumnalis) in the Colville River fishery during 1998-2002 raised concerns about the population status of this important subsistence resource. This retrospective analysis used both existing scientific data and traditional knowledge to analyze annual variation in harvest rates. A team of scientists and 10 residents from the Inupiat village of Nuigsut worked together to generate hypotheses, identify data sources, and interpret analytical results. We conducted statistical analyses of over 20 years of data on subsistence and commercial harvests of Arctic cisco on the Colville delta, movements and abundance of juvenile and adult Arctic cisco in the Prudhoe Bay region, and long-term data on weather, oceanographic conditions, and industrial development in the region. To separate the effects of human activities and natural environmental variation on Arctic cisco populations, we first analyzed long-term data sets on Arctic cisco abundance and regional environmental conditions. We determined that \sim 70% of the annual variation in abundance of juvenile Arctic cisco in the central Beaufort region can be explained by wind conditions during summer, which is consistent with previous studies. The residual variation was then analyzed using data from development activities related to oil and gas exploration. including Prudhoe Bay region causeways, offshore seismic surveys, and Colville River delta ice bridges and drilling. None of the anthropogenic activities that we analyzed showed clear effects on Arctic cisco recruitment, survival, or abundance. Although harvest rates have rebounded in recent years, low rates are predicted for several years starting in 2008.

Fish Habitat and Otolith Chemistry

Nate Bickford, UAF, nate@sfos.uaf.edu

The research performed by the Fisheries Otolith Group (FOG) explores the utility of otolith (fish ear stone) chemistry in the reconstruction of past habitat use, the identification of essential habitat, and the connectivity between fish populations. The identification of essential spawning habitat and the ability to assess recruitment within major commercial fish populations has profound consequences for these fisheries. By identifying past habitat use we can delineate stocks and identify stocks to natal regions. The location and identification of essential fish habitat has become a major focus of fisheries ecologists, particularly since the promulgation of the Sustainable Fisheries Act in 1996. Traditional assessments of habitat use have relied on mark and recapture techniques which often fail to identify critical juvenile habitats due to tag induced mortality and issues of poor re-capture reporting. In recent years marine fisheries researchers have increasingly relied on otolith microchemistry as a mechanism to locate nursery habitats and develop management strategies that protect those habitats that contribute significant numbers of recruits to the adult population (source habitats). This geochemical technique uses the chemical variations preserved in fish otoliths as natural tags of fish movement to and from habitat regions. This relatively new technique is a more effective method for estimating past habitat use by juvenile and adult fish than mark and recapture or traditional tag and release studies.

Monitoring Murres and Kittiwakes at Cape Lisburne, Alaska, 1976-2006

David G. Roseneau, Alaska Maritime National Wildlife Refuge, dave roseneau@fws.gov

Editor's note: We apologize that this abstract was incomplete when copied from the website.

... billed murres (Uria aalge and U. lomvia) and 20,000-30,000 black-legged kittiwakes (Rissa tridactyla) on about 7 km of precipitous, near continuous 15-200 m-high sedimentary limestone and shale sea-cliffs (about 30% of the murres are common murres and 70% are thick-bills). This large impressive seabird colony is one of the Alaska Maritime National Wildlife Refuge's 10 annual monitoring sites and the northernmost breeding location for these cliff-nesting species in Alaska. Murre and kittiwake populations have been monitored at Cape Lisburne since 1976. Based on 1976-2006 boat- and land-based counts, numbers of murres increased slowly during the mid-1970s mid-1980s, more than doubled during the mid-1980 - late 1990s, and then began gradually declining after 2000. Numbers of kittiwakes and their nests also increased at the colony during the mid-1970s - late 1990s, but these positive trends were limited to the west-facing cliffs. More recent land-based counts made during 2002-2006 suggest that numbers of birds may be starting to increase on the north-facing cliffs, although numbers of nests have remained relatively stable in this sector of the colony. The average productivity of these small gulls was lower in 1992-2006 than it was during 1976-1987 (0.5 vs. 0.9 eggs/chicks per nest). This change may be related to increasing sea-surface temperature and the earlier break up, dissipation, and retreat of sea-ice.

Identifying Individual Bowhead Whales through Aerial Photography

David Rugh, NOAA Alaska Fisheries Science Center, <u>Dave.Rugh@noaa.gov</u> Bill Koski, LGL Ltd., Environmental Research Associates

Aerial photography has been used over the past three decades to identify individual bowhead whales. There are currently >17,000 images of bowheads in archives maintained by the National Marine Mammal Lab in Seattle, Washington, and at LGL in King City, Ontario. Photographs were collected from aircraft flying directly over whales. mostly in the Beaufort Sea in summer and near Barrow during spring migrations. These photographs have been evaluated and categorized for quality and degree of identifiability of each whale and measured for whale length. Analyses of photographic data have provided information on many critical parameters used to evaluate the health of this population. For instance, comparisons of images from spring 1985, summer 1985, spring 1986, and summer 1986 provided an abundance estimate (6700 whales) close to the average estimate (6900 whales) from the North Slope Borough's ice-based counts in the same years, and both methods resulted in similar precision. Photographic data have also been used to estimate growth rates of individual whales, size at sexual maturity (13 m), survival rates (bowheads have an amazing longevity), calving intervals (3-4 years), population dynamics (whale lengths are an indicator of maturity classes), and stock structure (via resighting rates within and between various seas as well as testing interyear consistency of individual whales' migration dates). Although this stock is currently listed as Endangered, the abundance has been steadily increasing, and its status may need to be reevaluated. Analyses of aerial photographs of bowheads may play a significant role in making these management decisions.

Satellite Tracking of Western Arctic Bowhead Whales

Lori Quakenbush, Alaska Department of Fish and Game,

lori quakenbush@fishgame.state.ak.us

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100000000 10000000 Robert Small, Alaska Department of Fish and Game, robert_small@fishgame.state.ak.us John Citta, Alaska Department of Fish and Game, john_citta@fishgame.state.ak.us John Craighead George, North Slope Borough, <u>craig.george@north-slope.org</u>

The western Arctic stock of bowhead whales (Balaena mysticetus) are of high importance due to their nutritional and cultural role in Alaska Native subsistence lifestyle, their role in the marine ecosystem, and because their summer range overlaps areas with the potential for oil and gas development. Movement patterns and feeding areas of this stock of bowhead whales, however, are not well understood in some regions. Increasing our understanding of bowhead whale behavior will aid in planning and resource conservation. This study will attempt to attach up to 25 satellite transmitters to bowhead whales each year for the next five years. The study was designed cooperatively with subsistence whalers and with local, state, and federal agencies and uses tags developed by the Greenland Institute of Natural Resources. Alaska Native subsistence whalers have been important in the field component of this project during tagging efforts. Six Barrow whalers have been trained to deploy tags, which will greatly expand our opportunities for tagging. Two transmitters are reporting locations and one whale has been tracked over 2,500 km from Barrow east to Amundsen Gulf, Canada and then west beyond Barrow into the Chukchi Sea. As of 1 November 2006 both whales were near the northern coast of Chukotka, west of 179 degrees W longitude. Several areas appear to have been used for feeding based on movement patterns and residence times. We will report the most recent movements of the tagged whales in our presentation.

Microsatellite analysis of Bowhead whales (*Baleana mysticetus*) from the Bering-Chukchi-Beaufort Seas with regards to population stock structure and genetic bottlenecks

Ryan M.Huebinger, Department of Wildlife and Fisheries Sciences, Texas A&M University, College Station, TX 77843-2258, rhuebinger@tamu.edu

John C. Patton, Dept. of Forestry and Natural Resources, Purdue University, West Lafayette, IN 47907

John C. George, North Slope Borough, Department of Wildlife Management, Barrow, AK 99723

Robert S. Suydam, North Slope Borough, Department of Wildlife Management, Barrow, AK 99723

Geof H. Givens, Dept. of Statistics, Colorado State Univ., Fort Collins, CO 80523 John W. Bickham, Center for the Environment, Purdue Univ., West Lafayette, IN 47907

The bowhead whale, *Baleana mysticetus*, experienced a severe population bottleneck due to commercial whaling in the 19th and 20th Centuries. Previous genetic studies of the Bering-Chukchi-Beaufort Seas (BCB) population did not detect a significant genetic bottleneck. Studies of potential sub-stock structure within the BCB population have revealed some indication of geographic variation between individuals taken at St. Lawrence Island (SLI) and individuals harvested at Barrow, Alaska. However, previous analyses contained a limited number of samples from SLI. To further investigate this question additional samples were analyzed from SLI and compared samples from the Sea of Okhotsk and the Hudson Bay stocks of bowhead whales. A suite of 24 microsatellite markers derived from bowhead whales were developed and analyzed for these populations. Preliminary analyses demonstrated that little variation exists between animals harvested within the BCB population when compared to other stocks.

Preliminary Identification of Pacific Walrus Subpopulations From Whole Tooth Elemental Analysis

Chadwick V. Jay, USGS Alaska Science Center, chad_jay@usgs.gov Peter M. Outridge, Geological Survey of Canada, outridge@nrcan.gc.ca Joel L. Garlich-Miller, U.S. Fish and Wildlife Service, <u>Joel_GarlichMiller@fws.gov</u>

Identifying population structure in marine mammals often requires diverse sources of information because most species are widely distributed over remote environments. We used ICP-MS to measure the elemental composition of teeth from Pacific walruses (*Odobenus rosmarus divergens*) to identify groups of animals that might constitute different subpopulations. The Pacific walrus occurs in Arctic waters of Alaska and Russia and forages on the seafloor for bivalves. As such, groups of walruses that differ in their dental elemental composition might reflect geospatial differences in elements in surface sediments to which they were exposed during their lifetime, and hence, represent different subpopulations. We used discriminant analysis to identify differences in elemental profiles between two winter and three autumn groups of females and two winter and three autumn groups of males using teeth collected in different geographic areas during breeding and non-breeding periods. The greatest discriminators between groups were Zn, Sr, Ba, Pb, and U. These results will be considered with other evidence of population structure from ongoing genetics and animal tracking studies.

Diving behavior, habitat use, and movements of bearded seal (*Erignathus barbatus*) pups in the Bering and the Chukchi Seas

Michael Cameron, NOAA/National Marine Mammal Laboratory,

Michael.Cameron@noaa.gov Kathryn Frost, SFOS University of Alaska-Fairbanks, kjfrost@eagle.ptialaska.net Michael Simpkins, US Marine Mammal Commission, msimpkins@mmc.gov Chuck Schaeffer, Native Village of Kotzebue Alex Whiting, Kotzebue IRA, <u>sheep@otz.net</u>

Bearded seals (*Erignathus barbatus*) are harvested by Alaska Natives for subsistence, and live and pup in pack ice habitat that may be significantly affected by climate change. Relatively little research has been conducted on bearded seals in Alaska and no data exist on their seasonal movements, habitat use, or diving behavior. During October, from 2004 to 2006, in a cooperative effort between scientists and subsistence hunters, thirteen female, and thirteen male young-of-the-year bearded seals were captured and instrumented with satellite-linked dive recorders (SDRs) in Kotzebue Sound, AK. SDRs provide information on seal seasonal movements, haulout and dive behavior, which can be used to identify important habitats and to improve estimates from abundance surveys. Pups occupied areas as far north as Wainwright, AK, as far south as St. Lawrence Is., AK and west beyond the Gulf of Anadyr, Russia, Analyses of diving data indicate that most dives last from 4 to 6 minutes and, while most pups spent almost half of their total time near the sea floor, the amount of time spent at the bottom varied between individuals and with the season and time of day. Haulout time also varied with season and time of day. Five of the seals in 2006 had SDRs that also record the water temperature and salinity throughout the dive. Correlating these environmental characteristics with diving behavior will further improve our understanding of the important foraging habitats of young bearded seals.

Evidence of philopatry in ringed seals

Brendan P. Kelly, University of Alaska Southeast and Office of Polar Programs,

National Science Foundation, brendan.kelly@uas.alaska.edu John R. Moran, Auke Bay Laboratory, NOAA, John.Moran@noaa.gov Stephanie Sell, Central Michigan University, sell1sk@cmich.edu Peter Boveng, National Marine Mammal Laboratory, NOAA, peter.boveng@noaa.gov Micaela Ponce, University of Alaska Southeast, jnmep20@mail.uas.alaska.edu Rex Snyder, Alaska Nanuuq Commission, harpoon907@yahoo.com Bradley J. Swanson, Central Michigan University, <u>swans1bj@cmich.edu</u>

The sea ice ecosystem and subsistence economies in the Arctic are threatened by decreases in sea ice cover associated with climate change. Assessing the impacts on the ice-associated seals requires knowledge of their movement patterns and population biology. Thirteen ringed seals captured in northwestern Alaska were tagged with satellitelinked transmitters in April and May 2005. Seven ringed seals were tagged north of the Mackenzie River Delta in March 2006, and 5 seals were tagged in northwestern Alaska in April and May 2006. Tagged seals remained within a few kilometers of their capture sites until the ice broke up in July. In July-September, the tagged seals ranged over 1,000 kilometers from their capture sites. At freeze up the following autumn, tagged seals returned to their capture sites. We are analyzing microsatellite and mtDNA markers in over 1,000 samples collected from ringed seals in their breeding locations. In a preliminary analysis, 91% of the seals (n = 67) from three sites (Chukchi Sea, Western Beaufort Sea, and Eastern Beaufort Sea) were genetically assigned to their capture sites. The movement and genetic data suggest that inter annual site fidelity reflects philopatry and fine scale population structuring. The population genetic analyses will have greater power when more samples are analyzed.

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Landward shift in polar bear denning determined from satellite telemetry in Alaska

Anthony Fischbach, USGS Alaska Science Center, afischbach@usgs.gov Steve Amstrup, USGS Alaska Science Center, samstrup@usgs.gov David Douglas, USGS Alaska Science Center, <u>ddouglas@usgs.gov</u>

Polar bears in the northern Alaska region den in coastal areas and on offshore drifting pack ice. Human activities on and near shore have expanded in recent years while the dynamics, age-structure and physical composition of pack ice have been altered by climate warming. These changes emphasize that understanding the distribution of polar bear maternal dens is a conservation necessity. We identified denning events among 383 female polar bears fitted with satellite transmitters by examining changes in relocation frequency, location quality, and temperature and activity sensor data. The proportion of dens on pack ice between 137° W and 167° W longitude declined from 62% in 1985-1994 to 37% in 1998-2004 (p = 0.044, N = 124). We hypothesize that this landward shift was a response to reductions in stable old ice, increases in unconsolidated ice, and lengthening of the melt season, which have likely reduced the availability and quality of pack ice denning habitat. If these sea ice trends continue, as predicted, we expect the proportion of polar bears denning on coastal habitats will continue to increase, until such time as the autumn ice retreat precludes offshore pregnant females from reaching the Alaska coast in advance of denning.

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A Model for Autumn Pelagic Distribution of Adult Female Polar Bears in the Chukchi Sea, 1987-1994

George M. Durner, USGS Alaska Science Center, gdurner@usgs.gov David C. Douglas, USGS Alaska Science Center, ddouglas@usgs.gov Steven C. Amstrup, USGS Alaska Science Center, samstrup@usgs.gov Ryan M. Nielson, Western EcoSystems Technology, Inc., <u>mielson@west-inc.com</u>

We used satellite radio locations from female polar bears (Ursus maritimus), 1987-1994, to develop a Resource Selection Function (RSF) of autumn bear distributions in the Chukchi Sea. The RSF was generated to assist in the design of polar bear aerial surveys proposed by the United States Fish and Wildlife Service. The RSF was based on bathymetry and daily sea ice covariates extracted from passive microwave satellite imagery within pelagic habitat. Polar bears selected areas over relatively shallow waters in close proximity to the interface between 50% sea ice and higher concentrations, and medium amounts of ice cover. Cross-validation of the RSF indicated good predictive abilities (mean $r = 0.87 \text{ Å} \pm 0.13 \text{ STD}$). Also, 54% of polar bear locations occurred within the top 10% of RSF intervals, 68% within the top 15%, and 77% within the top 20%. The RSF was robust to inter-annual variability and worked best in October. Predictive performance of the RSF decreased by $\sim 3\%$ for each daily lag between sea ice measurements and bear locations, suggesting the bears respond to a quickly changing environment. Contemporary applications (1997-2005) of the RSF saw decreased performance. It performed well for October and November (60% of polar bear locations occupied the top 20% RSF intervals), but poorly in September. This likely resulted from habitat alteration due to recent changes in sea ice composition and because of a small sample of recent polar bears from a limited region of the Chukchi Sea.

Climate Change impacts in the Chukchi and Beaufort Seas, with strategies for future research

Russell R Hopcroft, UAF, hopcroft@ims.uaf.edu Bodil Bluhm, UAF, bluhm@ims.uaf.edu Rolf Gradinger, UAF, rgradinger@ims.uaf.edu Terry Whitledge, UAF, terry@ims.uaf.edu Tom Weingartner, UAF, weingart@ims.uaf.edu Brenda Norcross, UAF, norcross@ims.uaf.edu Alan Springer, UAF, <u>ams@ims.uaf.edu</u>

We summarize the major conclusions from a February 2006 workshop considering the effects of climate change in the Chukchi and Beaufort Seas, on the physics, chemistry and biology of these ecosystems. The common recommendations for future research in this region are also outlined.

Comparison of stable isotope ratios in muscle and epidermis of bowhead whales with reference to ancient whale skin

- Larissa Dehn, Institute of Arctic Biology, University of Alaska Fairbanks, Fairbanks, Alaska 99775-7000, ftld@uaf.edu
- Erich Follmann, Institute of Arctic Biology, University of Alaska Fairbanks, Fairbanks, Alaska 99775-7000, ffehf@uaf.edu
- Cheryl Rosa, North Slope Borough, Department of Wildlife Management, Barrow, Alaska 99723, cheryl.rosa@north-slope.org
- Craig George, North Slope Borough, Department of Wildlife Management, Barrow, Alaska 99723, <u>craig.george@north-slope.org</u>

Muscle and epidermis were collected from subsistence-harvested bowhead whales (*Balaena mysticetus*) from northern Alaska. Tissues were analyzed for both stable carbon and nitrogen isotope ratios to estimate carbon source and trophic position, respectively. Additionally, a bowhead whale skin sample, carbon dated to be 1050±70 years old, was obtained from an ancient ice-cellar in Gambell, Alaska.

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Isotope ratios in muscle indicate that bowheads feed low in the Arctic food chain on euphausids and copepods. Lipid-extraction is known not to alter isotope ratios in bowhead whale muscle. Similarly, this extraction methodology did not have an effect on nitrogen isotope ratios in bowhead skin (p=0.17). However, lipid-extracted skin was significantly enriched in carbon-13 over non-lipid-extracted epidermis (p=<0.0001), while carbon-13 in lipid-extracted skin was similar to muscle values. This is consistent with the lower lipid content associated with muscle versus epidermis. Nitrogen-15 was significantly higher in skin than muscle (p=0.0001). Thus, caution is warranted when assessing and interpreting feeding ecology of whales based on nitrogen isotope ratios in biopsy/skin samples compared to values generated for muscle, where different, tissuespecific enrichment factors should be applied.

Epidermal carbon and nitrogen isotope signatures were similar in both presentday bowhead whales and the ancient sample (p=0.07 and p=0.84 for δ 15N and δ 13C, respectively). Though only a single specimen, this suggests that feeding ecology of bowhead whales has remained stable for a millennium. However, biological variables, i.e., length and sex, are unknown for the ancient sample and δ 15N is negatively correlated to length in skin of present-day whales (p=<0.0001).

Patterns in life and environmental histories of *Myoxocephalus scorpius* in the Chukchi Sea

Matthew Keyse, University of Alaska-Fairbanks, fnmdk@uaf.edu Nate Bickford, University of Alaska-Fairbanks, nate@sfos.uaf.edu Brenda Norcross, University of Alaska-Fairbanks, <u>norcross@ims.uaf.edu</u>

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Myoxocephalus scorpius (short-horn sculpin) was collected from multiple stations in the Chukchi Sea during the 2004 RUSALCA cruise. Microchemistry in fish otoliths can be used to evaluate life and environmental histories. Because otoliths remain relatively unaffected by short-term changes in a fish's condition, microchemistry and physical banding of the otolith provide insight into the life and environmental histories. Using laser ablation inductively coupled plasma-mass spectrometry; we measured microchemistries in otolith edges and cores. From the elemental rations Sr87/Ca48 and Sr87/Sr86, we were able to discern three distinct water masses in the Chukchi Sea. Overall, we found that *M. scorpius* resides in the same water mass that it was spawned. However, there is some exchange of individuals between water masses. Otoliths also were used to estimate age and otolith growth of *M. scorpius*. Somatic growth showed similar patterns across all water masses. We also estimated condition factor from standard length and weight measurements of *M. scorpius* from each water mass. *M.* scorpius in water mass 1 had a better condition factor compared to M. scorpius in water mass 2 or water mass 3, and M. scorpius in water mass 3 had a better condition compared to *M. scorpius* found in water mass 2. Otolith microchemistry provides insight into the movement and distribution of *M. scorpius* in the Chukchi Sea, while somatic growth and condition factor provide information on the quality of the water masses in which M. scorpius resides.

Tuesday, 23 January 2007 8:00 - 9:45 AM Session Chair and Poster Review: Phyllis Stabeno

TALKS

Speaker	Title
Phyllis Stabeno	Was 2006 an anomalous cold year in a warming trend or a shift in decadal
	climate patterns
James Overland	What will the Bering Sea look like in the next 30 years?
Don Atwood	Monitoring Alaskan Marine Ecosystems with Synthetic Aperture Radar
Michael Litzow	Warming climate alters the biogeography of the southern Bering Sea
Meibing Jin	Late ice retreat and ice-associated phytoplankton blooms in the
	Southeastern Bering Sea
Carolina Parada	Settlement patterns of snow crab associated with warm (1979) and cold
	(1990) years in the Eastern Bering Sea

POSTERS

First Author	Title
Changming Dong	Sea-Ice Variation and its Effect on Oceanic Circulation in the Bering Sea
Georgina Gibson	SE Bering Sea Ecosystem Modeling
Falk Huettmann	A modeling method for predicting benthic biomass: using RandomForest
	to link survey data with environmental data for the Bering Sea region
Stephen Jewett	Retrospective Analyses Of Norton Sound Benthic Fauna
Tracic Momill	Prey availability and diet in Pacific walruses (Odobenus rosmarus
	divergens) around St. Lawrence Islan
Alexei Pinchuk	Distribution, egg production and growth of euphausiids in the vicinity of
	the Pribilof Islands, southeastern Bering Sea in August 2004
Bruce Wright	Paralytic Shellfish Poisoning in Aleut Communities

Was 2006 an anomalous cold year in a warming trend or a shift in decadal climate patterns?

Phyllis J. Stabeno and James E. Overland NOAA, Pacific Marine Environmental Laboratory, Seattle, WA 98115-6349 phyllis.stabeno@noaa.gov

The winter of 2006 ended a sequence of five years (2001-2005) in which temperatures in the Bering Sea were well above normal and ice extent was below normal. January 2006 was one of the coldest Januarys on record with extensive sea ice formation over the shelf and cold temperatures over the interior of Alaska. February and March were milder, but in April cold conditions returned resulting in extensive ice production and a persistence sea ice cover over the southern shelf well into May. Climatologically, it was not unexpected that 2006 would not be warm year, because of a la Nina and a negative Arctic Oscillation. What was critical is that the warm (~8 °C) ocean temperatures in September 2005 delayed the advance of ice in 2006. Arctic winds eventually cooled the water column, formed ice and advected it southward. For this year, depth averaged temperature over the southern shelf in September 2006 were markedly colder than in fall 2005. A second year of cold atmospheric conditions would bring sea ice well south of the Pribilof Islands in winter 2007, a condition not seen since the early-mid 1970s. However, the current el Nino and a variable Arctic Oscillation tend to mitigate this forecast. Was 2006 a one year event or an indication of a long term shift in the decadal climate patterns, slowing the rate of warming in the western Arctic?

What will the Bering Sea look like in the next 30 years?

James Overland, NOAA/PMEL, james.e.overland@noaa.gov Phyllis Stabeno, NOAA/PMEL, phyllis.stabeno@noaa.gov Muyin Wang, JISAO/U of Washington, muyin.wang@noaa.gov Nicholas Bond, JISAO/U of Washington, <u>nicholas.boand@noaa.gov</u>

Under proposed mid-range Intergovernmental Panel on Climate Change (IPCC) green house gas emission scenarios, anthropogenic impacts on future Bering Sea climate and ecosystems will be as large as those of natural variability in 30-50 years, when compared with 20th century climate. This result is consistent with a northward shift of the Aleutian Low storm track and an intensification of storms. While warmer temperatures (+1.7 °C by 2050 relative to the 1980-1999 mean) and less sea ice can be expected as a long term trend, there will remain much potential year-to-year and decade-to-decade variability, especially over the next few decades. Most likely is that the current rate of warming will slow for Alaska and the Bering Sea. Results are based on evaluation of 22 coupled atmosphere-ocean general circulation models made available through the Fourth Assessment Report of the IPCC. The spatial pattern of the future warming trend will also be more spatially uniform than that of the primary pattern of North Pacific variability, the Pacific Decadal Oscillation (PDO). While changes in North Pacific marine ecosystems have been correlated with phase changes of the PDO, 20th century relationships between climate and ecosystems may not be robust long into the 21st century.

Monitoring Alaskan Marine Ecosystems with Synthetic Aperture Radar

Don Atwood, Alaska Satellite Facility, datwood@asf.alaska.edu

Limited winter daylight and extensive cloud cover limit opportunities for using spaceborne optical sensors to monitor Alaskan waters. An alternative exists in the daynight, all-weather capabilities of synthetic aperture radar (SAR). The transmitted microwaves of SAR interact with the roughness of the sea surface. Since surface roughness is modulated by both atmospheric and oceanographic phenomena, SAR provides a unique means to observe sea ice, surface winds, frontal systems, upwelling, internal waves, currents, eddies, oil spills, storm water discharge, and coastal bathymetry.

The convergence of satellite orbits at the high latitudes of Alaska provides frequent coverage of our surrounding waters. This permits greater utilization of SAR data for near-real-time applications. Through the ready availability of image products, GIS compatible formats, and the development of new applications, SAR is beginning to be embraced by new communities of users. The intent of this presentation is to address current and planned developments of near-real-time products by the Alaska Satellite Facility at the University of Alaska Fairbanks. In particular, the utility of Radarsat data for routine wind retrieval, ice analysis, and ship detection in Alaskan waters will be addressed.

Warming climate alters the biogeography of the southern Bering Sea

Franz Mueter, Joint Institute for the Study of the Atmosphere and the Oceans, University of Washington, and Sigma Plus, Fairbanks, fmueter@alaska.net Mike Litzow, Alaska Fisheries Science Center, <u>mike.litzow@noaa.gov</u>

The biogeography of the demersal Bering Sea is largely structured by the pool of cold bottom water that is created by winter ice cover, and excludes non-cold tolerant species, including many groundfish. Warming climate can be expected to move the cold pool north and change community-wide distribution patterns. However, biological interactions may complicate responses to warming, so distribution shifts may create new community combinations instead of simply shifting existing communities polewards. We used NMFS Bering Sea trawl survey data from 1982-2006 to test for fish and invertebrate distribution shifts as the Bering Sea warms, and to relate variability in distribution change to commercial status, apparent temperature tolerance, life history traits, and trophic level. We found that the southern edge of the cold pool has moved approximately 230 km north since the early 1980s. Simultaneously the average center of distribution of 45 fish and invertebrate taxa has shifted 31 Å± 60 (SD) km northwards, with similar shifts in gradients of abundance and probability of occurrence. Total biomass, species richness and average trophic level have all increased in the area formerly covered by the cold pool as groundfish colonize newly-favorable habitat. These changes have direct management implications: 59% of variability in commercial snow crab catch during 1982-2005 is explained by declining sea ice cover. However, the metrics we examined generally failed to explain variability among taxa in distribution change. Understanding the mechanisms constraining species-specific responses to warming remains a major challenge for managing Bering Sea fisheries during a period of changing climate.

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Late ice retreat and ice-associated phytoplankton blooms in the Southeastern Bering Sea

Meibing Jin, Clara Deal, Jia Wang International Arctic Research Center University of Alaska Fairbanks Email: <u>mjin@iarc.uaf.edu</u>

The climate trends of reducing ice cover and rising temperature in the southeastern Bering Sea have profound impacts on the lower tropic level production and fishery production. By coupling pelagic and sea ice algal components, our 1-D ecosystem model successfully reproduced the observed ice-associated blooms in 1997 and 1999 at the National Oceanic and Atmospheric Administration/Pacific Marine Environmental Laboratory (NOAA/PMEL) mooring M2. The model results suggest that the iceassociated blooms were seeded by sea ice algae released from melting sea ice. For an iceassociated bloom to grow and reach the typical magnitude of phytoplankton bloom in the region, ice melting-resulted low-salinity stratification must be immediately followed by thermal stratification. The ice-associated blooms had little impacts on the annual primary production, but had significant impacts in terms of shifting phytoplankton species, and the timing and magnitude of the bloom. These changes, superimposed on a gradual ecosystem shift attributed by global warming, can dramatically alter the Bering Sea ecosystem.

Settlement patterns of snow crab associated with warm (1979) and cold (1990) years in the Eastern Bering Sea

Carolina Parada, NOAA, Seattle, WA, carolina.parada@noaa.gov Sarah Hinckley, NOAA, Seattle, WA, sarah.hinckley@noaa.gov Billy Ernst, Department of Oceanography, University of Concepcion, Chile, biernst@udec.cl Lobo Orensanz, CENPAT, Pto. Madryn Argentina, lobo@u.washington.edu

Dave Armstrong, SAFS, University of Washington, Seattle, davearm@u.washington.edu Enrique Curchitser,LDEO, Columbia University, USA <u>enrique@ldeo.columbia.edu</u>

An individual-based model for snow crab (Chionoecetes opilio) larvae coupled to a hydrodynamic model was implemented to study the transport and settlement patterns associated with warm (1979) and cold (1990) years in the Eastern Bering Sea (EBS). These years represent contrasting temperature conditions during the transport and settlement period (May to October). Several simulation experiments to assess the trajectory and settlement locations of virtual larvae released in the middle and outer domain of the EBS were performed. These experiments used release locations of crab larvae based on female effective reproductive output (FERO) calculations inferred from annual bottom trawl surveys. FERO is a function of several life history traits, including fecundity-at-age, fecundity-at-size, abundance-at-age and biennial/annual cycles. The simulation experiments were run between May and October, and particles were released based on FERO information. The behavior incorporated in the model for snow crab larvae simulates the behavior and biology of particles representing snow crab larval stages. This behavior is characterized by an initial bottom larval release and a vertical larval migration to the mixed layer where larvae stay up to settlement time. Initial simulations showed that 1979 and 1990 presented very different temperatures patterns. Even though current patterns for both years were quite similar, the settlement patterns differed. This study compares the differences for these years and the effect of temperature on settlement time and location.

Sea-Ice Variation and its Effect on Oceanic Circulation in the Bering Sea

Changming Dong, IGPP, UCLA, cdong@atmos.ucla.edu Paul Budgell, IMR, Norway, Paul.Budgell@imr.no Hongchun Zhang, JPL/Raython, zhc@pacific.jpl.nasa.gov Yi Chao, JPL, NASA, Yi.Chao@jpl.nasa.gov James McWilliams, IGPP, UCLA, jcm@atmos.ucla.edu

We investigate sea-ice variation and oceanic circulation in the Bering sea with multipleyear solutions from the Regional Oceanic Modeling System (ROMS) with both an eddyresolving configuration for the Pacific basin and a global configuration coupled to a dynamic-thermodynamic sea-ice model. The solution is assessed by comparisons with satellite observations for interannual and seasonal variations in sea-ice concentration and extent and sea-surface height. Solutions with and without the sea-ice coupling show significant differences in the Bering Sea circulation. Due to resolution limitations for the basin configuration, mesoscale currents and sea-ice patterns cannot be satisfactorily resolved, and a higher-resolution, embedded regional configuration is now being developed.

SE Bering Sea Ecosystem Modeling

Georgina Gibson, ARSC/AOOS, george@ims.uaf.edu Kate Hedstrom, ARSC/AOOS, <u>kate@arsc.edu</u>

A nutrient-phytoplankton-zooplankton (NPZ) model, coupled with the Regional Ocean Modeling System (ROMS) model has been developed for the South East Bering Sea. Our coupled ecosystem model is intended for use in examining hypotheses concerning spatial and temporal changes in lower trophic level production in the SE Bering Sea as a result of climate change and will also be used to estimate spatially and temporally explicit prey resources for target species (i.e. Pollock) in the Bering Sea. The NPZ model is based on the Coastal Gulf of Alaska (CGOA) model developed by Hinckley, Dobbins and Coyle, but has been re-parameterized to reflect the SE Bering Sea ecosystem and has the addition of a benthic component to reflect this important component of the ecosystem on the shallow SE Bering Sea shelf. Preliminary model results are presented for an off-shelf and an on-shelf station.

A modeling method for predicting benthic biomass: using RandomForest to link survey data with environmental data for the Bering Sea region

Falk Huettmann, EWHALE Lab, University of Alaska Fairbanks, fffh@uaf.edu Steffen Oppel, University of Alaska Fairbanks, <u>steffen.oppel@gmail.com</u>

Marine benthic organisms provide an important resource for several higher trophic level consumers such as marine mammals and birds. Over the past decades concentrated effort has been directed to survey and sample benthos at various localities in the Bering and Chukchi Seas. However, due to logistical constraints benthic sampling is unlikely to provide a spatially continuous map of benthic biomass. Such a map would be useful to examine resource selection and distribution of benthic biomass consumers at a larger scale. Here, we applied novel modeling methods to predict benthic biomass. A 'presence only' decision-tree modeling approach (RandomForest from Salford Systems Ltd; bagging) was used by linking the best currently available benthos data to monthly mean chlorophyll a concentrations, sea surface temperature, sea ice cover and other environmental predictors including bathymetry within ArcGIS. We present a modeled map of benthic biomass, and assess the relative importance of individual environmental predictors for the model. The value of metadata, alternative assessment data, continued data collection and further improvements of model predictions and inferences are highlighted. The modeling technique presented here is based on automated software methods, freely available online data and the latest modeling statistics such as bagging.

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Retrospective Analyses of Norton Sound Benthic Fauna

- Stephen Jewett, University of Alaska Fairbanks, School of Fisheries & Ocean Sciences jewett@ims.uaf.edu
- Toshide Hamazaki, Alaska Department of Fish & Game, Comm. Fish. Div., hamachan hamazaki@fishgame.state.ak.us
- Thomas Weingartner, University of Alaska Fairbanks, School of Fisheries & Ocean Sciences, weingart@ims.uaf.edu
- Seth Danielson, University of Alaska Fairbanks, School of Fisheries & Ocean Sciences, <u>seth@ims.uaf.edu</u>

The overall goal of this study is to conduct a retrospective analysis of the Norton Sound demersal trawl survey data from 1976 to 2006, examining changes in abundance and distribution of dominant benthic epifauna and demersal fishes in response to climate change using oceanographic and climatic covariates. Ten trawl surveys were conducted in Norton Sound by National Marine Fisheries Service (1976, 1979, 1982, 1985, 1988, 1991) and by Alaska Department of Fish & Game (1996, 1999, 2002, 2006) to monitor the distribution and abundance of red king crab and demersal fishes.

While there were minor differences in trawl gear used, sampling schedule, and total area trawled, all surveys had a similar format. Fish groups that dominated in abundance in several years were flatfishes (Pacific halibut, yellowfin sole, starry flounder, and Alaska plaice), cods (Pacific cod, Arctic cod, saffron cod, and walleye pollock), and sculpins (*Myoxocephalus* spp.). Invertebrate groups that dominated were sea stars (five species), crabs (red king crab, snow crab, helmet crab and hermit crabs), snails (four species), sea urchin, basket star and solitary tunicates.

While this study is in progress, available historical climatic and oceanographic data of the Norton Sound region has been gathered to examine changes that occurred from 1976 to 2006. These physical data, including water temperatures, meteorological, ice cover, river discharge, surface heat fluxes, large-scale climate indices, and regional circulations, will be analyzed with the dominant benthic animals for relationships. Ultimately, statistical models will be constructed to predict future faunal distributions with respect to climate and oceanographic changes.

Prey availability and diet in Pacific walruses (*Odobenus rosmarus divergens*) around St. Lawrence Island

Tracie Merrill, School of Fisheries and Ocean Sciences, UAF, t.merrill@sfos.uaf.edu Brenda Konar, School of Fisheries and Ocean Sciences, UAF, <u>bkonar@guru.uaf.edu</u>

This project will determine whether benthic walrus prey composition, abundance and biomass south of St. Lawrence Island has significantly changed in the past 30+ years. It also will try to relate these changes to current walrus diet. Presently, indications exist that benthic communities in the Bering Sea have undergone significant changes in recent years, potentially due to climate change and declining annual and multiyear sea ice coverage and thickness. Since a change in benthic walrus prey availability could significantly impact Pacific walrus (Odobenus rosmarus divergens) diet, it is important to reassess the status of walrus foraging grounds in the Bering Sea. This poster will present preliminary results on the current composition and biomass of potential benthic walrus prev south of St. Lawrence Island. From our preliminary analyses there appears to be a general trend with overall biomass of ophiuroids, bivalves and possibly gastropods declining between 1972 and 2006. In the next year, these benthic data will be compared to walrus stomach gut contents from the 2007 walrus harvest on St. Lawrence Island. Gut contents also will be compared between 1970 and 2007 to determine changes in walrus diet. It is hypothesized that changes in the benthic community will be mirrored by changes in walrus diet.

Distribution, egg production and growth of euphausiids in the vicinity of the Pribilof Islands, southeastern Bering Sea in August 2004

Alexei Pinchuk, University of Alaska, ftaip1@uaf.edu Kenneth Coyle, University of Alaska, <u>coyle@ims.uaf.edu</u>

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Spatial distribution, egg production and growth of the predominant euphausiids in the vicinity of the Pribilof Islands, Bering Sea were studied during August of 2004. Thysanoessa longipes were abundant in the oceanic water, while aggregations of T. inermis and T. raschii were found near the islands. Euphausia pacifica and T. spinifera occurred in much smaller quantities over the slope. The instantaneous growth rate (IGR) technique was applied to measure somatic growth. Juvenile T. inermis showed the most intensive growth of 6.17% of dry body weight per day. In contrast, the somatic growth of mature specimens was slow (<1% of dry body weight per day) for all species. Egg release corresponded to an average of 1.1% of female dry body weight per day for T. raschii indicating that enough resources were available for the animals to invest in egg production. The growth rates of adult T. inermis and T. raschii were ~4-6 times lower in 2004 than those reported for early summer of 1980-81 from the middle shelf. The egg production rates (expressed as % of female dry body weight per day) of T. raschii in our study were also lower than those in 1980-81, but the number of released eggs per female per day was similar. Our data conform to the trend shown for a number of euphausiid species with highest growth rates of adults occurring in spring during the phytoplankton bloom, and slowing by the summer, while those of juveniles remaining high throughout the production season.

Paralytic Shellfish Poisoning in Aleut Communities

Bruce Wright, Aleut International Association, brucew@apiai.org Ray RaLonde, Alaska Sea Grant, <u>afrlr@uaa.alaska.edu</u>

The PSP project objectives include developing methods for monitoring the occurrence and distribution of paralytic shellfish poison toxins in the Aleut Region (Aleutian Islands, Pribilof Islands and Commander Islands) and changes that occur in connection with climate change observations. Since 1973, there have been 150 PSP outbreaks reported in Alaska and three fatalities since 1994. The PSP project will investigate the increased risk of PSP as a result of climate change and the reliability of traditional knowledge used when harvesting clams and mussels. Primary targeted communities are Nikolskoye, Sand Point and Unalaska, and additional satellite communities include Adak, Akutan, Atka, Attu, Belkofski, King Cove, Nelson Lagoon, Nikolski, St. George and St. Paul. Species being sampled include: blue mussels, butter clams, surf clams, Alaska great tillin clams, cockles, little neck clams and razor clams. Generally, bivalves tested in the eastern Aleutians have tested positive for PSP and in the western Aleutians and Commander Islands have tested negative. Jellett test kit and HPLC test results will be presented and compared.

Tuesday, 23 January 2007 10:00 AM - 12:00 PM Session Chair and Poster Review: Kimberly Rand

TALKS

Speaker	Title
Paige Drobny	Squid Overload: Berryteuthis magister in the Bering Se
Robert Walker	Information from Archival Tags on Salmon in the Bering Sea, 2003-2006
Nicola Hillgruber	Distribution, condition, and age of chum salmon (Oncorhynchus keta)
	juveniles in Western Alaska
Sara Miller	Estimation of migration in an age-structured population dynamics model
	of Eastern Bering Sea walleye pollock (Theragra chalcogramma)
Kim Rand	Food Habits and Small Scale Habitat Utilization of Atka Mackerel in the
	Aleutian Islands, Alaska
Daniel Cooper	Spatial and temporal variability in Atka mackerel female maturity
Jesus Jurado-	Developing a statistical multi-species framework for a predator-prey
Molina	system in the eastern Bering Sea

POSTERS

First Author	Title
Mayumi Arimitsu	Food web linkages: Forage Fish in the Aleutian Archipelago
Michael Canino	Captivity effects on the mating behavior of Atka mackerel?
Sandi Neidetcher	The Development and Implementation of a Visual Maturity Key for Pacific Cod
Andrew Seitz	Seasonal dispersal and behavior of Pacific halibut (<i>Hippoglossus</i> stenolepis) in the Bering Sea
Haixue Shen	Using EDSU to investigate the spatial structure of walleye pollock (Theragra chalcogramma) schools in the eastern Bering Sea
Vardis Tsontos	A Web-based Fisheries Oceanographic Information System for the Bering Sea

Squid Overload: Berryteuthis magister in the Bering Sea

Paige Drobny, University of Alaska Fairbanks, fsspd@uaf.edu Nate Bickford, University of Alaska Fairbanks, nate@sfos.uaf.edu Brenda Norcross, University of Alaska Fairbanks, <u>norcross@ims.uaf.edu</u>

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The squid family Gonatidae, which normally contributes a large portion of biomass in the Bering Sea, was much more noticeable in the summer 2006 fishing season. Though the gonatid squid, *Berryteuthis magister*, is found throughout the Subarctic Pacific, their life history characteristics are poorly known. It has been shown that biological characteristics of *B. magister* differ between regions. For this study, *B. magister* samples from 2004 Bering Sea shelf cruise and 2006 commercial bycatch were collected and analyzed. Statoliths were analyzed to estimate age and growth. Trace elements in the statoliths were used to differentiate squid into stocks, track past movement patterns with associated life history and identify squid locations associated with differing water masses. Statistical analysis revealed patterns of change in squid distribution.

Information from Archival Tags on Salmon in the Bering Sea, 2003-2006

Robert Walker, University of Washington, rvwalker@u.washington.edu Jack Helle, NOAA Fisheries Auke Bay Lab, jack.helle@noaa.gov Kate Myers, University of Washington, kwmyers@u.washington.edu Nancy Davis, University of Washington, ncdd@u.washington.edu Jim Murphy, NOAA Fisheries Auke Bay Lab, jim.murphy@noaa.gov Vladimir Fedorenko, North Pacific Anadromous Fish Commission, <u>vladf@npafc.org</u>

Since 2003, 595 data logger tags and 862 disk tags purchased with NPRB funds have been released during the Bering-Aleutian Salmon International Survey (BASIS) program of the North Pacific Anadromous Fish Commission. Fifty archival tags have been returned from this program, mostly from chum (n=25) and sockeye (n=12) salmon. Almost all were from maturing fish in summer and fall. Most recoveries have come from Hokkaido (21), Russia (13), and western Alaska (10). Recoveries of archival tags include first recoveries of data tags from several geographic areas and stocks as well as multiple recoveries from Hokkaido chum and Bristol Bay sockeye salmon. Recoveries from several regions within the range of a species and multiple recoveries from the same region allow confirmation of general behavior patterns of a species. New types of data acquired include the first overwintering marine data from Pacific salmon (two years of data from a Yukon River Chinook salmon) and the first salinity data from a migrating Pacific salmon. Depth data from a limited number of DSTs confirm that Chinook and chum salmon have deeper vertical distributions (average daily maxima: Chinook: 130 m; chum: 58 m) than those of sockeye (22 m), pink (37 m), and coho salmon (46 m). Temperature ranges varied widely among water masses traversed by maturing salmon, while maximum daily depths remained fairly uniform. This indicates that salmon chose maximum depths and not temperature ranges, and that usual depths of maturing salmon may remain relatively constant across water masses and ocean areas.

Distribution, condition, and age of chum salmon (Oncorhynchus keta) juveniles in Western Alaska

Nicola Hillgruber, School of Fisheries and Ocean Sciences, University of Alaska Fairbanks, n.hillgruber@uaf.edu

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Christian E. Zimmerman, USGS Alaska Science Center, czimmmerman@usgs.gov Sean E. Burril, School of Fisheries and Ocean Sciences, University of Alaska Fairbanks, s.burril@uaf.edu

Little is known about the estuarine residence of juvenile chum salmon (Oncorhynchus keta) in Western Alaska. However, it is at this life stage that juveniles might experience high mortality rates that may ultimately determine year class strength. Recent fluctuations in the abundance of chum salmon in the Kuskokwim River have demonstrated a need for more information on chum salmon life history, but particularly on factors impacting the critical estuarine life stage. Here we present results on spatial and temporal patterns of distribution, condition, and age of chum salmon juveniles in 2003 and 2004 in Kuskokwim Bay. Results are being discussed in reference to patterns in physical and biological parameters. Combining data from both study years, we determined a residence period for chum salmon juveniles in the bay from the middle of May until late July: no chum salmon were caught in August. Mean size at estuarine arrival in May was 38.3 mm fork length (FL), with fish apparently growing in size to a mean FL of 51.3 mm in June. Analysis of otolith strontium to calcium ratios and microstructure was used to estimate duration of estuarine residence and growth rates. Energy density of juvenile chum salmon was highest early in the season with an energy density of 5200 cal/g in May, decreasing to 4932 cal/g in mid-June. Seasonally decreasing energy content, possibly as a result of elevated sea surface temperatures, might have implications for the survival probability of chum salmon juveniles in Kuskokwim Bay.

Estimation of migration in an age-structured population dynamics model of Eastern Bering Sea walleye pollock (*Theragra chalcogramma*)

Sara E. Miller (fssem1@uaf.edu) and Terrance J. Quinn II (Terry.Quinn@uaf.edu), Juneau Center, School of Fisheries and Ocean Sciences, University of Alaska Fairbanks James N. Ianelli (Jim.Ianelli@noaa.gov), Resource Ecology and Fisheries Management Division, Alaska Fisheries Science Center, National Marine Fisheries Service

The standard Eastern Bering Sea (EBS) walleye pollock (*Theragra chalcogramma*) agestructured stock assessment model does not include seasonal movement of the fish, being focused on the entire population. To increase biological understanding of walleye pollock on finer spatial and temporal scales, the standard model was extended into two-area (northwest and southeast EBS), two-season (A and B fishery season) movement models that allowed population parameters to be area-specific. Hypothesized movements included: (A1) (Y1) constant movement across ages (years), (A2) increasing movement from NW to SE as fish get older, (A3) (Y3) movement that varied freely by age (year), and (Y2) movement that varied by cold and warm years. The models covered from years 1977 to 2005 and from ages-3 to 10+ and used data from surveys and the fishery. For comparison, a version of the spatial, two-season movement models that did not contain movement was fitted to the data. Our age- and year-specific movement models produced similar estimates of biomass and population parameters as the standard stock assessment model. However, most models had either high variances for the migration parameters or the migration parameters converged at their boundary. The version of our spatial. twoseason movement models without movement fitted the data much worse than the movement models. More in-depth information on finer spatial and temporal scales is likely from spatially-explicit studies of EBS walleye pollock. Having additional information from a mark-recapture study would help to stabilize the spatial'movement models.

Food Habits and Small Scale Habitat Utilization of Atka Mackerel in the Aleutian Islands, Alaska

Kimberly Rand, University of Washington and Alaska Fisheries Science Center, kimberly.rand@noaa.gov

Sandra Lowe, Alaska Fisheries Science Center, sandra lowe@noaa.gov

This study examined spatial and temporal feeding patterns of Atka mackerel (Pleurogrammus monopterygius) from three local aggregations in the Aleutian Islands, Alaska. The primary area of abundance for Atka mackerel is contained within the Aleutian Island archipelago where they are not only an integral part of the trophic food web, but sustain a commercial fishery. To identify feeding areas important to their essential fish habitat (EFH), I examined spatial feeding patterns using average stomach fullness as a proxy for feeding intensity. Feeding intensity was examined relative to the Steller sea lion (Eumetopias jubatus) trawl exclusion zones at 10 nm or 20 nm around rookeries and haulouts. Trawl exclusion zones can be considered undisturbed habitat relative to fished areas, as no bottom trawling is permitted inside these zones. In two of the three study areas, there appeared to be distinct feedings grounds. Additionally, one of the areas showed significantly higher average stomach fullness inside the trawl exclusion zones. Essential fish habitat includes both the water column as well as bottom habitat. To understand the underlying mechanisms that may be contributing to the observed spatial patterns in feeding intensity, I examined several variables including bottom depth, average fish length per observation, time of day and temperature. Using both surface and bottom temperature, I identified areas where the water column was well mixed or stratified. The only significant factor explaining observed feeding patterns was water column structure (mixed vs. stratified). It appeared that Atka mackerel prefer areas of strong mixing for feeding.

Spatial and temporal variability in Atka mackerel female maturity

Daniel Cooper, AFSC, dan.cooper@noaa.gov Susanne McDermott, AFSC, susanne.mcdermott@noaa.gov Jim Ianelli, AFSC, jim.ianelli@noaa.gov

This study investigated spatial and temporal variability in Atka mackerel female maturity, representing one aspect of a larger study of Atka mackerel reproductive ecology. Atka mackerel show significant differences in maturity at length between geographic areas and years. Maturity at length and age were determined for females collected in NMFS areas 541 and 542 from 2002-2004 and compared to maturity data from 1993-1994. A method was developed using post-ovulatory follicles (POFs) as a tool to estimate maturity from samples including some post-spawning females. Atka mackerel exhibit a growth cline from east to west, with average length at age being significantly larger in the Eastern Aleutians than in the Central and Western Aleutian Islands. This study found that maturity was more dependent on age than length. Maturity at age was not significantly different between geographical areas or over time. This suggests that for a relatively short-lived, high-reproductive investment species like Atka mackerel, size plays a smaller role in spawning activity than age. However, given a certain age, the probability of a female being mature is size dependant. Therefore a model was developed incorporating age, length, and maturity to better fit the data. Spatial and temporal differences in growth and variations in year class strength explain much of the variability in maturity at length between years and geographic area.

Developing a statistical multi-species framework for a predator-prey system in the eastern Bering Sea

Jesus Jurado-Molina, University of Washington, jjurado@u.washington.edu Patricia A. Livingston, Alaska Fisheries Science Center, Pat.Livingston@noaa.gov Jim Ianelli, Alaska Fisheries Science Center, <u>Jim.Ianelli@noaa.gov</u>

Fishery managers need to consider multi-species interactions in their harvesting decisions as they move towards ecosystem-based fishery management. The importance of providing ecological forecasts to decision makers to aid in the selection of policy choices is receiving increased recognition. In the Alaska Fisheries Science Center we are developing a scientific framework for providing ecosystem-based advice for groundfish fisheries management. As part of this framework we developed a simple version of a multi-species statistical model for the Bering Sea implemented in EXCEL that included two species (walleye pollock and Pacific cod) and fitted total catch and age-composition data. A new version implemented in AD model builder is under development. This platform allowed increasing the complexity and flexibility of the model while reducing the computing time drastically. The new MSM version includes arrowtooth flounder as a new predator in the system. It fits age-composition data and size-composition data from surveys and the fishery, survey biomass data and total catch data. The use of the AD model builder platform has facilitated the estimation of model parameters, performance statistics, and their uncertainty with frequentist or Bayesian methods, in particular for the predation mortality, the suitability coefficients and for the first time for the residual mortality. These tasks were difficult to achieve in the previous platform due to computing time. Preliminary results from this work and future model improvements are presented. This model will be useful to understand the multispecies implications of various harvest regimes and to take a more holistic approach to fisheries management.

Food web linkages: Forage Fish in the Aleutian Archipelago

Mayumi Arimitsu, USGS-ASC, marimitsu@usgs.gov John Piatt, USGS-ASC John_Piatt@usgs.gov

Forage species are ecosystem indicators because they comprise a key node in marine food webs. They are planktivores that are consumed by seabirds, marine mammals and commercially important fish, and thus they provide a crucial link between primary and secondary producers and higher trophic level organisms. We studied forage fish in relation to physical and biological oceanography by opportunistically sampling areas with important concentrations of marine predators within the Alaska Peninsula and Aleutian Islands regions. Sampling efforts over this large spatial scale included vessel-based hydroacoustic surveys, mid-water trawling and nearshore seining and the collection of ancillary data on physical oceanography and primary production. We sampled at least 42 species in 32 beach seine hauls. Numerically, the most abundant nearshore fishes were pink salmon, surf smelt, larval gadids, Pacific sandlance and Pacific sandfish. Capelin, greenlings, pricklebacks and gunnels were also present in beach seine hauls. We also sampled at least 38 species in 33 modified-herring trawl sets. Numerically, the most abundant pelagic fishes were walleye pollock, Pacific sandlance, capelin and pacific cod. We also collected euphausiids, Pacific sandfish, squid and eulachon in pelagic trawls. Our opportunistic fishing efforts were successful in documenting forage fish abundance and occurrence over a large spatial-scale, however, we found some logistical difficulties with this approach because trawl fishing requires a large effort on the part of the science and boat crew.
Captivity effects on the mating behavior of Atka mackerel?

Michael Canino, Alaska Fisheries Science Center, <u>mike.canino@noaa.gov</u> Ingrid Spies, Alaska Fisheries Science Center, <u>ingrid.spies@noaa.gov</u> Susanne McDermott, Alaska Fisheries Science Center, <u>susanne.mcdermott@noaa.gov</u> Shannon Atkinson, Alaska SeaLife Center, <u>Shannon_Atkinson@alaskasealife.org</u> Jared Guthridge, Alaska SeaLife Center, <u>JaredG@alaskasealife.org</u>

Parentage analyses of egg masses produced in the wild and in captivity using microsatellite DNA markers showed different reproductive patterns. Nine cannibalized egg masses retrieved from adult stomachs indicated a complex polygamous mating system, with reproductive contributions from multiple males and females. In contrast, eleven egg masses produced by a captive population of 21 adult Atka mackerel in a large exhibit at the Alaska SeaLife Center showed no evidence of polygamous matings. We genotyped embryos in egg masses taken from two territories held by guardian males during the observation period August 25 - October 14. Embryos from five egg masses taken from one territory, and six from another, were all produced solely by matings between the attendant male and up to five individual females. Thirteen egg masses produced by a group of two males and four females in a smaller tank with reduced spawning habitat large enough for only a single breeding territory were also examined. One male held the territory for approximately half the breeding season and sired all egg masses during that period before being displaced by another male. Yet he continued to sire the vast majority of embryos produced in that tank during the remainder of the breeding period, perhaps via alternative reproductive strategies. The striking differences in parentage patterns between cannibalized egg masses collected in the field and those produced under different captive conditions suggest that polygamous mating behaviors may be density dependent. Experiments manipulating fish densities in captivity are planned to test this hypothesis.

The Development and Implementation of a Visual Maturity Key for Pacific Cod

Sandi Neidetcher, Libby Logerwell, Liz Conners, NMFS Alaska Fisheries Science Center

Pacific cod, Gadus macrocephalus, comprise an important commercial fishery in the Bering Sea. Still, little is known of their spawning processes. Studies have shown cod to be sensitive to water temperature and cod spawning has been documented to occur earlier in warmer climates. Scientists with the Fisheries Interaction Team have been developing a visual key used to assess the spawning condition of cod in the field. A visual key provides a quick and easily applicable tool, allowing for the large sample sizes and broad application necessary for such a wide ranging species. Because gonads mature gradually, data collections are often subjective. Histological samples were collected along with the visual stage assignments to evaluate misclassification error. The North Pacific Groundfish Observer Program provides an opportunity to collect data through fishery effort from a greater space and time scale than available to FIT scientists. In 2005 Observers were able to collecting large sums of data from a wide range of vessel and gear types. This presentation provides results from the visual key and histological comparison, along with the location and timing of spawning cod identified through Observer collections. These data provide a valuable baseline to monitor for changes in spawning processes over changes in water temperature and loss of sea ice.

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Seasonal dispersal and behavior of Pacific halibut (*Hippoglossus stenolepis*) in the Bering Sea

Andrew C. Seitz, Timothy Loher, Jennifer L. Nielsen and Brenda L. Norcross

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Pacific halibut (*Hippoglossus stenolepis*) are managed as one biological population extending from California through the Bering Sea. However, satellite tagging results from several experiments suggest that geographic landforms and discontinuities in the continental shelf appear to limit the interchange of Pacific halibut among areas and delineate the boundaries of potential populations in the Gulf of Alaska and eastern Bering Sea, with apparent smaller, localized populations along the Aleutian Islands. To further examine this hypothesis, we tagged and released twenty-four additional adult Pacific halibut summer 2006 with Pop-up Archival Transmitting tags set to release during the winter spawning season of 2007. The tag and release locations west of St. Matthew Island and north of Unimak Pass were chosen to fill two geographic gaps in tagging areas in the Bering Sea. Analysis of the seasonal dispersal patterns and spatial connectivity will help investigate the possibility of separate populations of Pacific halibut in the Gulf of Alaska, Bering Sea and Aleutian Islands.

Using EDSU to investigate the spatial structure of walleye pollock (*Theragra chalcogramma*) schools in the eastern Bering Sea

Haixue Shen, SFOS, University of Alaska Fairbanks, h.shen@uaf.edu Terrance J. Quinn II, SFOS, University of Alaska Fairbanks, terry.quinn@uaf.edu Vidar Wespestad, Resources Analysts International, vidarw@verizon.net Martin W. Dorn, Alaska Fisheries Science Center, Martin.Dorn@noaa.gov Matthew Kookesh, SFOS, UAF, <u>ravencoho@msn.com</u>

The spatial structure of fish aggregations can affect the catchability of the fishery. EDSU (elementary distance sampling unit) is a common measure used to analyze acoustic data for determining the spatial pattern of fish. Here a 1nmi EDSU was used to study the spatial structure of pollock schools during winter 2003. Pearson I[‡]2 tests showed strong evidence of clustering, as evidenced by more empty EDSUs and more EDSUs with large numbers of schools than expected from the Poisson process. Two separate periods were selected to investigate whether changes occurred in the spatial pattern during fishing. The frequency of occurrence of pollock schools was significantly greater in the first fishing period (p=0.048) and there were more EDSUs with large number of schools in the first period. Finally, twelve morphological, energetic and positional descriptors of schools were chosen to study spatial structure using semi-variogram. Of these, six descriptors exhibited structured in the semi-variograms, showing that there is a relationship between school characteristics and spatial structure.

A Web-based Fisheries Oceanographic Information System for the Bering Sea

Vardis Tsontos, Univ. of Southern California, tsontos@usc.edu Dale Kiefer, Univ. of Southern California, kiefer@usc.edu Patricia Livingston, NOAA AFSC, Pat.Livingston@noaa.gov Geoff Lang, NOAA AFSC, <u>Geoff.Lang@noaa.gov</u>

A prerequisite for better understanding the factors influencing the dynamics of marine populations in space and time is the integration, within a unified spatial modeling framework, of series of quantitative survey data on species distributions, environmental information, and model results. The interactive electronic fisheries atlas for the Bering Sea combines these features with standardized protocols for data access within an oceanographic Web-GIS to support the information needs of scientists and decision makers. Building upon informatics tools and approaches developed during GMBIS (Gulf of Maine Biogeographic Information System project), the Alaskan fisheries atlas combines historical fisheries catch survey and gut contents databases from NMFS-AFSC with coincident physical data and an extensive series of satellite imagery of diverse types. The resulting system allows users to interactively explore across the Internet via an intuitive, browser-based GIS interface the temporal evolution of species distribution patterns and trophic interactions in relation to diverse environmental datasets. This paper summarizes technical aspects of the system, and outlines its possible future usage as tool supporting marine ecosystem studies.

Tuesday, 23 January 2006 1:00 - 2:30 PM Session Chair and Poster Review: Alan Springer

TALKS

Speaker	Title
Alan Springer	Hot Oceanography?: A Seabird Story From The Pribilofs
Alexander	Early ice retreat has opposite effects on planktivorous and piscivorous top-
Kitaysky	predators
Ian Jones	On the meaning of annual variation in auklet (<i>Aethia</i> spp.) demographic parameters and chick diet
Steffen Oppel	King Eider winter movements in the Bering Sea tracked by satellite telemetry
Greg Balogh	Inter-specific Differences in Marine Habitat Use by Albatrosses in Alaska

POSTERS

First Author	Title	
Morgan Benowitz-	The integration of stress physiology, stable isotopes and regurgitations to	
Fredericks	assess the nature of changes in seabird diets	
Cooree Hunt	Marine birds and cetaceans around the Pribilof Islands reflect inter-annual	
George Hullt	and inter-decadal changes in zooplankton biomass	
Kathy Kuletz	The Alaska Pelagic Seabird Observer Program, Year One.	
	Protecting Aleutian Island Biodiversity: Island Habitat Restoration and	
Steve MacLean	Introduced Species Prevention	
David Roseneau	The Seabird Tissue Archival and Monitoring Project (STAMP) and	
	Community Involvement	

Hot Oceanography? A Seabird Story from The Pribilofs

Alan Springer, University of Alaska Fairbanks, ams@ims.uaf.edu Vernon Byrd, U.S. Fish and Wildlife Service, Vernon_byrd@fws.gov Sara Iverson, Dalhousie University, <u>Sara.Iverson@dal.ca</u>

Least auklets are copepod specialists, feeding primarily on the large calanoids Neocalanus plumchrus, N. cristatus, and Calanus marshall'ae: zooplankters such as euphausiids, hyperiid amphipods, juvenile decapods, and others are typically taken in lesser numbers. Copepods have historically been the dominant prey throughout the range of least auklets from the Aleutian Is. to Bering Strait, so when all three species became scarce in diets at St. Paul I., but not St. George I. (Pribilof Is.), in the early 2000s it signaled a significant change in oceanography and/or their food web nearby. *Neocalanus*, which are endemic to the basin south of the Pribilofs, are normally supplied to the shelf by oceanographic processes that apparently changed. Reductions in Calanus reflected a broad-scale decline in annual production, or summer standing stock. An oceanographic cruise in July-August 2004 confirmed physical structure south of the Pribilof Is. that created pronounced demarcation between oceanic and shelf taxa of zooplankton. These conditions developed after mid-July 2004, based on the time copepods disappeared from auklet chick meals and changes in adult fatty acid signatures. Furthermore, chick diets and adult fatty acids revealed that such conditions may have first occurred in summer 2002, developed much earlier in summer 2003, and repeated in 2005: all years were oceanographically warm, particularly 2003. The low abundance of copepods near St. Paul, as revealed by least auklets, might have had repercussions at numerous trophic levels and illustrates the importance to regional food webs of marine climate and crossshelf transport of oceanic waters.

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Early ice retreat has opposite effects on planktivorous and piscivorous top predators

Alexander Kitaysky, University of Alaska Fairbanks, ffask@uaf.edu Evgenia Kitaiskaia, University of Alaska Fairbanks, fnek@uaf.edu Morgan Benowitz-Fredericks, University of Alaska Fairbanks, ffzmb@uaf.edu Michael Shultz, University of Alaska Fairbanks, <u>ftmts@uaf.edu</u>

Our long-term study focused on testing relationships between climate and food web dynamics at several trophic levels by using endocrine tools to quantify nutritional stress in seabirds in the Bering Sea shelf ecosystem. High nutritional stress is indicative of difficulty obtaining sufficient prey to meet energy demands. We found consistent opposite relationships between the timing of ice retreat and nutritional stress in piscivorous vs. planktivorous seabirds breeding in the shelf regions during 1999-2005. Planktivorous species showed lower levels of nutritional stress in years with late ice retreat, conditions which are hypothesized to favor an early phytoplankton bloom, high production of C. marshallae, and delayed spawning by euphausiids. Conversely, piscivorous species had lower levels of nutritional stress in years with an early ice retreat and a late phytoplankton bloom - conditions hypothesized to be favorable for fish production. Whether similar processes occur during regimes that are colder or warmer than the current regime is unclear. We also need to link nutritional stress to concurrent data on distribution and abundance of zooplankton and forage fish. Without this link we have been able to identify changes in prey availability, but have limited information regarding the nature of the changes (abundance, composition or distribution of prey). Thus two fundamental topics remain to be addressed: (1) changes in prey availability under varying climate regimes; and (2) causal factors determining changes in prey availability. Our current results suggest that climate change may have different consequences for different trophic levels in the Bering Sea shelf ecosystem.

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On the meaning of annual variation in auklet (*Aethia* spp.) demographic parameters and chick diet

Ian L. Jones, Department of Biology, Memorial University of Newfoundland, iljones@mun.ca

Jeffrey C. Williams, Alaska Maritime NWR, Aleutian Island Unit, Jeff Williams@fws.gov

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Least (Aethia pusilla), Crested (A. cristatella) and Whiskered Auklets (A. pygmaea) are abundant planktivorous seabirds of the Bering Sea and adjacent areas. Because they prey mostly on Calanoid copepods and euphausiids, their trophic position is low compared to other seabirds and annual variation in reproductive performance, survival and diet might reflect changes in ocean productivity and associated climate and oceanographic variation. To investigate this possibility, we measured auklet productivity, chick diet and survival at Buldir, Kiska and Kasatochi islands, spanning more than 500 km across the western Aleutian islands, during 1990-2006. Productivity was measured by checking samples of breeding crevices for evidence of hatching and chick fledging. Survival was measured by color-marking and resighting adults (Least and Crested Auklets), and banding and recapturing adults (Whiskered Auklets), at the three breeding colonies. Chick diet samples were collected from adults provisioning chicks. We looked for evidence of covariation of auklet demography and diet with large and local scale indices of climate and oceanography. We are also interested in covariation the aspects of auklet biology among colonies. If both survival and productivity are driven by indirect large-scale oceanographic phenomena that enhance ocean productivity then we would expect to see strong correlations between annual survival and productivity and we would expect to see similar trends across islands. In fact, there is growing evidence of some differences in survival and productivity between even adjacent Aleutian islands and lack of correlation in these across years, suggesting that some major assumptions about auklet biology need further investigation.

King Eider winter movements in the Bering Sea tracked by satellite telemetry

Steffen Oppel, University of Alaska Fairbanks, steffen.oppel@gmail.com Lynne Dickson, Canadian Wildlife Service, Lynne.Dickson@ec.gc.ca Abby Powell, USGS, Alaska Cooperative Fish and Wildlife Research Unit, University of Alaska Fairbanks, <u>ffanp@uaf.edu</u>

King Eiders are sea-ducks that breed in arctic regions around the world. Birds from western North America and eastern Russia migrate into the Bering Sea to winter in shallow coastal waters between the Chukotka Peninsula, Southwest Alaska and the southern tip Of the Kamchatka Peninsula. Due to the difficulty in observing the ducks at sea during winter very little is known about King Eider behavior and movements during the wintering period. Since 2002 we have equipped more than 100 King Eiders from Alaskan and Canadian breeding grounds with implanted satellite transmitters and followed the movements of 92 individuals throughout their wintering period in the Bering Sea. In this talk we will present results on migration timing and winter movements of King Eiders in the Bering Sea. King Eiders spent between 2-9 months on the wintering grounds, and 60% of the individuals we tracked used more than one wintering site. The total distance King Eiders moved during the winter was extremely variable, but for most individuals considerably higher than for related sea-duck species. We explored whether sea-ice conditions are correlated with winter movements of King Eiders, and found that the majority of movements did not appear to be related to local sea ice conditions. Altogether King Eider wintering is highly dynamic and extremely variable between individuals. This has implications both for management of marine areas as well as for the survival prospects of the species in the light of climatic changes in the Bering Sea.

Inter-specific Differences in Marine Habitat Use by Albatrosses in Alaska

Robert M. Suryan, Hatfield Marine Science Center, Oregon State University, rob.suryan@oregonstate.edu

Gregory R. Balogh, U.S. Fish and Wildlife Service, greg_balogh@fws.gov Karen N. Fischer, Department of Fisheries and Wildlife, Oregon State University, karen.fischer@oregonstate.edu

We integrated satellite-tracking of albatrosses and remotely sensed data to compare marine habitat use among North Pacific albatrosses. This is the first synoptic satellite tracking study of all North Pacific albatross species, which are highly migratory yet abundant in Alaskan waters, especially during summer, their post-breeding season. Most albatrosses were captured at-sea in the Aleutian Islands; seven of the short-taileds were captured at the breeding colony on Torishima, Japan. During July to November 2005 and 2006 we successfully tracked 14 short-tailed (*Phoebastria albatrus*), 7 black-footed (*P. nigripes*), and 18 Laysan albatrosses (*P. immutabilis*) in or through Alaskan waters, accumulating over 15,000 locations.

Albatross species show strong differences in habitat associations, even within a given geographic region. Short-tailed albatrosses (particularly adults and sub-adults) had the strongest association with continental shelf break and slope regions, followed by black-footed albatrosses. Laysans most often frequented oceanic habitats well offshore of the continental slope, but still north of the sub-arctic transition domain. Black-footed and juvenile short-tailed albatrosses ranged most widely, traveling to the Gulf of Alaska, the California Current System off the west coast of Canada and the U.S., and the sub-arctic transition domain between Alaska and Hawaii. In contrast, adult and sub-adult short-tailed albatrosses remained primarily in Alaskan waters, showing striking differences in movement patterns compared to juveniles. These results provide an improved understanding of ecological relationships among North Pacific albatrosses, as well as indicating differences among species and age classes (and genders) in potential interactions with regional fisheries.

The integration of stress physiology, stable isotopes and regurgitations to assess the nature of changes in seabird diets

Morgan Benowitz-Fredericks (ffzmb@uaf.edu), Alexander Kitaysky (ffask@uaf.edu), Alan Springer (ams@ims.uaf.edu), Justine Sears (<u>ftjss1@uaf.edu</u>)

We studied seasonal and interannual dynamics of food availability to planktivorous least auklets (Aethia pusilla) breeding on St. Paul Island in 2003 and 2004. We assessed diet using a combination of three techniques: quantification of the "stress" hormone corticosterone (an endocrine indicator of nutritional stress), identification of prev composition from regurgitations during the chick rearing stage, and analysis of stable isotope signatures (SIA) in red blood cells. Corticosterone provides information about how hard birds had to work to obtain food, while the other two techniques provide information about prey identity over short (regurgitations) and long (SIA) temporal scales. We found changes in prey availability and composition both within and between years. In 2003, high corticosterone in both June and early July indicated that food availability was poor in the first part of the season. However, SIA data indicated a change in primary prey type, and diet data suggest that auklet switched from consuming primarily hyperiids to primarily euphausiids. In contrast, in 2004, food availability was good early in the season but became abruptly worse in late July. This change coincided with enrichment of the $\delta 15N$ signature, and the disappearance of *Neocalanus* from the diet in conjunction with increased reliance on euphausiids and crab juveniles. Our results show that by combining the three techniques it is possible to reconstruct a complete picture of seasonal dynamics in prey availability in a marine top-predator. We suggest that in order to best utilize top predators to provide information about ecosystem responses to environmental fluctuations, multiple approaches be employed.

Marine birds and cetaceans around the Pribilof Islands reflect inter-annual and inter-decadal changes in zooplankton biomass

G.L. Hunt, Jr., J. Jahncke, K.O. Coyle, J. Napp and P.J. Stabeno

We compared the numbers of seabirds and cetaceans observed around the Pribilof Islands on a series of research cruises between 1977 and 2004 with records of meso-zooplankton and euphausids obtained in net samples near the Pribilof Islands and at Mooring 2. We found that piscivorous seabirds were numerous around the Pribilofs in the 1970s and 1980s, and then declined to low numbers by 1999-2004. In contrast, planktivorous birds were scarce in the 1970s, very abundant in the 1980s, and then declined to low numbers in 1999-2004. Baleen whales were likewise scarce in the 1970s, relatively abundant in the 1980s, and since then have been observed less frequently. During the study period, nets hauls by the Japanese fisheries training vessel Oshoro Maru showed a low biomass of zooplankton in the early 1980s, a high biomass in the mid- to late-1980s, and an abrupt decline in the biomass of zooplankton after 2000. Similarly, comparison of zooplankton tows around the Pribilof Islands and at Mooring 2 in 1999 and 2004, demonstrate not only a decline in the biomass of zooplankton between 1999 and 2004, but also a shift in the dominance of relatively large species, to dominance of small species. We hypothesize that these changes reflect changes in the timing of retreat of seasonal ice cover and in water temperature and stratification. Since the larger species of zooplankton are important prey for fish, including adult walleye pollock, these changes in the zooplankton community could impact fish resources of commercial importance.

The Alaska Pelagic Seabird Observer Program, Year One

Kathy J. Kuletz, Elizabeth A. Labunski, David B. Irons U. S. Fish and Wildlife Service, 1011 E. Tudor Rd., Anchorage, AK 99503

Seabirds spend most of the year dispersed offshore, and in Alaska, non-breeding birds from southern regions may comprise nearly half of the summer bird population. Managers need current information on the spatial and temporal distribution of birds at sea to address conservation issues related to fisheries, shipping, oil exploration, and spills. Seabirds also serve as indicators of changes in marine ecosystems. The North Pacific Pelagic Seabird Database (NPPSD) contains historic at-sea survey data, primarily from the 1970's- 1980's. Since then, many seabirds have declined and changes have occurred in ocean ecosystems. In 2006, the U.S. Fish and Wildlife Service received two-year funding from the North Pacific Research Board to reinstitute an at-sea monitoring program and to update the NPPSD. Collaborators included NOAA-Fisheries and other vessel-based research programs. Oceanographic and fisheries research vessels provided observation platforms for seabird surveys, and the associated biological and environmental data of these collaborators will be used for analyses of factors affecting seabird distribution. Between May and October, 2006, we joined 12 cruises for a total of 168 days at sea, 146 survey days, and 14,263 km of survey transects. We record all marine bird and mammal observations into a gps-integrated computer. Coverage included shelf edge and mid-shelf waters in the Bering Sea, Aleutian Islands, and smaller areas of the Gulf of Alaska. The most abundant birds were murres (Uria spp), northern fulmars (Fulmarus glacialis), and shearwaters (Puffinus spp). Murres were abundant in the northern Bering Sea and shelf edge, fulmars occurred throughout southern mid-shelf waters, and shearwaters were aggregated near Unimak Pass.

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Protecting Aleutian Island Biodiversity: Island Habitat Restoration and Introduced Species Prevention

Steve A. MacLean, The Nature Conservancy, smaclean@tnc.org Stacey Buckelew, Island Conservation, buckelew@biology.ucsc.edu Gregg Howald, Island Conservation, Howald@islandconservation.org Greg Siekaniec, Alaska Maritime National Wildlife Refuge

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The Alaska Maritime National Wildlife Refuge (AMNWR) hosts one of the most diverse and dense concentrations of seabirds in North America. However, introduced rats (Rattus spp.) have likely extirpated some colonies and actively threaten others. The Nature Conservancy (TNC) has partnered with AMNWR and Island Conservation (IC) to restore seabird habitat in the Aleutian Islands by eradicating rats. Trial eradication was conducted in fall 2006 on five islands adjacent to Adak Island to test the efficacy of bait containing the rodenticide brodifacoum, as part of a multi-faceted program designed to test restoration techniques. The efficacy of the trial was measured using radio-collared rats, and the impact to non-target species, particularly Song Sparrows (Melospiza *melodia*) was monitored. All radio-collared rats (n=44) were recovered dead during the trial, 88% were recovered below ground. Mortality of song sparrows also was high (60% of radio-tagged sparrows [n=10] were found dead within 21 days). Preliminary results indicate that techniques were successful in removing rats from the islands, although they also suggest that mitigation may be required for at-risk landbirds during future full-scale eradications. The materials and methods tested here, combined with extensive efforts to prevent new rat introductions, are important parts of an integrated rat management plan for the Bering Sea. The partnership between TNC, AMNWR, IC, and local and tribal governments is one of the most progressive seabird conservation programs in the world. and may ultimately result in the survival of hundreds of thousands of seabirds.

The Seabird Tissue Archival and Monitoring Project (STAMP) and Community Involvement

David G. Roseneau, Alaska Maritime National Wildlife Refuge, <u>dave_roseneau@fws.gov</u>

Paul R. Becker, National Institute of Standards and Technology
Steven J. Christopher, National Institute of Standards and Technology
Glenn K. Chen, Bureau of Indian Affairs
Rusty D. Day, National Institute of Standards and Technology
Michael B. Ellisor, National Institute of Standards and Technology
David Point, National Institute of Standards and Technology
Rebecca S. Pugh, National Institute of Standards and Technology
Kristin S. Simac, USGS Alaska Science Center
Stacy S. Vander Pol, National Institute of Standards and Technology; and
Geoffrey S. York, USGS Alaska Science Center

The Seabird Tissue Archival and Monitoring Project (STAMP) is a collaborative effort by the U.S. Fish and Wildlife Service's Alaska Maritime National Wildlife Refuge (USFWS-AMNWR), the U.S. Geological Survey-Biological Research Division (USGS-BRD), the National Institute of Standards and Technology (NIST), the Bureau of Indian Affairs Alaska Region Subsistence Branch (BIA-ARSB), and 19 Alaskan communities to monitor long-term (100-year) trends in persistent, potentially harmful bioaccumulative contaminants in the Bering and Chukchi seas and Gulf of Alaska using murre (Uria aalge and U. lomvia) and gull (Larus hyperboreus, L. glaucescens and Rissa tridactyla) eggs and other seabird tissues. STAMP collects, banks, and analyzes the eggs and tissues for about 100 potentially harmful persistent bioaccumulative toxins (PBTs), including polychlorinated biphenyls (PCBs, 65 congeners), dichlorodiphenyltrichloroethane (DDT, 6 related compounds), chlordanes (6 related compounds), hexachlorocyclohexane (HCH, 3 congeners); hexachlorobenzene (HCB), toxaphene, dieldrin, mirex, polybromated diphenyl ethers (PBDs, 12 congeners), organotins (several closely related compounds), and mercury. STAMP was initiated in 1999 and began directly involving rural communities and local residents in the egg collecting work in 2002. As of 2006, people from 19 Alaskan communities and 1 in the Commander Islands in Russia have helped collect murre and gull eggs at 22 different seabird nesting locations. Public participation has become a key component of the STAMP program and will be expanded to other coastal and insular areas of Alaska and the Russian Far East. The NPRB is currently supporting some of the analytical work (NPRB Project 534).

Tuesday, 23 January 2007 2:30 – 4:45 PM

Session Chair and Poster Review: Andrew Trites

TALKS

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Speaker	Title
Mary-Anne Lea	On their own: migrations of northern fur seal pups from increasing and
· .	decreasing populations
Pamela Lestenkof	Fine scale foraging behavior of female northern fur seals (Callorhinus
	ursinus)
Allison Banks	Consequences of fur seal foraging strategies (COFFS): interannual
	variability
Vladimir Burkanov	Overview of abundance and trends of northern fur seal (Callorhinus
-	ursinus) in Commander Islands, 1958-2006, caveats and conclusions.
John Bickham	Population and Evolutionary Genetic Analyses Using Multiple Nuclear
	and Mitochondrial Loci in Steller Sea Lions.
Kelly Newman	Killer Whales Do It In The Dark: Nocturnal Activity By Transients At St.
	Paul Island
David Mellinger	An acoustic survey for right and other endangered whales in the Bering
	Sea

POSTERS

First Author	Title
Brian Battaile	The Decline and Fall of the Alaskan Pinniped Empire
Vladimir Durtanov	Northern fur seal (Callorhinus ursinus) pup production in the Kuril
Viadimir Burkanov	Islands, 2005-2006.
Emily Fruzza	Empowering Communities through Real-Time Monitoring
Michalla London	At-sea trip durations of juvenile Steller sea lions (Eumetopias jubatus)
Michelle Lander	in response to environmental heterogeneity
Androw Malayanaku	Predation on Northern Fur Seals in the Pribilof Islands: A Baseline
Andrew Ivialavalisk	Study
Rosa Meehan	How to count walrus: logistical challenges
Lice Manager	Spatial and temporal distribution of calling right whales on Southeast
	Bering Shelf, 2000-2005

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Mathew Myers	Organochlorine Contaminants (OCs) in Endangered Steller Sea Lion
	Pups (Eumetopias jubatus) and Correlations between OCs and
	Physiological Biomarkers
Zimentre Nedezhde	Foraging behavior and methods of analysis of feeding preferences in sea
Zimenko Nauezhua	otters on Commanders
Suzann Speckman	Estimating the Size of the Pacific Walrus Population
Andrew Trites	Summer haulouts are breeding sites: redefining the reproductive strategy
Andrew Trites	of Steller sea lions
Mark Udevitz	Factors affecting haul-out behavior of Pacific walruses in Bering Sea ice
Uesther Vulselie	Habitat Use and Numbers of Humpback Whales in the Eastern Aleutian
Heatner vukelic	Islands
Tonyo Zonnolin	Out to eat in the Bering Sea: Summer foraging by female northern fur
	seals (Callorhinus ursinus) from the Pribilof Islands, Alaska.

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On their own: migrations of northern fur seal pups from increasing and decreasing populations

Mary-Anne Lea, National Marine Mammal Laboratory, AFSC-NOAA, Seattle, Mary-Anne.Lea@noaa.gov

Tom Gelatt, National Marine Mammal Laboratory, AFSC-NOAA, Seattle, Tom.Gelatt@noaa.gov

Devin Johnson, National Marine Mammal Laboratory, AFSC-NOAA, Seattle, Devin.Johnson@noaa.gov;

Jeremy Sterling, National Marine Mammal Laboratory, AFSC-NOAA, Seattle, Jeremy.Sterling@noaa.gov

Rolf Ream, National Marine Mammal Laboratory, AFSC-NOAA, Seattle, Rolf.Ream@noaa.gov

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Sharon Melin, National Marine Mammal Laboratory, NOAA, <u>Sharon.Melin@noaa.gov</u> Rod Towell, National Marine Mammal Laboratory, NOAA, <u>Rod.Towell@noaa.gov</u>

Northern fur seal numbers are declining at their primary breeding sites on St Paul and St George Is. at the Pribilof Islands, Alaska, by ~6% per annum, while smaller populations in the Aleutian islands and California have increased. To better understand the possible influence of post-weaning migration patterns on juvenile survival, we deployed satellite transmitters on 99 newly weaned northern fur seal pups from four sites: St Paul Is, (SP, n=44), St George Is. (SG, n=20), Bogoslof Is. (BOG, n=20) and San Miguel Is. (SM, n=15) in fall 2005. The mothers of 18 pups were also tracked during their winter migrations to assess the relationship between female departure time and pup departure date and behavior. Pups from the three Alaskan breeding sites departed earlier than those in California (F1,95=91.1, p<0.0001) and dispersed widely throughout 22 Aleutian passes, with some heading into Russian waters before generally traveling southward to the North Pacific transition region. Conversely pups from SM all traveled north, remaining within the neritic zone. We modeled at-sea locations to produce a predicted path with hourly locations and used swim speeds and bearings from this predicted path to identify change-points in pup behavior throughout the winter migration. Finally, the departure dates of mother-pup pairs varied by an average of 5.8 days indicating that the direction taken by pups on departing their natal site is likely influenced by local oceanographic and weather patterns and not maternal experience.

Fine scale foraging behavior of female northern fur seals (Callorhinus ursinus)

Pamela M. Lestenkof, Marine Mammal Research Unit, University of British Columbia, lestenko@zoology.ubc.ca

Andrew W. Trites, Marine Mammal Research Unit, University of British Columbia, trites@zoology.ubc.ca

The decline of the Pribilof Island population of northern fur seals (*Callorhinus ursinus*) since the late 1970s is not well understood. It has been suggested that commercial fisheries may be affecting the abundance of fur seals' key prey, contributing to their decline and (or) impeding their recovery. Previous studies have identified the at-sea locations, movement patterns and two-dimensional plots of time and depth of fur seals, but the resolution of data has been too coarse to assess critical habitat and the spatial overlap with fisheries. With the advent of new data loggers, more dive parameters can be collected allowing dives to be depicted in three dimensions. Information collected by a 12-channel dead-reckoner was used to determine the pelagic habitat of fur seals during the breeding season on a finer spatial scale than is currently available. A total of 16 lactating fur seals were tracked from St. Paul Island in 2005 and 2006. We obtained detailed information on fur seal diving patterns and movements in the Bering Sea. These results provide a better understanding of fur seal foraging behavior and ultimately provide an improved assessment of critical habitat and the degree of spatial overlap with fisheries. Studying fur seal foraging behavior at a fine scale is a necessary step towards addressing the question of potential interactions between northern fur seals and commercial fisheries operating in the vicinity of the Pribilof Islands.

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Consequences of fur seal foraging strategies (COFFS): interannual variability

Alison Banks, University of Alaska Fairbanks, banks@sfos.uaf.edu Alan Springer, University of Alaska Fairbanks, ams@ims.uaf.edu Sara Iverson, Dalhousie University, siverson@dal.ca Rolf Ream, NMML/AFSC/NOAA, Rolf.Ream@noaa.gov Jeremy Sterling, NMML/AFSC/NOAA, Jeremy.Sterling@noaa.gov Brian Fadely, NMML/AFSC/NOAA, Brian.Fadely@noaa.gov

We are examining foraging strategies of female fur seals and consequences to growth and fitness of themselves and their pups in contrasting ecoregions of the eastern Bering Sea: St Paul I. (Pribilof Is.) on the continental shelf, where the population has declined by >50% since the 1960s; and Bogoslof I. in the Aleutian Basin, where the population has grown exponentially since the mid-1970s. Our goal is to determine whether the decline on the Pribilofs is due to food limitation caused, perhaps, by climate change or commercial fishing. We completed two field seasons: 2005, when oceanographic conditions were 'warm', and 2006 when conditions were 'cold'. In both years females gained mass during the winter migration period and lost mass during the summer breeding season: females at St. Paul foraged farther and longer than females at Bogoslof; male pups at Bogoslof, but not St. Paul, gained more mass per day than female pups; and pups of both sexes at Bogoslof gained mass at a higher rate than pups at St. Paul. Pups at both islands gained more mass per day in 2005, the warm year, than in 2006, the cold year; however, the difference between years was much larger at St. Paul. These results suggest that the change in marine climate between 2005 and 2006 was broad scale and affected females' abilities to provision pups in similar ways in the two ecoregions, likely through a reduction in prey availability, but was much more pronounced on the continental shelf than in the basin.

Overview of abundance and trends of northern fur seal (*Callorhinus ursinus*) in Commander Islands, 1958-2006, caveats and conclusions

Vladimir Burkanov^{1,2} and Don Calkins³

1: National Marine Mammal Laboratory, NMFS, NOAA

2: Kamchatka Branch of the Pacific Institute of Geography, FEB, RAS, Russia

3: Alaska SeaLife Center

The northern fur seal population in the Commander Islands has grown from 38,000 pups in the late 1950s to 75,000 pups in the mid-1970s, at a rate of 2.8%. Since that time the population has remained stable producing between 65,000 and 75,000 pups annually. We reviewed and interpreted old data files to summarize the Commander Island fur seals counts during this period. Although pup counts began to decrease in the late 1980s, a high variance in counts and increasing numbers of bachelor males on the rookery following the cessation of the commercial harvest suggested that the population was stable or even increasing during that period. The retirement of experienced scientists and reduced funding contributed to poor data collection and the interpretation of the system. During several years (1997, 1999, 2000, 2004 and 2005) the reliable method of counting pups from land was replaced by extrapolations based on the maximum number of females counted on rookeries in the middle of July. An August, 2006 land count conducted on all rookeries in the Commander Islands totaled 59,805 pups (55,972 alive and 3,833 dead). We used the land counts of pups, accounted for the general distribution and abundance of non-pup fur seals throughout the Commander Islands and concluded that the population of northern fur seals slightly decreased between the late 1980s and mid 1990s, but has remained relatively stable to the present and produces approximately 60,000 pups annually.

Population and Evolutionary Genetic Analyses Using Multiple Nuclear and Mitochondrial Loci in Steller Sea Lions

John W. Bickham, Center for the Environment, Purdue University, bickham@purdue.edu

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Ryan M. Huebinger, Department of Widlife and Fisheries Sciences, Texas A&M University, rhuebinger@yahoo.com

Thomas R. Gelatt, National Marine Fisheries Service, National Marine Mammal Laboratory, Tom.Gelatt@noaa.gov

Greg O'Corry-Crowe, National Marine Fisheries Service, Southwest Fisheries Science Center, Greg.O'Corry-Crowe@noaa.gov

Joseph I. Hoffman, Department of Zoology, University of Cambridge, jih24@cam.ac.uk

Steller sea lion (*Eumetopias jubatus*) is widely distributed in the North Pacific Ocean and Bering Sea, with rookeries that range from Central California to the Sea of Okhotsk. Throughout much of its range, populations have declined since the 1970's, and the western stock of Steller sea lion is listed as endangered. Studies of the genetics of this species using both nuclear and mitochondrial genetic markers have revealed a surprising level of genetic diversity indicating deep population subdivision and the existence of multiple genetic stocks. These stocks ostensibly reflect genetic divergence among Pleistocene glacial isolates. The degree of genetic differentiation, and the markers that define the populations, are a reflection of the age and timing of the isolation. This paper discusses the use of multiple genetic markers to reveal population genetic patterns, the stock structure of Steller sea lions, and the evolutionary history of the species that is revealed by probing the genome in this manner.

Killer Whales Do It In The Dark: Nocturnal Activity by Transients At St. Paul Island

Kelly Newman, University of Alaska Fairbanks, k.newman@sfos.uaf.edu Alan Springer, University of Alaska Fairbanks, <u>ams@ims.uaf.edu</u>

Observations of transient killer whales in the act of predation are rare because transients hunt by stealth, their range is large, feeding bouts are infrequent in terms of sighting opportunities, and they apparently feed at night as well as during the day. We used a 'Pop-Up' Autonomous Recording Unit (ARU) to expand the observation window of transient killer whales by monitoring them acoustically from June 22 - July 12, 2006 near a fur seal rookery at St Paul Island, Alaska, an important predation hot-spot in the Bering Sea. The ARU recorded continuously with a sampling rate of 0.1-16,000 Hertz. Killer whale vocalizations were detected on all of the 13 days analyzed so far. Whales were most active from the end of civil twilight (00:26 on 1 July) through mid-morning. Fewest vocalizations were recorded between 1800-2400. We presume that vocal whales were feeding, based on the paradigm that transients are most vocal when attacking and feeding on other marine mammals, and only transient killer whales have been identified at St Paul I. We also presume that they were preving upon fur seals, as numerous observations have been made during daytime at St. Paul I. of killer whales attacking fur seals, and only fur seals. Nocturnal hunting is an important reason why it has been difficult to understand the foraging behavior and diets of these elusive predators, and must be considered when drawing conclusions about the roles transient killer whales play in marine ecosystems.

An acoustic survey for right and other endangered whales in the Bering Sea

David K. Mellinger, Oregon State University, David.Mellinger@oregonstate.edu Kate Stafford, University of Washington, stafford@apl.washington.edu Sue E. Moore, NOAA/AFSC and University of Washington, Sue.Moore@noaa.gov Sharon Nieukirk, Oregon State University, Sharon.Nieukirk@oregonstate.edu Sara Heimlich, Oregon State University, Sara.Heimlich@oregonstate.edu Robert P. Dziak, NOAA/PMEL and Oregon State University, <u>Robert.P.Dziak@noaa.gov</u>

To determine the extent and seasonality of the distribution of right and other whales on the southeastern and south-central Bering Sea Shelf, an acoustic study was initiated there in May 2006. Similar acoustic searches for right whales have been performed successfully in the Gulf of Alaska, on the (Nova) Scotian Shelf, and in one area of the southeastern Bering Sea. Three autonomous hydrophones were deployed in the Bering Sea at sites of long-term oceanographic moorings M2, M4, and M5 of NOAA's Pacific Marine Environmental Laboratory. The acoustic instruments, located on the 70-meter isobath, are recording ambient sound continuously for over 14 months in the frequency range of 1-900 Hz, a range that includes most vocalizations of baleen whales. After retrieval of the instruments in summer 2007, we will extract their data and (pending further funding) analyze it using software optimized for the detection of calls of right, fin, humpback, blue, and sperm whales. The results will be used to characterize the seasonal distribution of these whale species in the southeastern and south-central Bering Sea. When combined with in-situ and satellite oceanographic data, we hope to obtain increased understanding of the oceanographic processes that result in occurrence of these cetaceans.

The Decline and Fall of the Alaskan Pinniped Empire

Brian Battaile, MMRU UBC, b.battaile@fisheries.ubc.ca Andrew Trites, MMRU UBC, <u>a.trites@fisheries.ubc.ca</u>

We correlated the population trajectories of 30 Steller sea lion rookeries in the Gulf of Alaska and Aleutian Islands with those of 20 northern fur seal rookeries in the Pribilof Islands using pup and adult survey estimates from 1978 to 2004. Our results indicate that the Steller sea lion decline and northern fur seal decline are correlated in time, but that the sea lion decline lags behind the fur seal decline by 2 to 8 years, depending upon the rookery. This indicates that the two declines are likely related in the cause but that either the driving mechanism is species specific or a time delay in a single mechanism occurs due to the distance between the habitats of the two species. One possible explanation is that the sea lion can delay a population decline by enhancing the chances of juveniles surviving, by delaying age at weaning in times of nutritional stress. However, in a chronically reduced carrying capacity, such a strategy may eventually lead to a severe population crash, such as the one they experienced, below their carrying capacity. Since 1998, the fur seal has been slowly declining, possibly from further reductions in carrying capacity. The Steller may be still be below its carrying capacity, depressed by such density independent effects as killer whale predation. If the carrying capacities of the two species are linked as our correlations suggest, then the Steller sea lion may again face density dependent declines in the near future

Northern fur seal (*Callorhinus ursinus*) pup production in the Kuril Islands, 2005-2006

Vladimir Burkanov^{1,2,} Russel D. Andrews^{3,4}, Don Calkins³ and Jason Waite³ 1: National Marine Mammal Laboratory, NMFS, NOAA

2: Kamchatka Branch of the Pacific Institute of Geography, FEB, RAS, Russia

3: Alaska SeaLife Center

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4: School of Fisheries and Ocean Science, University of Alaska Fairbanks

Historically, Northern fur seals were widely distributed in the Kuril Islands across 9-10 rookeries. Uncontrolled harvest in the 19th century eradicated the population and fur seals were considered extinct there until 1955-56. This first survey counted 800-900 seals on Khitraya Rock (Srednego Islands complex) and 2,000 seals on Fur Seal Rock (Lovushki Islands complex). Regular surveys started in 1962 when approximately 1000 pups were counted on Lovushki and only 2 on Srednego. Pup production grew rapidly between 1962-1977 (19.9% annual increase). The population stabilized around 1978 and the pup production trend from 1978-1988 became slightly negative (-0.8%). Surveys ceased in 1988. Spook counts were conducted between July 31 and August 14 in 2005 and August 11-16 in 2006. At Lovushki, we counted 11,248 (±268) live and 611 dead pups in 2005 and 12,180 (±280) live and 840 dead in 2006 (+8.3%). At Srednego we counted 17,544 (±335) live and 789 dead pups in 2005 and 12,985 (±285) live and 1,085 dead pups in 2006 (-25.6%). Total pup production in the Kuril Islands was 30,192 in 2005 and 27,090 in 2006. High inter-annual variation at Srednego was probably because surveys were conducted later than was optimal and pups were old enough to swim. Pup production has increased 82.4% since 1988 (+3.8% annually) and is now comparable to the Tuleny (Robben) Island population. Total abundance of fur seals in the Kuril Islands currently exceeds 100,000 individuals.

Empowering Communities through Real-Time Monitoring

Emily Fruzza, The Alaska Sea Otter and Steller Sea Lion Commission, efruzza@seaotter-sealion.org

Sharon Svarny-Livingston, Qawalangin Tribe of Unalaska, <u>qtnalemp@arctic.net</u> Wanda Kaiser, Native Village of Port Lions""The Real-Time Community Sea Otter

Monitoring project was designed to monitor the occurrence of sea otters around specific local coastal communities, and document interactions between sea otters and their predators, prey, weather, and human activities in real-time. The Alaska Sea Otter and Steller Sea Lion Commission (TASSC) worked with two Tribal Governments to implement the project; the Qawalangin Tribe of Unalaska, and the Native Village of Port Lions. This pilot project provided Tribes with the resources necessary for their community to monitor sea otters via an internet-based bulletin board.

In Port Lions, 33 observations were posted to the community monitoring board, detailing sea otter, other marine/land mammal, bird, and red tide observations. In Unalaska, 91 observations were posted to the community monitoring board, describing sea otter, other marine/land mammal, and bird observations. Seasonal sea otter movements as well as population changes were documented. The data collected via the online monitoring boards enabled TASSC to evaluate the effectiveness and utility of this pilot project. Preliminary analysis indicates that, if continued, there is great potential for this project to provide a better understanding of sea otter populations in these specific communities.

At-sea trip durations of juvenile Steller sea lions (*Eumetopias jubatus*) in response to environmental heterogeneity

Michelle E. Lander, National Marine Mammal Laboratory, Michelle.Lander@noaa.gov Thomas R. Loughlin, National Marine Mammal Laboratory, trlwc@comcast.net Miles L. Logsdon, University of Washington, mlog@u.washington.edu Glenn R. VanBlaricom, University of Washington, glennvb@u.washington.edu Brian Fadely, National Marine Mammal Laboratory, <u>Brian.Fadely@noaa.gov</u>

Large-scale climate change, which possibly affected the distribution, abundance, or quality of prey resources, has been implicated as one of the many hypotheses for the precipitous decline of Steller sea lions (Eumetopias jubatus). Although regime shifts and decadal oscillations of environmental indicators have dramatically altered the ocean structure and physics in the North Pacific and Bering Sea, these areas are also characterized by inter-annual and seasonal environmental variability, resulting in the need to understand how this variability currently affects the behavior and distribution of Steller sea lions at smaller spatial and temporal scales. Although the foraging behavior of juvenile Steller sea lions has been fairly well detailed, further analyses of telemetry data are needed to assess relationships of foraging effort with respect to spatial patterns of oceanographic features, which may ultimately affect the distribution of prey. To assess the hypothesis that foraging effort of sea lions fluctuates in response to localized environmental change, satellite-relayed data loggers were deployed on juvenile Steller sea lions (n=22) from July 2002 to May 2004 within areas of the Aleutian Islands and Gulf of Alaska. Trip durations of Steller sea lions were examined with respect to corresponding patterns of environmental heterogeneity, which were delineated using an assortment of metrics to characterize patches and gradients of sea surface temperature.

Predation on Northern Fur Seals in the Pribilof Islands: A Baseline Study

Andrew Malavansky, St. George Traditional Council Kayumixtax Eco-Office, andymalavansky@yahoo.com

Aquilina D. Lestenkof, Aleut Community of St. Paul Island Tribal Government, Ecosystem Conservation Office, adlestenkof@tribaleco.com

Desiree Lekanof, St. George Traditional Council Kayumixtax Eco-Office,

Michael C. Brewer, Aleut Community of St. Paul Island Tribal Government, Ecosystem Conservation Office, mcbrewer@tribaleco.com

Kate M. Wynne, School of Fisheries and Ocean Sciences, University of Alaska Fairbanks ffkmw@uaf.edu

Amanda M. Merklein, Community and Ecology Resources, mandybruce@co-eco.com Bruce W. Robson, Community and Ecology Resources, <u>mandybruce@co-eco.com</u>

During 2006, the St. George Island Traditional Council, in collaboration with the St. Paul Island Tribal Government and the University of Alaska, Fairbanks, collected baseline information on the distribution and behavior of predators on northern fur seals in the Pribilof Islands region. We used two methods to collect data; a logbook program in the local halibut fishery, and a local and traditional knowledge (LTK) survey. Emphasis was placed on assessing current and historical trends in the location, numbers and seasonality in killer whale and Steller sea lion observations, as well as the frequency and extent of observed predation events. During the 2006 commercial halibut fishery, 15 boats from St. Paul and 3 boats from St. George participated in the logbook program, representing nearly complete coverage of the local fleet. From mid-June through late-September, fishermen from ten boats reported 21 sightings of killer whales in both the near-shore waters around the Islands and at the continental shelf break, however no direct predation events were observed by local fishermen. A total of 49 LTK interviews were conducted and interviewees reported 29 sightings of killer whales during 2006. Predation on northern fur seals by both killer whales and Steller sea lions was reported during LTK interviews in observations spanning the period from 1976 to the present. Gear interactions with killer whales were also reported by fishermen on local boats, however killer whale depredation on halibut longline gear was more common in the distant waters near the continental shelf break than near the islands.

How to count walrus: logistical challenges

Rosa Meehan, USFWS MMM 1011 E Tudor Road Anchorage Alaska 99503 Rosa Meehan @fws.gov

Suzann Speckman, USFWS MMM Suzann_Speckman@fws.gov R. Bradley Benter, USFWS MMM, Brad_Benter@fws.gov Joel Garlich-Miller, USFWS MMM Joel_Garlich_Miller@fws.gov John Trent, USFWS MMM John_Trent@fws.gov

Counting Pacific walrus involved gathering data throughout their range, a significant challenge as walrus winter in the Bering Sea and follow the ice edge as it seasonally moves north and south. We determined that the most predictable time and location to find walrus was during the late winter and early spring, when walrus congregate in the Bering Sea. Logistic challenges included balancing timing to maximize daylight for aerial surveys and yet conduct the survey prior to significant ice (and therefore walrus) movement, so the survey began in March. We needed direct access to walrus for tagging. which required ship travel into the ice pack. Due to study design requirements, we utilized two ships; we contracted with a Russian company (FESCO) for an icebreaker to access the area south of St. Lawrence Island and an ice-reinforced ship to access the area south of Nunivak Island. The Russian icebreaker provided a critical platform that was worth the complex contracting. The international border with Russia provided a third aspect to the complexity that was resolved through developing compatible data collection techniques and then using both Russian and US aircraft and scientific teams in their respective airspaces. Successful implementation the overall study design benefited from significant contributions by our Russian colleague and numerous agencies and groups that provided either financial or logistic support.

Spatial and temporal distribution of calling right whales on Southeast Bering Shelf, 2000-2005

Lisa M. Munger¹, Sean M. Wiggins¹, Sue E. Moore², and John A Hildebrand¹ 1. Scripps Institution of Oceanography, University of California, San Diego, 9500 Gilman Drive, La Jolla, CA, 92093-0205, USA

2. NOAA National Marine Mammal Laboratory & Alaska Fisheries Science Center, 7600 Sand Point Way N.E., Seattle, WA 98115-6349, USA

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We analyzed passive acoustic recordings made by long-term autonomous seafloor packages and temporary hydrophones in the Southeast Bering Sea (SEBS) middle-shelf region in 2000-2005 to investigate the distribution and relative abundance of calling North Pacific right whales (Eubalaena japonica). The recording range of hydrophones on the broad, shallow SEBS shelf is on average several tens of kilometers, and up to 100 km. Right whale calls were detected seasonally as early as May and as late as December. The presence of right whales in the Bering Sea in December is noteworthy, as visual search effort has not been conducted during winter and previously it was assumed that right whales left the Bering earlier in the year. There appears to be a net movement of calling right whales from east to west and northwest throughout the year, with May and June calls recorded on instruments near the entrance to Bristol Bay, and most of the lateseason calls (Nov & Dec) recorded slightly northeast of the Pribilof islands. Right whales called on fewer days in early summer, whereas the highest calling rates and longest consecutive calling periods were recorded in late summer and early fall, suggesting that the whales pass through the study area quickly and sporadically early in the summer, and remain for longer periods in late summer and fall. However, calling right whales were not resident in any monitored area in the SEBS for periods longer than 5-6 days at any time of year. Calling right whale groups were larger (>2 or 3 calling animals) later in the year, based on caller locations and ranges estimated using hyperbolic localization (recordings from multiple instruments) and normal mode theory (single instrument recordings). Further analyses of habitat variables, calling behavior and caller group sizes are underway.

Organochlorine Contaminants (OCs) in Endangered Steller Sea Lion Pups (*Eumetopias Jubatus*) and Correlations between OCs and Physiological Biomarkers

Matthew Myers and Shannon Atkinson, Alaska SeaLife Center,

matthew myers@alaskasealife.org

Investigations into the cause of the Steller sea lion decline have focused on numerous factors. including toxicity caused by the accumulation of organochlorines (OCs). OCs, such as polychlorinated biphenyls (PCBs) and dichlorodiphenyltrichloroethane (DDT) have been shown to effect marine mammal populations. Average OC concentrations were significantly higher in Russian animals compared to western Alaska (for PCBs and DDTs $p = \langle 0.001 \rangle$ and in both areas females had higher levels than males. ΣPCB and ΣPCB TEO lipid adjusted concentrations measured in Steller sea lion pup blood were compared to levels associated with biological and physiological effects in several species of mammals. In western Alaskan pups, 20% to 40% of our sample population exceeded threshold concentrations. In Russian pups, 38% to 64% exceeded threshold concentrations. The rookery at Koslova Cape in Russia had the highest mean concentrations of PCBs in our study and was further investigated for associations between OCs and physiological biomarkers. A significant negative relationship was revealed in male pups between $\sum PCBs$ wet weight and mass (r = 0.71, p < 0.001). We also discovered another significant negative relationship in male pups between **SPCBs** wet weight and retinol, or vitamin A, which is associated to growth (r = 0.67, p = 0.001). While the specific role these chemicals may have in either the decline or the failure of the endangered Steller sea lion population to recover needs to be further investigated, this study indicates specific areas and animals that may be most at risk.

Foraging behavior and methods of analysis of feeding preferences in sea otters on Commanders

Zimenko Nadezhda, Russian Federal Research Institute of Fisheries and Oceanography, <u>n_zimenko@vniro.ru</u>

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The sea otter, Enhydra lutris, population at Commander Islands, Russia increased from very low numbers in the early 1900s to near equilibrium density by the 1980s. Animal density at Medny was stable already in 1960s, on the contrary animal density at Bering kept to the low limit till late 1960s and increased steadily from early 1970s to late 1980s. So, aquatories of Medny and Bering may be categorized as established (occupied >25 years) and intermediate (occupied 5-15 years). Sea otter diet and foraging strategies were studied on Medny in 1987-97 by observing foraging otters and scat analysis. Some similar data were compared with those obtained in 1930s and 1987. In comparison with 1930-31 species composition of eaten prey in scats in 1995-97 was not different significantly but percent volume of main prey types and prey size had changed essentially. Species composition of eaten prey and percent volume of 12 from those ones in comparison with 1987 was not differing significantly in 1995-97 (chi-square contingency test). Otters wich have been observed at Madny preferred to feed on the same type of prey during the same foraging trip. They obtained up to 35.15 kcal per dive. Caloric intake was depended on type of item and used foraging strategy. Number of dives and mean number of obtained preys calculated per 1 min of foraging trip did not differ in different foraging strategies. Caloric intake calculated per 1 min of foraging trip may be used to define a success of used foraging strategy.

Estimating the Size of the Pacific Walrus Population

Suzann G. Speckman, U.S. Fish and Wildlife Service, Marine Mammals Management, 1011 E. Tudor Road, Anchorage, Alaska, USA Suzann Speckman@fws.gov Vladimir Chernook, GiproRybFlot, Research and Engineering Institute for the Development and Operation of Fisheries, 18-20 Malaya Morskava str., St. Petersburg 190000, Russia, chernook@grf.spb.ru Douglas Burn, U.S. Fish and Wildlife Service, Marine Mammals Management, 1011 E. Tudor Road, Anchorage, Alaska, USA Douglas Burn@fws.gov Mark S. Udevitz, U.S. Geological Survey, Alaska Science Center, 1011 E. Tudor Road, Anchorage, Alaska, USA MUdevitz@usgs.gov Anatoly Kochney, ChukotTINRO, Pacific Research Institute of Fisheries and Oceanography, Laboratory of Marine Mammals Study, P.O. Box 29, Anadyr, Chukotka, Russia kochnev@anadyr.ru Alexander Vasilev, GiproRybFlot, Research and Engineering Institute for the Development and Operation of Fisheries, 18-20 Malaya Morskaya str., St. Petersburg 190000, Russia vasilev@grf.spb.ru R. Bradley Benter, U.S. Fish and Wildlife Service, Marine Mammals Management, 1011 E. Tudor Road, Anchorage, Alaska, USA Brad Benter@fws.gov Alexander Lisovsky, GiproRybFlot, Research and Engineering Institute for the Development and Operation of Fisheries, 18-20 Malaya Morskava str., St. Petersburg 190000, Russia lisovsky@grf.spb.ru The U.S. Fish and Wildlife Service, in collaboration with the U.S. Geological Survey and Russian scientists from GiproRybFlot and ChukotTINRO, conducted a survey in March-April 2006 to estimate the size of the Pacific walrus population, U.S. and Russian scientific crews coordinated aerial surveys over the ice-covered continental shelves of the Bering Sea on both sides of the international border. The study area was partitioned into survey blocks, and a systematic sample of transects within each block was sampled with airborne thermal scanners using standard strip-transect survey methods. The amount of heat produced (thermal signature) was recorded for each walrus group that was detected by a thermal scanner. A sample of walrus groups along a scanned transect was photographed using digital cameras. Counts of walruses in photographed groups are used in a generalized linear model to determine the relationship between thermal signatures and numbers of walruses in a group. This model will be used to estimate the number of

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and numbers of walruses in a group. This model will be used to estimate the number of walruses in groups that were not photographed. Only walruses that are hauled out on pack-ice can be detected in thermal imagery. Therefore, the population estimate derived from thermal scanning will be corrected for walruses in the water. Satellite transmitter data from tagged walruses will be used to estimate the proportion of the population that was in the water and not available for detection by the thermal scanners. The final population estimate will be developed cooperatively by U.S. and Russian scientists, and results are expected in late 2007.

Summer haulouts are breeding sites: Redefining the reproductive strategy of Steller sea lions

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Andrew W. Trites, Marine Mammal Research Unit, University of British Columbia, trites@zoology.ubc.ca

Andrea P. Coombs, Marine Mammal Research Unit, University of British Columbia

Steller sea lions (Eumetopias jubatus) are commonly thought to rest at haulout sites and breed at rookeries. To test the assumption that breeding does not occur at haulouts, we recorded reproductive behavior (through direct observations of courtships and copulations with bulls) at two haulout sites in Alaska during the spring and summer seasons over 3 years. Mature males were noted to hold territories on the haulouts, and were seen to engage in courtships and copulations with nonpregnant females that were either unencumbered or nursing pups or juveniles from the previous year. Breeding at these haulouts appeared to occur one to two weeks earlier than it did on the rookery. Our observations suggest that the breeding strategy for Steller sea lions should be redefined to recognize that summer haulouts are important breeding areas for nonpregnant females. Consequently, haulouts should not be thought of as strictly non-breeding sites. Steller sea lions use 88 rookeries and about 600 haulouts throughout their range with a large portion of the population remaining at haulouts during the breeding season. The reproductive behavior that occurs at haulouts during summer may therefore be significant to the recovery of Steller sea lions, and should be considered when implementing management strategies.

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Poster: Bering Sea & Aleutian Islands – Marine Mammals

Factors affecting haul-out behavior of Pacific walruses in Bering Sea ice

Mark S. Udevitz, USGS Alaska Science Center, mudevitz@usgs.gov Chadwick V. Jay, USGS Alaska Science Center, cjay@usgs.gov Anthony. S. Fischbach, USGS Alaska Science Center, afischbach@usgs.gov Joel L. Garlich-Miller, USFWS Marine Mammals Management, joel_garlichmiller@fws.gov

Understanding haul-out behavior of ice-associated pinnipeds is essential for designing and interpreting population surveys and for assessing effects of potential changes in their ice environments. We used satellite-linked transmitters to obtain sequential information about location and haul-out status for Pacific walruses in the Bering Sea during early spring of 2004, 2005, and 2006. These data were matched with weather data from NOAA's National Centers for Environmental Predictions and used in a generalized, linear, mixed effects model to assess relations between walrus haul-out status and environmental conditions, providing the first quantitative analysis of walrus haul-out behavior in sea ice habitat. The tagged walruses averaged only about 20% of their time hauled out on sea ice. Probability of being hauled out increased with temperature and barometric pressure and decreased with wind speed. The model also included random effects and a complex error structure to account for correlations among different walruses at any given time and among different times for any given walrus. The associated covariance estimates indicated that the probability of being hauled out varied among walruses, increased with the proportion of other walruses hauled-out concurrently, and was higher for walruses that were hauled-out at the previous time-point. This information will be used to estimate the proportion of the population that was available to be detected in an aerial infrared survey of the Pacific walrus population conducted jointly by the United States and Russia in spring of 2006.

Habitat Use and Numbers of Humpback Whales in the Eastern Aleutian Islands

Heather Vukelic, University of Alaska Fairbanks, fthev@uaf.edu

Although humpback whales, *Megaptera novaeangliae*, have received considerable study in parts of the North Pacific, most work has occurred from the Shumagin Islands eastward. This study extends detailed work into the Eastern Aleutian Islands between Unimak Pass and Samalga Pass. In order to examine numbers, habitat use, and distribution of humpback whales on their coastal feeding grounds, surveys based on photo identification of individuals was conducted during the summers of 2001-2006. Photographic data was contributed by several groups including National Marine Mammal Laboratory, North Gulf Oceanic Society, Cascadia Research Collective/BBC, and Southwest Fisheries Science Center. Between 2001 and 2005, an estimated 250 to 300 individual whale were identified by North Gulf Oceanic Society over 84 survey days. Photographic data will be used in mark recapture analysis in order to estimate annual numbers of whales using the region. Spatial and temporal data from encounters will be placed in a GIS database for examination of patterns of use by groups and individuals. GIS will also be used to determine important habitat and site fidelity within the region. Results will be viewed in the context of bathymetric and oceanographic features.

Poster: Bering Sea & Aleutian Islands – Marine Mammals

Out to eat in the Bering Sea: Summer foraging by female northern fur seals (*Callorhinus ursinus*) from the Pribilof Islands, Alaska

Tonya Zeppelin, National Marine Mammal Laboratory, tonya.zeppelin@noaa.gov Kathryn Call, National Marine Mammal Laboratory, kate.call@noaa.gov Rolf Ream, National Marine Mammal Laboratory, <u>rolf.ream@noaa.gov</u>

We used diet and satellite telemetry data to describe the relationship between breeding sites and foraging habitats of adult female northern fur seals from the Pribilof Islands. Alaska. Scats (n = 4171) were collected between 1987 - 2000 (July-September) and satellite transmitters (n = 39) were deployed on seals during the 2004 breeding season (July - October) at rookeries on St. Paul and St. George Islands. We found differences in diet (frequency of occurrence of prey) and foraging behavior (trip direction, distance; and duration) of individual seals among islands and rookery sites. Our data indicate spatial and dietary partitioning as females from four geographic areas were associated with specific hydrographic domains: middle shelf domain (50-100m), outer shelf domain (100-200m), and oceanic domain (>200m). Walleye pollock is found in all hydrographic domains and was the dominant prey for all females. However, other prey species which are characteristic of specific domains were associated with females from specific geographic areas. Telemetry data corroborated the diet data. For example, scat from rookeries on the east side of St. Paul had the highest occurrences of Pacific sand lance, a prey associated with the middle shelf domain where telemetry data showed these females spent 90% of their time. The spatial and dietary partitioning observed in this study provides insight into how changes in the Bering Sea environment and prey distributions might affect the Pribilof Island fur seal population.

Bering Sea & Aleutian Islands Human and Community Impacts & Ecosystem Perspectives

Tuesday, 23 January 2007 4:45 – 5:45 PM Session Chair and Poster Review: Randy Hagenstein

TALKS

Speaker	Title
Randy Hagenstein	The Pribilof Island Collaborative: Complex Problems/Collaborative
	Solutions
Sarah Kruse	The Pribilof Islands: Establishing a Socioeconomic Baseline
Ellen Lance	Evaluation of three techniques for baseline monitoring of petroleum
	hydrocarbon contamination in Nelson Lagoon, Alaska

POSTERS

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First Author	Title
Douglas Dasher	Aleutian Alaska Monitoring and Assessment Program (AKMAP)
	Benthic Habitat Transect Methods
K David Hymonhach	The Bering Ecosystem Study (BEST): a new program for the eastern
K. David Hyrenbach	Bering Sea
Sarah Kruse	Life Cycle Assessment of Alaska Salmon Fisheries
Clarence Pautzke	Bering Sea Integrated Ecosystem Research Program
Michael Smelen	Contaminants in Sediment, Water, and Select Plants and Animals in the
	Coastal Yukon Delta National Wildlife Refuge region of Alaska
William Sydeman	Seabird-sockeye salmon co-variation in the eastern Bering Sea:
	ecosystem indicators, salmonid predictors, and the trophic equivalency
	hypothesis

Bering Sea & Aleutian Islands – Human & Community Impacts

The Pribilof Island Collaborative: Complex Problems/Collaborative Solutions

Randy Hagenstein, Heather McCarty, Karin Holser, Lori Swanson

The Pribilof Island Collaborative (PIC) is an ad hoc advisory body comprised of community leaders, scientists, fishing industry representatives, and NGO advocates who come together regularly to discuss issues and propose research and policy measures that support the Pribilof Island communities and the local wildlife resources those communities depend on. The forum provides a transparent and cooperative atmosphere for the participants to share information and candidly voice their concerns. At each meeting, scientific experts presented information on a variety of resource issues including halibut, crab, fur seals, seabirds, and socioeconomics. Because of the PIC's diverse membership and collaborative design, the wildlife and fisheries management and research recommendations made by the PIC have been helpful with the North Pacific Fishery Management Council, National Marine Fisheries Service, U.S. Fish & Wildlife Service, North Pacific Research Board and other key decision making bodies. And, because of the otherwise-unlikely personal relationships forged through this process, the PIC has collectively advocated real conservation measures including: reducing input of nets and other wildlife-entangling marine debris, taking steps to reduce harmful seabird/ fisheries interactions, supporting regulatory changes for Pribilovian fishermen yielding a greater catch and alleviating fishing pressure in locally depleted areas, and implementing strict policies to help prevent the spread of alien predatory rats to bird-rich Pribilofs and other Bering Sea islands. This collaborative effort engages interests in a way that is inclusive and responsive, providing an effective model for addressing localized resource issues on a broad community scale.

Bering Sea & Aleutian Islands – Human & Community Impacts

The Pribilof Islands: Establishing a Socioeconomic Baseline

Sarah Kruse, Ecotrust, skruse@ecotrust.org Astrid Scholz, Ecotrust, astrid@ecotrust.org Henry Huntington, Huntington Consulting, <u>hph@alaska.net</u>

Environmental changes and challenging conditions in commercial and subsistence fisheries around the Pribilof Islands pose difficulties for the local economy. In collaboration with the Pribilof Islands Collaborative (PIC), we identified socioeconomic data gaps that, if filled, would help decision-makers plan for and mitigate eventual fishery regulations and other management measures, and enhance local economic development and stewardship of marine resources.

In this paper we present methods and results from a baseline project funded by the North Pacific Research Board with the purpose to support evaluation, monitoring, and prediction of (a) the value of commercial fisheries to the islands and the region, (b) the social impacts of changes in fisheries management, (c) the potential for local economic development, and (d) the role of subsistence activities in relation to environmental, economic, and social health.

This project utilizes both quantitative data, including fishery dependent and independent data, and qualitative data, relying on the traditional ecological knowledge of Pribilof Island residents. An on-island survey provides both new statistics and insight into how residents of both islands view life in their communities and the surrounding marine environment.

This project focuses proactively on research questions and information needs identified by PIC stakeholders, rather than retroactively gathering what data are available to fulfill regulatory requirements for socioeconomic impact assessments. This project's research agenda not only analyzes the linkages between the environment, economy and local communities, but also establishes a baseline for future research and a foundation for continued data collection and analysis activities on the islands.

Bering Sea & Aleutian Islands – Human & Community Impacts

Evaluation of three techniques for baseline monitoring of petroleum hydrocarbon contamination in Nelson Lagoon, Alaska

Ellen Lance, US Fish and Wildlife Service, Ellen_Lance@fws.gov Mari Reeves, US Fish and Wildlife Service, Mari_Reeves@fws.gov Kimberly Trust, US Fish and Wildlife Service, <u>kim_trust@evostc.alaska.state.us</u>

Three techniques were used to measure hydrocarbon contamination in the relatively pristine and extremely valuable marine environment of Nelson Lagoon. As expected, hydrocarbon levels were low, but some polycyclic aromatic hydrocarbons were detected. Bioaccumulation of some PAHs was evident by examining the tissues of blue mussels (*Mytilus edulis*). Water sampling, using semipermeable membrane devices revealed similar results overall, but not the same analytes. Similarly, sediment sampling detected tewer polycyclic aromatic hydrocarbons overall, but some analytes were not detected using the other two techniques. Nelson Lagoon had little hydrocarbon contamination compared to other sites, but there was evidence that some pollutants occur in this marine environment. All three techniques detected a unique suite of analytes.

Aleutian Alaska Monitoring and Assessment Program (AKMAP) Benthic Habitat Transect Methods

Douglas Dasher¹, Stephen Jewett², Terri Lomax¹, Jim Gendron¹, Max Hoberg², Heloise Chenelot², Shawn Harper², Reid Brewer³, Mandy Lindeberg³ and Roger Clark⁴

- 1. Alaska Department of Environmental Conservation, Division of Water, 610 University Avenue, Fairbanks, AK 99709. E-mail: doug_dasher@dec.state.ak.us.
- 2. University of Alaska Fairbanks, School of Fisheries and Ocean Science
- 3. NOAA/NMFS, Auke Bay Laboratory, Juneau, Alaska
- 4. Taxanomic consultant

The Aleutian Islands extend over 1,900 km westward from Unimak Island to Attu Island covering some of the most biologically diverse marine ecosystems in the world. Numerous species of fish, mollusks and crustaceans, birds and marine mammals live in this region. The Aleutian Islands consists of volcanic oceanic islands delineating the North Pacific Ocean from the Bering Sea. Sub-littoral zones often consist of rocky substrate, but seldom do fine grain sediment environments occur. AKMAP coastal surveys are based the Environmental Protection Agency National Coastal Assessment (NCA) procedures using a probabilistic sampling design featuring monitoring of select environmental indicators. Data is integrated from multiple media, including water quality data, sediment data, biological, physical and chemical parameters to assess ecosystem conditions. Traditional NCA uses a multi-tiered sediment triad approach focused on fine grain sediments and cannot characterize the status of this regions rocky benthic ecological resource. Dive transect and quadrat methods were developed to collect benthic data for rocky and sedimentary benthic habitats. This poster presents the methodology and its application to the Aleutian AKMAP assessment during 2006 and 2007.

The Bering Ecosystem Study (BEST): a new program for the eastern Bering Sea

K. David Hyrenbach, University of Washington, khyrenba@u.washington.edu George L. Hunt Jr., University of Washington, <u>geohunt2@u.washington.edu</u>

The Bering Ecosystem Study Program (BEST), a new NSF-sponsored research program, seeks to develop a fundamental understanding of how climate change will affect the marine ecosystems of the eastern Bering Sea, the continued use of its resources, and the economic, social and cultural sustainability of the people who depend on them. Fieldwork will span four years (2007-2010) with a final synthesis year (2011). In the first competition, five proposals were funded. A second competition, in partnership with the NPRB Bering Sea Integrated Ecosystem Research Program (BSIERP) solicitation, is anticipated for field work starting in 2008. The first cruise, planned for 9 April - 8 May 2007, will be a cooperative effort by BEST and NOAA researchers onboard the U.S. Coast Guard ice-breaker Healy. The study area spans the SE shelf, between the inner domain (50m depth) and the basin (2000m depth), from Unimak Pass (54.6 degrees N) to near Saint Lawrence Island (62.2 degrees N). A social science component, developed in collaboration with Alaskan Native Communities, will investigate the social, economic and cultural impacts of environmental variability in the Bering Sea. A Planning Office (http://fish.washington.edu/best) will facilitate the outreach and educational activities for the program, and will coordinate BEST research with the work of other U.S. and foreign programs working in the Bering Sea and other sub-arctic seas. Through close cooperation and integration of these efforts, a much stronger program will emerge than could have been sustained by any one agency alone.

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Life Cycle Assessment of Alaska Salmon Fisheries

Sarah A. Kruse, Ecotrust, skruse@ecotrust.org Peter Tyedmers, Dalhousie University, peter.tyedmers@dal.ca Astrid Scholz, Ecotrust, astrid@ecotrust.org Ulf Sonesson, The Swedish Institute for Food and Biotechnology Anna Flysjo, The Swedish Institute for Food and Biotechnology Nicole Arsenault, Dalhousie University

In this paper we present findings specific to the capture fisheries for salmon in Alaska from an international comparative study of the life-cycle socioeconomic and environmental impacts of farmed and wild salmon production in the North-East Pacific, Chile and the North-East Atlantic. Our research systematically assesses and compares impacts associated with contemporary commercial salmon fisheries in Alaska, up to the point at which salmon are delivered to the dockside including differences that result from the three dominant fishing gears used in the region (purse seine, gillnet and troll).

To answer the questions outlined above, we use a modified Life Cycle Assessment (LCA) framework. LCA is a standardized, quantitative method for calculating a product's, process' or activity's environmental load throughout all its phases. While originally designed to evaluate the impacts of manufactured products, LCA is increasingly being applied to food production systems. This project utilizes both existing data sources and results from a random sample mail survey of Alaska salmon permit holders.

We expand the scope of the traditional biophysical analysis where relevant and possible to account for ecological relationships and impacts common to the systems being evaluated. In addition, we develop a set of socioeconomic impact categories. Social values and sustainability have been recognized as a major issue in both capture fisheries and aquaculture (Philips et al. 2001), but little systematic work has been done to date to integrate these considerations within a biophysically-based assessment such as LCA.

Bering Sea Integrated Ecosystem Research Program

Clarence Pautzke, NPRB, cpautzke@nprb.org Francis Wiese, NPRB, francis.wiese@nprb.org Carolyn Rosner, NPRB, <u>carolyn.rosner@nprb.org</u>

The North Pacific Research Board's 2005 Science Plan was developed with guidance from the National Research Council and strongly promotes integrated ecosystem research off Alaska. NPRB's first such program is the Bering Sea and Aleutian Islands Integrated Ecosystem Research Program (BSIERP). The BSIERP aims to better understand the key processes regulating the production, distribution and abundance of marine organisms in the Bering Sea and the Aleutians and how these processes may change quantitatively under various natural and human-induced scenarios (particularly climate change), as well as the economic and sociological impacts that may result from various scenarios. A partnership between NPRB and the National Science Foundation (NSF) has been developed to field a more comprehensive ecosystem study in the eastern Bering Sea shelf region between the Aleutians and St. Lawrence Island for 2007-2013. The scientific foundations for this partnership are the BSIERP and the 2005 Bering Ecosystem Study (BEST), each of which seek to support scientific research that will improve understanding of how the highly productive marine ecosystem of the Bering Sea may respond to climate change, particularly as mediated through changes in seasonal sea ice cover. Such a joint program would serve as a central hub to which other science programs (such as NOAA's NPCREP and LOSI) could link to form one stronger program. The partnership is a robust \$35 million ecosystem research program in the Bering Sea for which funding decisions will be made by July 2007.

Contaminants in Sediment, Water, and Select Plants and Animals in the Coastal Yukon Delta National Wildlife Refuge region of Alaska

Michael Smolen, Center for the Environment, Purdue University, msmolen@tds.net Albert Simon, Paimiut Environment Office, Native Village of Paimiut, <u>albertpaimiut@yahoo.com</u>

Most studies of contaminant levels in wildlife, fish, and plants in rural areas of Alaska are associated with either point source pollution problems or the contaminant levels in species harvested by Native peoples. However, there is little known of the background levels that can include deposition from long-range transport. This study was conducted to determine the patterns and concentrations of chemicals known to be generated locally or to move long distances through the air and water currents. With these data, we seek to provide preliminary data that can separate local sources in the environment from longrange transport and contribute to the development of models that can identify the magnitude of seasonal changes in deposition from snow, ice, and weather patterns. Primary focus is on legacy the chemicals (POPs-101 congeners) and pesticides (DDT, DDE, hexachlorobenzene, chlordanes, dieldrin, pentachloroanisole, endosulfan, mirex). Polyaromatic hydrocarbons (24 parent and 25 alkylates) were included. Samples analyzed are freshwater, brackish/saltwater, river and bay sediments, blackfish (Dallia pectoralis), tomcod (Eleginus gracilis), Alaska razor clams (Siliqua alta), blue mussels (Mytilus edulis), marsh marigolds (Caltha palustris), and Labrador tea (Ledum palustris). Three localities were selected to cover the coastal region between the Yukon River Delta and Nelson Island (Black River, Kokechik Bay/Kokechik River, and Kashunuk/Aphrewn rivers). Each area is of primary importance to local Native people as sites where they collect fish, shellfish, and vegetable plants and berries. No site is situated near Native villages.

Seabird-sockeye salmon co-variation in the eastern Bering Sea: Ecosystem indicators, salmonid predictors, and the trophic equivalency hypothesis

William J. Sydeman¹, Christine L. Abraham¹, G. Vernon Byrd²

- 1. Marine Ecology Division, PRBO Conservation Science, 3820 Cypress Drive #11, Petaluma, California, 94954, USA
- 2. Alaska Maritime National Wildlife Refuge, U.S. Fish and Wildlife Service, 95 Sterling Hwy, Suite 1, Homer, AK 99603, USA <u>wsydeman@prbo.org</u>

Seabirds (Rissa spp. and Uria spp.) and sockeye salmon (Onchorhynchus nerka) of the eastern Bering Sea share similarities in their trophic ecology. We tested the role of seabirds as indicators of the food web conditions that may affect sockeye salmon survival at sea by investigating co-variation between seabirds breeding on the Pribilof Islands and returns of Bristol Bay sockeye at lags of up to 5 years. Seabird phenology (hatching dates of eggs) and productivity (number of young raised to independence per breeding pair), which vary in relation to prey availability, were inversely and positively related. respectively, with sockeye returns, with the strongest co-variation found 2, 3, and 4 years before sockeye returns. Detrended breeding phenology of Red-legged Kittiwakes (Rissa brevirostris) on Saint Paul Island explained 50% of the sockeye returns with a 3 year lead. Coupling kittiwake phenology with existing annual predictions for Bristol Bay salmon improved forecasts (i.e., increased R2 value). The co-variation between seabird breeding parameters and sockeye returns supports the hypothesis that variation in seabird breeding parameters index food web conditions that also affects salmon survival at sea. Relative to the year of return, the strong co-variation at year-3 supports previous work suggesting that the first and/or second year at sea is important in determining sockeye year-class strength. This study demonstrates that seabirds can be used to both understand current ecosystem conditions and suggests a potential role for seabirds in forecasting commercially-valuable fisheries.

Wednesday, 24 January 2007 8:00 - 9:30 AM Session Chair and Poster Review: Scott Pegau

TALKS

Speaker	Title
Scott Pegau	Connecting Oceanography and Fisheries in the Offshore Test Fishing
	Program
William Sydeman	Meso-marine ecosystems of the North Pacific: seasonal and interannual
	variability
Tal Ezer	Modeling and satellite observations of tidally-driven currents and mud
	flats flooding in Cook Inlet, Alaska
Lisa Etherington	Oceanography of Glacier Bay: Implications for biological patterns and
	productivity in a temperate glacial fjord
Mario Tamburri	ACT and Integrated Sensor Systems for Vessels of Opportunity

POSTERS

First Author	Title
Claude Belanger	Exchange between Prince William Sound and the Gulf of Alaska: Data over an annual cycle
Edward Cokelet	Climate Shift and Ecosystem Differences Observed in Alaskan Ferry Oceanographic Measurements
Russell Hopcroft	The Gulf of Alaska Seward Line - 2005 & 2006
Carol Ladd	Eddies in the Eastern Gulf of Alaska
Megan Wolfe	The Wind Field over the Northeast Gulf of Alaska Shelf: A QuikSCAT Perspective

Connecting Oceanography and Fisheries in the Offshore Test Fishing Program

W. Scott Pegau, Kachemak Bay Research Reserve, scott_pegau@fishgame.state.ak.us Mark Willette, Alaska Department of Fish and Game, mark willette@fishgame.state.ak.us

The Offshore Test Fishing program has been collecting salmon fisheries and surface oceanographic condition measurements through the month of July in lower Cook Inlet since 1979. Beginning in 2002, conductivity-temperature-depth measurements were added to those being collected by the test vessel. These oceanographic measurements compliment the fisheries information being collected by allowing us to examine how the marine conditions affect the migration of salmon back to upper Cook Inlet. In this presentation we examine the variability in oceanographic conditions within and between years, the ability to use the surface measurements to infer subsurface conditions, a preliminary analysis of which conditions affect the catch per unit effort, and a possible oceanographic trigger that may alter the fish migration pattern.

Meso-marine ecosystems of the North Pacific: seasonal and interannual variability

W.J. Sydeman¹, S.D. Batten², M. Henry¹, C. Rintoul¹, D.W. Welch³, K.H. Morgan⁴, and K.D. Hyrenbach¹

- 1. PRBO Conservation Science, Marine Ecology Division, 3820 Cypress Drive, Petaluma, CA 94954 USA <u>wsydeman@prbo.org</u>
- 2. SAHFOS, Citadel Hill, Plymouth, PL1 2BP, UK
- 3. Kintama Research, 4737 Vista View Cresent, Nanaimo, B.C. V9V 1N8 Canada
- 4. Canadian Wildlife Service, c/o Institute of Ocean Sciences, 9860 West Saanich Road, Sidney, B.C. V8L 4B2 Canada

We studied physical and biological variability across the sub-arctic North Pacific Ocean (along a 7,500 km transect from British Columbia, Canada, to Hokkaido, Japan) to test the hypothesis that 'eco-regions' of the North Pacific are persistent between seasons and years. Plankton samples were collected with a Continuous Plankton Recorder (CPR) while observers recorded marine birds and mammals. Physical oceanographic properties were measured using data loggers and XBTs. Temperature and chlorophyll a concentrations were obtained from satellite imagery. Using multi-dimensional clustering of physics, plankton and top predator data for data collected in 2002, we identified 10 distinct North Pacific biological communities (eco-regions) which we term 'meso-marine ecosystems' (MMEs). MMEs have clear bathymetric and boundary current associations (Batten et al. 2006, DSR II). Using data from all years (2002-2005), we now investigate the temporal persistence of MMEs over 4 years and 3 seasons (winter, summer, fall). Eco-regional boundaries were persistent through time, but varied, to a certain extent, by season. Regular monitoring of MMEs, including dynamic changes in plankton and predator communities, will enhance our ability to detect the ecosystem fluctuations that affect fish and other species, thereby promoting an ecosystem-approach to ocean resource management.

Modeling and satellite observations of tidally-driven currents and mud flats flooding in Cook Inlet, Alaska

Tal Ezer, Princeton University, ezer@splash.princeton.edu Lie-Yauw Oey, Princeton University, <u>lyo@splash.princeton.edu</u>

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A Wetting and Drying (WAD) algorithm is implemented in a three-dimensional ocean circulation model of Cook Inlet, Alaska, where large tidal ranges of about 10 m regularly expose extensive mud flats. In addition to tidal forcing from the Gulf of Alaska, the model also includes the effects of stratification, local winds and river runoffs from melting ice. A realistic model of this type can be a useful tool to support research and preservation efforts of the sensitive ecosystem of the Cook Inlet region. The model successfully simulates large amplification of tides and propagation of fast (3-4 m/s) tidal bores over shallow mud flats. The simulated return flows during ebb expose large areas of the mud flats. Satellite images obtained from MODIS were used to evaluate the model results by identifying the location, extent and temporal changes of exposed mud flat regions. In the future, the satellite data will be used to improve the model topography; currently, the detailed topography of the mud flat regions is largely unknown. In the deep channel of the central Inlet, confluence of saline water of the lower Inlet with brackish water from rivers and melting ice from the upper Inlet produces a salinity front with strong vertical circulation cells and surface convergence of currents that resemble observed 'rip tides'.

Oceanography of Glacier Bay: Implications for biological patterns and productivity in a temperate glacial fjord

Lisa L. Etherington¹, Philip N. Hooge², Elizabeth R. Hooge

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U.S. Geological Survey, Alaska Science Center, 1011 E. Tudor Rd., Anchorage, AK 99503

¹ current address: NOAA, Cordell Bank National Marine Sanctuary, P.O. Box 159, Olema, CA 94950, lisa.etherington@noaa.gov

²current address: National Park Service, Denali National Park, P.O. Box 9, Denali Park, AK 99755, <u>Philip Hooge@nps.gov</u>

This study describes the first comprehensive record of the seasonal periodicity and spatial distribution in phytoplankton biomass and oceanographic conditions within the temperate glacial fiord of Glacier Bay, Alaska. Ten years of data indicate that near-surface salinity. temperature, stratification, turbidity and euphotic depth exhibited strong seasonal patterns that appear to be driven by freshwater input that was highest in summer, emphasizing the critical role of glacier and snow melt to this system. We observed oceanographic conditions suggestive of strong competing forces influencing water column stability: high levels of freshwater discharge promoted stratification from spring through fall in the upper fjord, while strong tidal currents over the shallow entrance sill enhanced vertical mixing. Where these two processes met in the central deep basins there was intermediate stratification and higher light levels. These conditions in the central Bay were associated with the highest chlorophyll-a levels. A key finding of our study was that relatively high chlorophyll-a concentrations were sustained throughout the spring, summer, and fall – a pattern that contrasts with classical models of nutrient limited systems and with observed patterns within many mid-latitude systems, fjords worldwide, and Alaska estuaries. Our observations suggest that the hydrographic conditions of Glacier Bay may replenish nutrients to moderately stratified surface waters, which could lead to a highly productive system that fuels an abundance of higher trophic levels. This study represents one of the few long-term, detailed studies of a fjord system within southeast Alaska and its results further our understanding of physical-biological coupling within fjord estuaries.

ACT and Integrated Sensor Systems for Vessels of Opportunity

Mario Tamburri, Alliance for Coastal Technologies, Chesapeake Biological Laboratory tamburri@cbl.umces.edu

To better understand and manage our oceans and coastal systems, there is a clear need for higher resolution spatial and temporal environmental data. While efforts such as the Integrated Ocean Observing System (IOOS) are evolving to provide some of this critical information, recent efforts that take advantage of vessels of opportunity as mobile platforms for environmental data collection have shown great promise. In fact, the installation of self-contained, low-maintenance sensor system modules on commercial vessels has become an important monitoring and scientific tool in many regions. Since several groups around the world have begun to work with integrated sensor packages on vessels of opportunity, the Alliance for Coastal Technologies (ACT) and the National Oceanography Centre, Southampton, UK (NOCS) held a workshop to examine in depth the current state of technology in this area, build consensus on recommendations to improve instrument packages that better address user needs and explore how these systems might become a key component in ocean observing efforts. This presentation will describe the ACT program and summarize the findings and recommendations of this specific workshop.

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Poster: Gulf of Alaska - Climate & Oceanography

Exchange between Prince William Sound and the Gulf of Alaska: Data over an annual cycle

Claude Belanger, Prince William Sound Science Center, belanger@pwssc.gen.ak.us Stephen Okkonen, University of Alaska Fairbanks, <u>okkonen@alaska.net</u>

Prince William Sound (PWS) is a small sub-arctic semi-enclosed sea located along the southern coast of Alaska. It is surrounded by mountains, glaciers, coastal rivers, and numerous bays and fjords, and it is connected to the northern Gulf of Alaska (GOA) via two major passages, Hinchinbrook Entrance (HE) and Montague Strait (MS). Previous studies identified the exchange between the northern GOA and PWS as one of the main physical processes influencing the biology of phytoplankton, zooplankton, and juvenile fish within the sound (Vaughn et al., 2001). Because the magnitude and variability of this exchange were not precisely known, nor was the relative importance of several forcings that could modulate this exchange, an observational program aiming to provide an improved description of the flow through these straits was initiated in June 2005. This program takes cross-strait variability into account, addressing a weakness of the previous observations. An array of moorings instrumented with upward- and downward-looking Acoustic Doppler Current Profilers (ADCPs) at mid-water column depth was deployed in HE and MS and in one of the minor passages (Prince of Wales Passage) in the southwest part of the sound. The moorings were also equipped with conductivity and temperature probes (CTs). This observational program is intended to last for five years. Data from the first annual cycle are presented.

Climate Shift and Ecosystem Differences Observed in Alaskan Ferry Oceanographic Measurements

- E. D. Cokelet, NOAA/Pacific Marine Environmental Laboratory, Edward.D.Cokelet@noaa.gov
- A. J. Jenkins, University of Washington, Joint Institute for the Study of the Atmosphere and Ocean, Antonio.Jenkins@noaa.gov
- W. S. Pegau, Kachemak Bay Research Reserve, scott pegau@fishgame.state.ak.us
- C. W. Mordy, University of Washington, Joint Institute for the Study of the Atmosphere and Ocean, Calvin.W.Mordy@noaa.gov
- M. E. Sullivan, University of Washington, Joint Institute for the Study of the Atmosphere and Ocean, <u>Peggy.Sullivan@noaa.gov</u>

An oceanographic monitoring system aboard the Alaska Marine Highway System ferry F/V *Tustumena* has measured for over two years in the Alaska Coastal Current (ACC). The underway system measures at 4-m depth: (1) temperature and salinity - basic physical variables, (2) nitrate - an essential phytoplankton nutrient, (3) chlorophyll fluorescence - an indicator of phytoplankton concentration, (4) colored dissolved organic matter fluorescence - an indicator of terrestrial runoff, and (5) optical beam transmittance - an indicator of suspended particle concentration.

The ACC temperature was warmer in 2005 than in 2006. The between-year difference at the summer peak was approximately 2Ëš C. Maps show the pattern over 1000 km from Kodiak to Unimak Pass, confirming the differences to be regional. These interannual differences are consistent with longer-term climate variations in the context of the Pacific Decadal Oscillation (PDO), the first principal component of sea surface temperature anomalies in the North Pacific. 2005 is a warm year in the PDO, and 2006 is a cold year. The ferry measurements are capable of detecting a climate signal.

Simultaneous measurements of nitrate and chlorophyll fluorescence show different regimes on the route between Homer and Kodiak. Near Kodiak and Homer, chlorophyll is high and nitrate is low, implying that phytoplankton bloom and deplete nutrients. In the Kennedy and Stevenson Entrances to Shelikof Strait, chlorophyll is low and nitrate is high. This implies that vertical mixing replenishes the nitrate from deeper waters and impedes primary production by cycling phytoplankton cells into low-light conditions below the photic zone.

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The Gulf of Alaska Seward Line - 2005 & 2006

Russell R Hopcroft, UAF, hopcroft@ims.uaf.edu Kenneth Coyle, UAF, coyle@ims.uaf.edu Tom Weingartner, UAF, weingart@ims.uaf.edu Terry Whitledge, UAF, <u>terry@ims.uaf.edu</u>

The Seward Line in the Northern Gulf of Alaska has been the focus of multidisciplinary sampling for 9 years. Here we report on the observations of physical oceanography, nutrients, phytoplankton, and zooplankton over that period. In particular, we compare the patterns during 2005 and 2006 to the prior period, comment on inter-annual variability and consider how events such as El Niño and regime shifts may be impacting this region.

Eddies in the Eastern Gulf of Alaska

Carol Ladd, NOAA/PMEL, carol.ladd@noaa.gov William R. Crawford, IOS, CrawfordB@pac.dfo-mpo.gc.ca W. Keith Johnson, IOS, johnsonk@pac.dfo-mpo.gc.ca Nancy B. Kachel, JISAO, UW, Nancy.Kachel@noaa.gov Phyllis J. Stabeno, NOAA/PMEL, Phyllis.Stabeno@noaa.gov Frank Whitney, IOS, <u>WhitneyF@pac.dfo-mpo.gc.ca</u>

The eastern boundary of the Gulf of Alaska (GOA) spawns numerous, anticyclonic eddies that can persist for years. These eddies influence physical and chemical water properties and biota in the GOA. Three groups of eddies (Haida, Sitka, and Yakutat eddies) are primarily distinguished by their formation regions. A multi-disciplinary, international cruise sampled three such eddies (one from each of the three formation regions) soon after their formation in the spring of 2005. Satellite altimetry, ocean color, and satellite tracked drifter data were used in near real time to direct the sampling, allowing an unprecedented accuracy in sampling the centers of these eddies. Shipboard measurements included temperature and salinity, macronutrients, iron, chlorophyll, and zooplankton observations. Differences between the three eddies are significant and appear to reflect differences in formation region and mechanism.

The Wind Field over the Northeast Gulf of Alaska Shelf: A QuikSCAT Perspective

Megan Wolfe, Thomas Weingartner, and Seth Danielson

Institute of Marine Science, University of Alaska, Fairbanks, AK 99775 m.wolfe@sfos.uaf.edu

The wind field over the Northeast Gulf of Alaska shelf is poorly known given the complex coastal orography, remote setting, and scarcity of direct observations. We used the twice daily, 25 km resolution winds estimated by the scatterometer aboard the OuikSCAT satellite between July 1999 and April 2006 to construct a wind field climatology for the Northeast Gulf. The along-shelf winds are downwelling-favorable year-round but maximal in winter and minimal in summer. Over the British Columbian shelf, however, winds are upwelling favorable in summer implying along-shelf divergence in the wind field over Southeast Alaska. From September through April, the along-shelf winds have a jet-like structure with maximum winds typically occurring within 75 km of the coast. This jet-like structure is a reflection of the barrier jets that can develop throughout the year but most frequently between September and April. Alongshelf de-correlation space and time scales are ~ 1000 km and 3 days, respectively and these scales are similar throughout the year. We find only a weak correlation between upwelling indices estimated from scatterometer winds with those computed by the Pacific Fisheries Environmental Laboratory using forecast models, suggesting that the latter may not be a good proxy of along-shelf wind variability for the Gulf of Alaska.

Wednesday, 24 January 2007 9:30 - 11:00 AM Session Chair and Poster Review: Kenneth Coyle

TALKS

Speaker	Title
Kenneth Coyle	Calibration of a nutrient - phytoplankton - zooplankton model for use with
	a three dimensional physical model to simulate ecological mechanisms on
	the northern Gulf of Alaska shelf
Jon Houghton	Rocky Intertidal Benthos in Iniskin/Iliamna Bay - a 28-Year Baseline and
	Hints of Climate Change?
Nick Harman	Role of Grazers in the Recolonization of Hard Bottom Communities in
	Kachemak Bay, Alaska
Dennis Lees	Clams And Armor: Were They Casualties of the War on the Beaches?

POSTERS

First Author	Title
Sonja Batten	Zooplankton populations on the Alaskan Shelf and northern Gulf of
	Alaska
Ben Daly	Temporal and Spatial Variability of Nearshore Crab Larvae
Don Field	Remote Sensing of Seagrass Resources in Kachemak Bay, Alaska
Cail Invino	Development and Testing of a Probability-based Intertidal Monitoring
Gail Irvine	Scheme for Sitka National Historic Park, Alaska
Mandy Lindeberg	www.seaweedsofalaska.com - a photo-rich portal to the taxonomy of
	Alaskan seaweeds and their habitats
Courtney Lyons	Community structuring impacts of Enteroctopus dofleini in Prince
	William Sound, Alaska
Jeffrey Napp	Autonomous Zooplankton Sampling for Ocean Observing Systems.

Calibration of a nutrient - phytoplankton - zooplankton model for use with a three dimensional physical model to simulate ecological mechanisms on the northern Gulf of Alaska shelf

K. O. Coyle, Institute of Marine Science, University of Alaska, coyle@ims.uaf.edu S. Hinckley, Alaska Fisheries Science Center/NMFS, Sarah.Hinckley@noaa.gov A. J. Hermann, Joint Institute for the Study of the Atmosphere and Ocean,

University of Washington, <u>Albert J.Hermann@noaa.gov</u>

The GLOBEC program recently completed a seven-year study of the oceanography and ecology on the northern Gulf of Alaska shelf. The GLOBEC long-term observation program (LTOP) collected oceanographic and biological observation along the Seward line during six cruises per year from 1998 through 2004. The North Pacific Research Board has continued support for the LTOP program, permitting collection during two cruises per year in 2005 and 2006. To aid in understanding the mechanistic link between the physical forcing and ecosystem response, an eleven-box ecological model has been developed and embedded into a three-dimensional physical model simulating currents and density fields on the shelf. To insure that the ecological model accurately reflects conditions on the shelf as measured by the LTOP program, model simulations have been generated and compared with actual measurements of phytoplankton, microzooplankton and mesozooplankton biomass done by LTOP. Initial comparisons of model results with LTOP measurements are presented, to illustrate our progress to date in tuning the model to simulate conditions on the northern Gulf of Alaska shelf. Future simulations using the fully parameterized 3-dimensional model will aid in understanding and quantify the potential effects of climate change on the northern Gulf of Alaska ecosystem.

Rocky Intertidal Benthos in Iniskin/Iliamna Bay: A 28-Year Baseline and Hints of Climate Change?

Jon Houghton, Pentec Environmental/Hart Crowser, Inc., jon@pentecenv.com Dennis Lees, Littoral Environmental and Ecological Services, dennislees@earthlink.net Sandra Lindstrom, University of British Columbia <u>sandrcl@telus.net</u>, and Jason Stutes, Pentec Environmental/Hart Crowser, Inc. <u>jason.stutes@pentecenv.com</u>

Littoral habitats in lower Cook Inlet represent important areas of diversity and productivity that support numerous species of ecological and economic importance. In addition, some species present appear to be relict arctic biota and have further importance in a biogeographical context. This study describes benthic marine flora and fauna in Iniskin and Iliamna bays based on work conducted by the authors over the last 28 years. Two stations sampled in recent (2004-2006) work were identical in location to those sampled under other programs during the late 1970s and in 1996, thus providing a substantial historical perspective. A stratified random approach was used to characterize biota at each of three elevations (upper, middle, lower) at seven rocky stations. The area experiences winter icing that severely impacts at least upper and middle intertidal rocky assemblages. Data from 1978 and 1996 showed a high degree of stability in upper and middle intertidal rocky assemblages. Upper zones were dominated by seasonal growths of barnacles with longer-lived species such as rockweed relegated to sheltered crevices. The middle elevation was strongly dominated by red algae that regenerate from holdfasts each spring. However, in 2004 there was a remarkable increase in rockweed, a perennial poorly suited to withstand icing. This suggested a reduced ice stress that allowed greater development of rockweed. In 2005, the red algae regained dominance at one site while rockweed remained co-dominant at the other. Implications of this and other patterns are discussed in the context of regional climate patterns.

Role of Grazers in the Recolonization of Hard Bottom Communities in Kachemak Bay, Alaska

Nick Harman, University of Alaska Fairbanks, ftnwh@sfos.uaf.edu

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Constant disturbance by storms and grazing in kelp forests causes patchiness. Recruitment and survivorship are important factors in the recolonization of these patches. Grazers can have damaging effects on sessile assemblages by feeding on macroscopic life stages of sessile organisms. However, grazing may also inhibit the recruitment and growth of microscopic life stages of sessile organisms, possibly hindering the development of mature assemblages. A comparative caging experiment was used to determine if grazing by macrograzers (larger than 2.5 cm) has a significant effect on substrate recolonization by sessile organisms in understory kelp beds in Kachemak Bay, Alaska. Barnacle recruitment was high in 2005; cover reached approximately 80% on caged treatments, and significant differences between treatments were apparent. From mid-summer to early fall large aggregations of the dorid nudibranch Onchidoris bilamellata were observed feeding on barnacles, reducing cover to 0% in many instances. This experiment was repeated in 2006 with contrasting results; barnacle cover reached approximately 40% on caged treatments, and no Onchidoris bilamellata were observed at any study site. These data suggest that although grazing did not inhibit recruitment of sessile organisms in 2005, predatory grazers did have a significant impact on the survivorship of sessile recruits, which could ultimately impact recolonization of the substrate. However, predatory grazers were absent and thus had no effect on recruitment or survivorship in 2006, which suggests high interannual variability in this system.

Clams and Armor: Were They Casualties of the War on the Beaches?

Dennis Lees, Littoral Ecological & Environmental Services, dennislees@earthlink.net William Driskell, <u>bdriskell@comcast.net</u>

NOAA treatment effects studies from 1989 through 1997 suggested that bivalve assemblage on beaches in Prince William Sound treated with high-pressure washing were severely injured in terms of abundance, species composition, and function. In 2002, we assessed the generality and persistence of this apparent injury to this assemblage. We found that the initial conclusions were accurate, indicating that a considerable proportion of mixed-soft beaches in treated areas of the sound remain extremely disturbed. Moreover, these beaches are functionally impaired in terms of their ability to support foraging by humans and nearshore vertebrate predators such as sea otters. Large, longlived hard-shell clams remained 66% less abundant at washed sites than at oiled-butunwashed sites. We found that standard sediment properties did not appear implicated in lagging recovery. But, based on several lines of evidence, we deduced that a major cause for the delay was disruption of surface armoring (stratified organization of mixed-soft shoreline sediments common in southcentral Alaska) by beach washing. Based on the apparent recovery trajectory, we predict that recovery to pre-spill status will take many years. We also concluded that biota living in armored beaches is richer and more mature than one would predict based on median grain size alone.

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Zooplankton populations on the Alaskan Shelf and northern Gulf of Alaska

Sonia Batten, Sir Alister Hardy Foundation for Ocean Science, soba@sahfos.ac.uk

The Continuous Plankton Recorder has sampled the Alaskan shelf and Gulf of Alaska on a seasonal basis since 2000, crossing the Alaskan Coastal Current and Alaska Stream at 3 locations; south of Prince William Sound (2000-2003), south of Cook Inlet (2004-2006) and through Unimak Pass (2000-2006). Interannual variability in mesozooplankton biomass has been large through this time period (up to a factor of 7) and the different regions have different standing stocks of zooplankton. Although not all transects have been sampled for the same time period there is evidence of synchrony in biomass changes across the region; 2005 saw the highest measured biomass of the time series in each region. The synchrony occurs in both shelf and oceanic areas south of Cook Inlet and Prince William Sound, suggesting links between the Gulf of Alaska and the adjacent shelf, as well as links through the coastal and shelf edge current system. This presentation will also examine zooplankton community composition in each shelf and Gulf of Alaska region.

Temporal and Spatial Variability of Nearshore Crab Larvae

Ben Daly, School of Fisheries and Ocean Sciences, University of Alaska Fairbanks, 245 O'Neill Bldg. P.O. Box 757220 Fairbanks, Alaska 99775-7220, daly@sfos.uaf.edu

Brenda Konar. Global Undersea Research Unit, University of Alaska Fairbanks, 217 O'Neill Bldg. P.O. Box 757220 Fairbanks, AK 99775-7220 <u>bkonar@guru.uaf.edu</u>

Larval crab distribution exhibits temporal and spatial variation. Seasonality and the potential effects of habitat on spatial distribution are poorly understood for most crabs, especially non-commercially important species. Documenting larval crab distribution in time and space is a critical step in understanding dispersal patterns and population connectivity. This study will: (1) compare temporal variability between species in the zoeal and megalopa stages and (2) compare habitat use between species over time regardless of larval stage. Nine sites of varying complexity in Kachemak Bay, Alaska were surveyed monthly from June 2005 to September 2006 to measure habitat variables and quantify larval crabs. Temporal and spatial distribution was variable between species. Differences in temporal variability were probably due to species specific tolerances to various physical and biological variables. Spatially, highest abundances were seen in habitats with less structural complexity. Kelp densities suggested that spatial differences were likely due to physical transport mechanisms and not biotic influences. Temporal and spatial distribution of larval crabs was driven by multiple environmental factors and must be addressed on an individual species level.

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Poster: Gulf of Alaska - Lower Trophic Levels

Remote Sensing of Seagrass Resources in Kachemak Bay, Alaska

Don Field, NOAA Center for Coastal Fisheries and Habitat Research, <u>Don.Field@noaa.gov</u> Kris Holderied, NOAA Kasitsna Bay Lab, <u>Kris.Holderied@noaa.gov</u> Mark Fonseca, NOAA Center for Coastal Fisheries and Habitat Research, Mark.Fonseca@noaa.gov

Seagrass is an essential fish habitat for many species of marine and estuarine fish and shellfish, and is a trust resource for the National Oceanic and Atmospheric Administration (NOAA). Eel grass (Zostera marina), a species of seagrass, is found throughout many areas of Kachemak Bay and the embayments that surround it. Previous helicopter mapping surveys provided some indication of seagrass occurrence in the bay, but a mapping exercise specifically focused on delineating its distribution and abundance has never been undertaken. In response to this management need, a remote sensingbased mapping effort was initiated in 2005. This survey was part of a larger cooperative effort being undertaken by the NOAA Center for Coastal Fisheries and Habitat Research (CCFHR) in Beaufort, NC, the NOAA Kasitsna Bay Lab and the Kachemak Bay National Estuarine Research Reserve (KBNERR). In the summer of 2005, 1:24,000 color aerial photographs were collected for areas of known seagrass occurrence in the Kachemak Bay area. The photos were obtained at low tide, under excellent atmospheric condition, and with no clouds. The photos were scanned to a one-meter resolution and processed to provide the data in digital orthophoto quads (DOOs). During the summer of 2005, the investigators also used underwater video, coupled with Differential Global Positioning System (DGPS) technology, to collect ground data to aid in delineating intertidal, and where possible, subtidal seagrass and algal communities. Imagery and the preliminary results from this study are presented, with suggestions for future work.

Development and Testing of a Probability-based Intertidal Monitoring Scheme for Sitka National Historic Park, Alaska

Gail V. Irvine, USGS-Alaska Science Center, gail irvine@usgs.gov

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Intertidal zones, a habitat bridging terrestrial and marine ecosystems, are vulnerable to effects from humans, as was well-demonstrated by the Exxon Valdez oil spill (EVOS). Following the EVOS, the National Park Service (NPS) and other agencies in Alaska became interested in being able to detect changes occurring within these highly productive habitats, including having the ability to separate anthropogenic-induced changes from naturally occurring variation. In 1999, in conjunction with the NPS, I began design of an intertidal monitoring protocol for Sitka National Historic Park (NHP) that was adapted from a design I had developed for Glacier Bay National Park and Preserve (NP&P). The huge disparity in the sizes of the parks and the lengths of their coastlines drove the changes. At Glacier Bay NP&P there are 25 sites, at Sitka NHP, the entire intertidal of the park is viewed as one site. The basic design at Sitka has involved: 1) defining the sampling unit, 2) sampling sessile species via point counts along 15 'vertical' transects, 3) sampling select large mobile invertebrates via band surveys, and 4) sampling small mobile invertebrates via quadrat sampling set along the vertical transects. Sampling was also conducted in 2002 and 2003. Trends in the predominant species were examined and then power analyses were conducted to determine whether the design had the ability to detect prescribed levels of change. Details of the design and power analyses are presented here.

www.seaweedsofalaska.com - A photo-rich portal to the taxonomy of Alaskan seaweeds and their habitats

Mandy Lindeberg, Auke Bay Laboratories Alaska Fisheries Science Center NOAA/NMFS, Mandy.Lindeberg@noaa.gov Sandra Lindstrom, University of British Columbia, sandracl@interchange.ubc.ca Susan Saupe, Cook Inlet RCAC, Saupe@circac.org

SeaweedsofAlaska.com has been developed to complement and aid ongoing habitat mapping and research in the coastal areas of Alaska. The website provides a searchable taxonomic database linked to dynamic web pages. Imagery includes Alaskan seaweeds in their natural habitats, herbarium specimens, and photomicrographs. Baseline information covers taxonomic classification and geographic distribution. At present, 125 species commonly encountered in coastal Alaska are represented. More species will be added as the site is developed, and detailed descriptions for these species are being solicited. Additional site information includes maps, descriptions of the regions, and examples of coastal habitat classifications. Through multiple partnerships and sponsorship by the Cook Inlet Regional Citizens Advisory Council, this website will serve as a valuable resource for researchers studying the nearshore of Alaska and complement other online database.

Community structuring impacts of *Enteroctopus dofleini* in Prince William Sound, Alaska

Courtney Lyons, Alaska Pacific University, courtney.lyons@gmail.com David Scheel, Alaska Pacific University, dscheel@alaskapacific.edu Leslie Cornick, Alaska Pacific University, lcornick@alaskapacific.edu Roman Dial, Alaska Pacific University, <u>roman@alaskapacific.edu</u>

The role of *Enteroctopus dofleini* on community structure, represented by taxa abundance, richness and Berger-Parker Index (unevenness) and the extent to which it is a generalist predator were assessed. Surveys quantifying benthic epifauna, octopus density and midden contents were conducted at two beaches, one with low octopus density (due to human harvest) and one with unreduced octopus density (control site). Live prey was also fed to a captive octopus to determine prey handling time. Habitat characteristics and octopus diets did not differ between sites. Epifaunal analyses were performed on several data subsets- all taxa, crab taxa only, non-crab taxa, dietary taxa, non-dietary taxa and grazers. Significant differences existed between sites in crab taxa: abundance and richness decreased while unevenness increased at the control site with inversed patterns at the octopus harvest site. Grazer abundance, richness and Berger-Parker Index were also significantly higher at the control site. In addition, laboratory experiments indicated that size was the best predictor of prey handling time. Results support the hypothesis that octopuses act as top-down controls on community structure creating a trophic cascade through specialist predation on crabs.

Autonomous Zooplankton Sampling for Ocean Observing Systems

Jeffrey M. Napp, NOAA-Alaska Fisheries Science Center, Jeff.Napp@NOAA.gov. D.Van Holliday, BAESystems, Van.Holliday@BAESystems.com Charles F. Greenlaw, BAESystems, Charles.Greenlaw@BAESystems.com Phyllis J. Stabeno, NOAA-Pacific Marine Environmental Laboratory, Phyllis.Stabeno@NOAA.gov

Continuous operation of autonomous instrumentation is essential for implementation of the U.S. Integrated Ocean Observing System in Alaska (AOOS). A multi-frequency acoustical sensor, appropriate for the size-abundance estimation of zooplankton from ca. 0.25 mm to > 25 mm total length, was successfully deployed and recovered during three sequential summers from a Gulf of Alaska biophysical shelf mooring. The instrument package autonomously sampled a single depth in the upper water column every 24 minutes in 2002 for >130 days, every 20 minutes in 2003 for >113 days, and every 20 minutes in 2004 for > 142 days. Volume backscattering strengths (Sv) revealed significant, interannual differences in the sound scattering. In spring of 2002 we observed the highest biovolume of all three years; total biovolume was similar in the spring of 2003 and 2004, but was distributed differently among copepod-like and euphausiid-like scatterers. Within a single year, 2004, we observed both an increase in biovolume and the presence of a wider range of sizes when comparing April and August data. The same instrument was deployed on the Bering Sea shelf in the summer of 2006 with real-time data transmission. Successful autonomous operation of acoustical instruments for estimation of zooplankton size and abundance and optic size and biomass for phytoplankton will be crucial for observing this often under-sampled element in remote locations such as the Bering Sea and Gulf of Alaska.

Gulf of Alaska Fish & Fish Habitat

Wednesday, 24 January 2007 11:00 AM - 2:15 PM Session Chair and Poster Review: Brenda Norcross

TALKS

Speaker	Title
Brenda Norcross	A model of early life history survival for Pacific herring in Prince William
	Sound
Elizabeth	Distribution and feeding ecology of juvenile walleye pollock and capelin
Logerwell	in the Gulf of Alaska
Soon Doword	Assessing residence time and habitat use of coho and sockeye salmon in
Sean Powers	Alaska estuaries
Drage Finney	Effects of Marine Derived Nutrients on Biological Production in Sockeye
Bruce Finney	Salmon Systems
Gregg Rosenkranz	Machine Vision Benthic Imaging in the Gulf of Alaska
Julie Nielson	Using a synthetic aperture acoustic telemetry method to determine the
	location, timing and spatial aggregation of female Tanner crabs during
	reproductive events
John Harper	The ShoreZone Coastal Dataset as a Research Tool
Matthew Berman	Spatial Fisheries Values in the Gulf of Alaska

POSTERS

First Author	Title
William Bechtol	Three-Stage Catch Survey Analysis of Kodiak Red King Crab
,	Diet and trophic ecology of skates in the Gulf of Alaska (Raja and
David Ebert	Bathyraja spp.): ecological information for ecosystem-based management
	of demersal resources
	Life History and Population Dynamics of Alaskan Skates: Providing
David Ebert	Essential Biological Information for Effective Management of Bycatch
	and Target Species
Dowonne Elinn	Spatial and temporal variation in Steller sea lion prey: Using modeled
Rowenna Finn	oceanographic data to create seasonal prey distribution maps
Scott Gallager	Development of an Optical Image Database and Processing Tools for
	Automated Classification of Benthic Habitat and Enumeration of
	Commercially Important Scallop Stocks
Richard Gustafson	Small Mesh Trawl Surveys in Kachemak Bay, Alaska

Gulf of Alaska Fish & Fish Habitat

POSTERS (continued)

First Author	Title
Jodi Harney	Modeling habitat capability for invasive species using the ShoreZone
	mapping system
Ron Heintz	The Influence of Adult Salmon Carcasses on Energy Allocation in Dolly Varden Char
	Polybrominated diphenyl ethers (PBDEs) in sediments and biota in a
Lisa Hoferkamp	pristine Southeast Alaska watershed and near a municipal waste landfill, Juneau, Alaska
	Nearshore Fish and Invertebrate Assemblages in Iniskin/Iliamna Bay,
Jon Houghton	Lower Cook Inlet
Deter Hulcon	Estimation of Temporal Variation in Maturity-at-age of Pacific herring
Peter Huison	(<i>Clupea pallasi</i>) in Sitka Sound, Alaska
Scott Johnson	Integration of a Nearshore Fish Atlas in Alaska with ShoreZone Coastal
	Mapping: an Interactive Website
Coatt Johnson	Seasonal Distribution and Habitat Use of Forage Fish in Nearshore Waters
Scott Johnson	of Prince William Soun
	Preliminary evaluation of geographic structure and cohort variation of
L. Kamin	Alaskan Pacific ocean perch (Sebastes alutus) from microsatellite
	variation.
	Arrowtooth flounder Atheresthes stomias diet and prey consumption near
Brian Khoun	Kodiak Island, Alaska
Dulan Lanaa	Restoration of Essential Fish Habitat in Coastal Alaska Using Artificial
Brian Lance	Reefs: A Demonstration Project
T1 Mauleia	Structure of nearshore fish assemblages in relation to varying levels of
Joel Markis	habitat complexity
Many Mania	Update on ShoreZone Mapping in Alaska, British Columbia, and
wary worns	Washington
Bonita Nelson	Effect of Habitat on Forage Fish Condition in Prince William sound
TalOtia	Temporal Stability in the Fatty Acid Composition of Herring from
Ted Otis	Different Stocks
Concline Denode	Hindcasting walleye pollock recruitment and examining pollock stock
Carolina Parada	structure in the Gulf of Alaska using a biophysical model
Joel Rice	On the Use of Bycatch Data for Stock Assessment: A Case Study of Spiny
	Dogfish (Squalus acanthias) in Alaska.
Chris Rooper	Characterizing Trawlable and Untrawlable Substrate Using Single Beam
	Echo Sounder Data to Improve Estimation of Commercial Groundfish
	Abundance
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Gulf of Alaska - Fish & Fish Habitat

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POSTERS (continued)

First Author	Title
Clifford Ryer	Moving toward a process-based understanding of essential fish habitat in
	juvenile flatfish nurseries
Cindy Tribuzio	Preliminary results of a demographic analysis of spiny dogfish in the Gulf
	of Alaska
Emily Waschak	An Analysis of Larval Survival Rates and Maternal Parameters for the
	Deepwater Rockfish Species Pacific Ocean Perch, Sebastes alutus, in the
	Gulf of Alaska.
Mark Willette	Improving Preseason Forecasts of Kenai River Sockeye Salmon Runs
	through Salmon Smolt Monitoring: Technology Development
Andreas Winter	Testing the feasibility of walleye pollock live-capture for tagging surveys
A model of early life history survival for Pacific herring in Prince William Sound

Brenda Norcross, Seanbob Kelly, Terrence Quinn, II, and Peter-John Hulson School of Fisheries and Ocean Sciences, University of Alaska Fairbanks, <u>norcross@ims.uaf.edu</u>

Using published data, we integrated information about survival and its uncertainty in egg, larval and juvenile life stages into a mathematical model to characterize the early life history of Pacific herring (*Clupea pallasii*). The early life history model predicted survival after the first year to be 118 herring out of one million eggs, with a 95% confidence interval of (5, 2,822). Our modeling efforts support Hjort's concept of mortality in the larval stages as the most 'critical period' in determining year-class strength of herring fisheries. Estimates of survival of the egg stages, fall juvenile stage and winter juvenile stage were two orders of magnitude greater than the survival of the larvae stage. A single-stage sensitivity analysis demonstrated that the largest influence on total survival was daily mortality in the larval stage. An interaction sensitivity analysis of all possible paired life stages showed that the combination of the egg stage with the larval life stage contributed the most to total survival. Environmental processes, including food availability, water temperature, and transport processes, are key factors in the larval stage.

Distribution and feeding ecology of juvenile walleye pollock and capelin in the Gulf of Alaska

Elizabeth Logerwell, Janet Duffy-Anderson, and Matthew Wilson NOAA/Alaska Fisheries Science Center, <u>libby.logerwell@noaa.gov</u>

We present information on the effects of local hydrography on the distribution and feeding ecology of two key forage species in the GOA, juvenile walleye pollock and capelin. In 2005, a research cruise was undertaken in Barnabus Trough, east of Kodiak Island. Similar to previous years (2002 and 2004), physical oceanographic sampling indicated a mid-trough front separating two different water masses. Also similar to previous years, the distribution of fish was different in the two water masses. Mixed schools of age-0 pollock and capelin where found offshore in cool, high-salinity water, and capelin (mixed with jellyfish) were predominant inshore in warmer, low-salinity water. Diet analyses indicate that age-0 pollock consumed primarily euphausiids and large copepods offshore, while capelin consumed mostly small calanoid copepods and larvaceans inshore and offshore. Euphausiids are an energy-rich prey taxa, and capelin have been previously demonstrated to readily consume euphausiids in the GOA. As such, why were euphausiids not a larger component of the diets of capelin offshore, and why were some capelin distributed inshore and feeding on small copepods? One hypothesis is that euphausiids, although presumably more abundant offshore, were more patchily distributed than small copepods, making offshore waters less reliable feeding areas for capelin. Consistent with this hypothesis, 14% of the capelin offshore had empty stomachs, whereas only 5% of capelin inshore had empty stomachs. Further analyses of diet data and zooplankton net tow data will be used to interpret the patterns in fish distribution and diet we have observed.

Assessing residence time and habitat use of coho and sockeye salmon in Alaska estuaries

Sean Powers, Department of Marine Science,

University of South Alabama and the Dauphin Island Sea Lab, spowers@disl.org; Mary Anne Bishop, Prince William Sound Science Center, mbishop@pwssc.gen.ak.us Gordon Reeves, Pacific Northwest Research Station, US Forest Service & Dept. Fisheries & Wildlife, Oregon State University

Substantial variability in the early life history and migratory behavior of coho (Oncorhynchus kisutch) and sockeye (Oncorhynchus nerka) salmon exist on both local and regional scales. For both species, juveniles have been found in estuaries as age 0 fry. 0+, 1, and 1+ year-old smolts. Once in the estuary, an area seldom studied in regards to salmon, residence time is highly variable (days to months) and is probably correlated to the age of outmigration (i.e. longer residence has been reported for age 0 salmon). We quantified estuarine residence time of coho and sockeye salmon using traditional fisheries sampling (mid-water trawls, fyke nets and seine samples) and microchemical analysis of strontium concentration in otoliths of juvenile and adult coho and sockeye within the Copper River Delta. Our project demonstrated the usefulness of the latter technique in examining the duration of freshwater, estuarine and marine residence time. Overall, there was general agreement between results of the intensive field collections and otolith chemical signatures with respect to estuarine residence time. Both techniques indicated a relatively brief period in estuarine waters (10-45 day, average 30 days) for both species. Because estuarine habitats are critical for osmoregulatory adjustment to marine waters and offer rich foraging opportunities for smolt, estuarine habitats represent essential habitat for salmonid fisheries. Consequently, alteration or degradation of these habitats resulting from natural (e.g., tectonic activity, climate regime shifts) or anthropogenic perturbations (e.g., oil spills, coastal development) may have serious consequences for sustainable harvest of salmonids.

Effects of Marine Derived Nutrients on Biological Production in Sockeye Salmon Systems

Bruce Finney, Institute of Marine Science, University of Alaska Fairbanks, finney@ims.uaf.edu
Terry Whitledge, Institute of Marine Science, University of Alaska Fairbanks, terry@ims.uaf.edu
Dean Stockwell, Institute of Marine Science, University of Alaska Fairbanks, dean@ims.uaf.edu
Switgard Duesterloh, Alaska Department of Fish and Game, Kodiak, AK, switgard_duesterloh@fishgame.state.ak.us
Steven G. Honnold, Alaska Department of Fish and Game, Kodiak, AK, steve_honnold@fishgame.state.ak.us
Steve Thomsen, Alaska Department of Fish and Game, Kodiak, AK, steve thomsen@fishgame.state.ak.us

Marine-derived nutrients (MDN) transported by salmon into freshwaters when they return to spawn may be an important control on salmon production. Thus, feedbacks between escapement, aquatic productivity and subsequent salmon production may be influenced by climate and commercial fishing. This EVOS/GEM project was developed to examine the role of MDN in lake productivity by integrating studies of nutrient cycling, primary productivity, zooplankton, juvenile sockeye and stable isotopes. Karluk Lake (Kodiak Island, AK), with a large natural population of returning sockeye, is compared to nearby control Spiridon Lake, which is stocked annually with juvenile sockeye, but without access for returning adults. Detailed, contemporaneous sampling of the water column was conducted 8 times/year throughout the growing season from 2004-2006. Two lake and two river stations were sampled from each system for temperature, nutrients, chlorophyll, zooplankton biomass/species composition, etc. In addition, the primary productivity rate of each lake was measured, as well as ¹³C and ¹⁵N stable isotope ratios of phytoplankton, periphyton, zooplankton and smolts. Significantly higher levels of total phosphorus, chlorophyll a, primary productivity and zooplankton biomass are observed in Karluk relative to Spiridon. Average ¹⁵N values for phytoplankton, zooplankton and sockeye smolts are >4 o/oo higher in Karluk than Spiridon. Nutrients, productivity and biota ¹⁵N in Karluk have larger seasonal variability with peaks in spring and late-summer. The enhanced plankton biomass and productivity in the anadromous system, coupled with ¹⁵N enrichment in biota and differing seasonal patterns, are consistent with the positive influence of MDN on productivity.

Machine Vision Benthic Imaging in the Gulf of Alaska

Gregg Rosenkranz, Alaska Department of Fish and Game, gregg_rosenkranz@fishgame.state.ak.us

The Alaska Department of Fish and Game has been exploring imaging techniques for weathervane scallop (*Patinopecten caurinus*) stock assessment since 2000. The latest generation of equipment is patterned after the Habcam system developed at Wood's Hole Oceanographic Institution and employs a machine vision camera and strobe lighting mounted on a towed sled. Image data are streamed to the towing vessel over single mode optical fiber using off-the-shelf gigabit ethernet hardware. The equipment was deployed during a recent survey of scallop beds in the eastern Gulf of Alaska at depths 50-110 m. This talk is intended to introduce new imaging technology and ongoing data processing work to Alaska oceanographic researchers.

Using a synthetic aperture acoustic telemetry method to determine the location, timing and spatial aggregation of female Tanner crabs during reproductive events

Julie Nielsen, USGS/UAF, jnielsen@uaf.edu Jim Taggart, USGS, jim_taggart@usgs.gov Tom Shirley, Texas A&M University, <u>Thomas.Shirley@tamucc.edu</u>

Adult female Tanner crabs exhibit extreme aggregation and mounding associated with larval hatching at one location near Kodiak, Alaska. We hypothesized that adult female Tanner crabs in Glacier Bay, Alaska exhibit a similar degree of aggregation. We attached sonic tags to 50 adult female Tanner crabs in Glacier Bay and located them throughout the winter and spring to determine whether tagged crabs aggregate during larval hatching. We used a new acoustic telemetry technique (Synthetic Aperture Positioning System by Lotek Wireless) to estimate positions for large numbers of tagged animals with 20 m accuracy using towed hydrophones. We tracked tagged crabs every 8 weeks from October through February and every 2 weeks between March and the end of May. To determine the timing of larval hatching and clutch extrusion we captured adult females in pots during the spring tracking trips. Beginning in March, tagged crabs began to concentrate at several locations at depths of 100 - 150 m. Aggregation of tagged crabs was greatest, though never extreme, when larval hatching was first observed. After the onset of larval hatching, many tagged crabs made rapid movements to shallower waters where crabs with newly-extruded clutches were captured. At the end of the study, tagged crabs were spreading out and returning to deeper waters. Although we observed aggregation of tagged crabs at the time of larval release, it occurred at a much larger scale than was observed in Kodiak. After spawning, crabs may move to shallow waters to mate before returning to deep water.

The ShoreZone Coastal Dataset as a Research Tool

John Harper, Coastal and Ocean Resources Inc., john@coastalandoceans.com Jodi Harney, Coastal and Ocean Resources Inc., jodi@coastalandoceans.com Neil Borecky, Coastal and Ocean Resources Inc., neilb@coastalandoceans.com Mary Morris, Archipelago Marine Research Ltd., marym@archipelago.ca Susan Saupe, Cook Inlet Regional Citizens Advisory Council, saupe@circac.org Mandy Lindeberg, NOAA/NMFS Auke Bay Lab, mandy.lindeberg@noaa.gov K Koski, The Nature Conservancy, <u>kkoski@tnc.org</u>

The ShoreZone coastal dataset presently includes more than 12,000 km of Gulf of Alaska coastline, with an additional 13,000 km of mapping in progress and at least 6,000 km of aerial imaging surveys planned for 2007. The entire coastline of British Columbia $(\sim 40.000 \text{ km})$ and Washington state $(\sim 5.000 \text{ km})$ have previously been mapped using the ShoreZone technique. While there are gaps, funded and proposed programs will largely fill these gaps during the next five years, resulting in a contiguous, continental-scale dataset for nearshore and coastal research that extends from the Columbia River mouth to Bristol Bay (nearly 100,000 km of shoreline). Research applications of the coastal database include habitat capability modeling, three example of which are presented: (a) herring spawning potential model, (b) Pacific sand lance spawning potential model, and (c) nearshore habitat complex model. The herring model is based on a comparison of 27 vears of historical spawning observation maps to 5,000 km of ShoreZone mapping data in BC. The Pacific sand lance model is based on a combination of expert knowledge and the correlation between mapped spawn sites and ShoreZone data. The nearshore habitat model is based on expert knowledge only. The application of ShoreZone data to the NOAA Fish Atlas is also reviewed. Habitat capability models are powerful spatial resource management tools, particularly for nearshore fisheries (such urchin harvesting quotas of British Columbia).

Spatial Fisheries Values in the Gulf of Alaska

Matthew Berman, Institute of Social and Economic Research, University of Alaska Anchorage, matthew.berman@uaa.alaska.edu

Edward Gregr, Marine Mammal Research Unit, University of British Columbia, gregr@zoology.ubc.ca

Gaku Ishimura, Fisheries Economics Research Unit, University of British Columbia, g.ishimura@fisheries.ubc.ca

Rowenna Flinn, Marine Mammal Research Unit, University of British Columbia, r.flinn@fisheries.ubc.ca

We develop methods to estimate spatial variation in economic values of ocean fisheries, and apply the methods to groundfish fisheries in the Gulf of Alaska. The research addresses two related objectives: (1) explicitly link spatial variability of fisheries biomass and values over time to environmental variables; and (2) develop the ability to estimate the opportunity cost to the fishing industry of time and area closures at scales relevant to management decisions. The approach involves two stages of statistical analyses. First, we associate catch per unit of effort (CPUE), derived from biomass surveys and fisheries data, with a set of environmental variables at a detailed spatial scale (3km grid) and short time step (2 wks). Environmental variables include bathymetry, remotely sensed physical and biological observations, and output of a modeled physical oceanography. Second, we explain variation in the location and intensity of fisheries effort over time as a function of predicted CPUE and spatial regulatory and cost factors. The improvement on methods to estimate time-varying opportunity costs of spatial fisheries closures has direct applications to management, such as for evaluating proposed boundary changes of marine protected areas or effects of environmental contamination. The research also has implications for projecting spatial fishery effects of climate variability and change, as a step toward dynamic spatial models linking fisheries with ecosystems.

Three-Stage Catch Survey Analysis of Kodiak Red King Crab

William R. Bechtol and Gordon H. Kruse, University of Alaska Fairbanks, JCSFOS, <u>ftwrb2@uaf.edu</u>, gordon.kruse@uaf.edu

Waters around Kodiak Island in the central Gulf of Alaska once supported the world's largest fishery for red king crab (Paralithodes camtschaticus). The fishery exhibited low-level harvests in the 1950s. However, annual landings increased rapidly in the 1960s to a peak harvest of 42,800 mt (94.4 million lb) in 1965. Stock abundance declined dramatically in the late 1960s, and again in the early 1980s, and a commercial fishery closure since 1983 has not resulted in stock recovery. The failure of this crab resource to recover remains a mystery. Our project goal is to use numerical modeling in a retrospective analysis to understand the conditions surrounding the rise, collapse, and failure to rebuild of the red king crab stock around Kodiak Island. Specific objectives are to: (1) reconstruct king crab spawning stock abundance and recruitment over 1960 to present; (2) explore potential stock-recruitment relationships; and (3) analyze temporal changes in the stock biogeography with respect to oceanographic conditions, ecological factors, and historical harvests. A stock synthesis model incorporating a variety of data will ultimately be developed. As an interim step, here we describe a three-stage catchsurvey analysis (CSA) using fishery data for 1972 to 1983, pot survey data for 1972 to 1985, and trawl survey data for 1985 to 2004. Carapace length is used to assign male crabs as pre-recruits, recruits, or post-recruits. An analogous female model was developed with 'recruits' as females that mature in the current year. Model results and future research plans are discussed.

Diet and trophic ecology of skates in the Gulf of Alaska (*Raja* and *Bathyraja* spp.): Ecological information for ecosystem-based management of demersal resources

David A. Ebert, Joseph J. Bizzarro, Simon Brown and Gregor M. Cailliet Pacific Shark Research Center/Moss Landing Marine Laboratories <u>debert@mlml.calstate.edu</u>

Elasmobranch (shark, skate, and ray) fishes have played important roles in marine ecosystems throughout their history, often occupying the highest trophic levels as apex predators. Despite the fundamental significance of feeding relationships in understanding food web dynamics, community structure, and energy transfer in marine systems. little is known about the feeding ecology of most elasmobranch species. This is especially true of batoids, which have received considerably less scientific attention than sharks. In the Gulf of Alaska (GOA) skates (*Raja* and *Bathyraja* spp.), among the most common bycatch species taken in groundfish fisheries, support a recent directed fisherv from . Kodiak Island, and are also potentially important predators in benthic communities. However, published information on diet and trophic ecology of skates in this region is virtually non-existent. The objectives of this proposed study are therefore to determine diet composition and trophic ecology of the most abundant skates in GOA demersal fisheries through stomach content analyses. Specific research objectives are to determine the diet, trophic levels, and foraging habitats of Raja binoculata, R. rhina, Bathyraja aleutica, and B. interrupta. In addition, temporal, ontogenetic, and intergender aspects of diet will be compared within and among species. Successful completion of this study will elucidate the ecological role of skates in the GOA ecosystem and provide quantitative information for ecosystem modeling and effective management of skates and other co-occurring groundfish populations. Preliminary results of this research will be presented.

Life History and Population Dynamics of Alaskan Skates: Providing Essential Biological Information for Effective Management of Bycatch and Target Species

David A. Ebert, Wade D. Smith, Diane L. Haas, Shaara M. Ainsley and Gregor M. Cailliet, Pacific Shark Research Center/Moss Landing Marine Laboratories <u>debert@mlml.calstate.edu</u>

The Pacific Shark Research Center (PSRC) has been engaged in a broad-based program to study the life history (i.e.; age and growth, reproduction, feeding ecology) of skates (Chondrichthyes; Rajiformes) in Alaskan waters. The susceptibility of skates to fishing pressure has been well documented in the North Atlantic where fishing pressure has notably impacted the abundance, population structure, and distribution of several species. Results from this project will serve to support ongoing National Marine Fisheries Service groundfish surveys and provide an improved understanding of the basic life history of skate species. Research on basic biology, life history, and demography of skates will contribute significantly to the body of information necessary for assessing their population dynamics and status. This should enable better decision-making in areas of public policy, especially regarding fisheries management. Additionally, results of this research will be incorporated into a life history data matrix developed by the PSRC (http://psrc.mlml.calstate.edu/) for eastern North Pacific (ENP) chondrichthyans, and made available to professionals and the general public via the worldwide web. Activities conducted by the PSRC provide benefits in the areas of original research, education, and cooperative programs involving ENP skate resources.

Spatial and temporal variation in Steller sea lion prey: Using modeled oceanographic data to create seasonal prey distribution maps

Rowenna Flinn, Marine Mammal Research Unit, University of British Columbia. r.flinn@fisheries.ubc.ca

Edward Gregr, Marine Mammal Research Unit, University of British Columbia. gregr@zoology.ubc.ca

Matt Berman, University of Alaska Anchorage. m.berman@fisheries.ubc.ca Gaku Ishimura, Fisheries Centre, University of British Columbia.

g.ishimura@fisheries.ubc.ca

Andrew W Trites, Marine Mammal Research Unit, University of British Columbia trites@zoology.ubc.ca

Predictions of the spatial and temporal distributions for dominant prey species of Alaskan Steller sea lions (*Eumetopias jubatus*) were developed by relating fish abundance to modeled oceanographic variables and remote sensing data. Using oceanographic model output increased the resolution of the analysis and number of abiotic variables available to determine the distribution of the fish species. Variables that correlated significantly with fish abundance were used to predict the spatial distribution of the prey species at a monthly time scale within the range of Steller sea lions in Alaska. These statisticallyderived distributions can be combined with more qualitative predictions of prey species for which appropriate abundance data are unavailable. The resulting prey surfaces describe potential Steller sea lion feeding areas and provide an expanded view of how their diet can vary spatially and temporally. This variation is presumably explained through ecological interactions with different oceanographic variables depending on abiotic and biotic limitations, and on the preferences of the prey species.

Development of an Optical Image Database and Processing Tools for Automated Classification of Benthic Habitat and Enumeration of Commercially Important Scallop Stocks

Scott M. Gallager^{1,2}, Richard Ta'ylor², Norman Vine², Lakshman Prasad³, Sriram Swaminarayan³, Rajan Gupta³, Nancy David³, Amber York², Jonathan Howland¹, Paul Rago⁴, Dvora Hart⁴, Gregg Rosenkranz⁵

- 1. Woods Hole Oceanographic Institution, Woods Hole, MA, sgallager@whoi.edu
- 2. Advanced Habitat Imaging Consortium, http://HabCam.whoi.edu
- 3. Los Alamos National Laboratory, Los Alamos, NM
- 4. National Marine Fisheries Service, Woods Hole, MA
- 5. Alaska Department of Fish and Game, Kodiak, AK

Understanding and characterizing benthic habitat is essential for multi-species management and for detecting how organisms respond to both short and long-term sources of environmental change. Optical imaging provides multi-scale information from microns to 1000's km with the ability to visually identify substrate and epi-benthic organisms. However, the volume of data requires automated tools to realize the goal of broadscale habitat classification. Using color imaging systems we are currently surveying ocean bottom along the Northeast coast from Georges Bank to the Mid Atlantic Bight, and along the shelf of the Gulf of Alaska. From these surveys we selected 20,000 images from each of four regions representing diverse substrate and faunal composition. Each image is classified both manually and automatically. Manual classification is by substrate type (e.g., mud, sand, cobble), organism taxon (e.g., scallop, starfish, flounder) and size of each target. Automated classification begins with image correction for color, light field illumination, background and foreground segmentation based on texture and color, and extraction of segmented regions of interest (ROI). A classifier (Support Vector Machine) is trained with a library of targets from the manually identified data base. Associations of targets with texture categories are made through discriminate analysis. Size, shape and density of scallops and other benthic organisms are added to a georeferenced database for later display and visualization. Segmentation of foreground targets from background substrate is the most challenging problem. Our unique collaboration intends to bring advanced techniques to bear on this problem.

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Small Mesh Trawl Surveys in Kachemak Bay, Alaska

Richard L. Gustafson and Kenneth J. Goldman, Alaska Department of Fish and Game, Homer, AK; richard gustafson@fishgame.state.ak.us

Between 2004 and 2006, the Alaska Department of Fish and Game (ADF&G) conducted a standardized small-mesh bottom survey for monitoring pandalid shrimp and associated fish populations in Kachemak Bay, Alaska. This EVOS funded survey enabled the continuation of a time series extending to the 1970s that is used by ADF&G to monitor stock status, and was used to establish harvest guidelines of pandalid shrimp stocks in the Southern District of the Cook Inlet Management Area prior to the collapse of that fishery. Abundances of many apex populations, particularly apex level piscivores, declined in the Gulf of Alaska (GOA) from the 1970s through the 1990s. Our survey data also show a shift in Kachemak Bay from a crustacean-dominated forage population to a population dominated by fish, particularly gadid species such as pollock and cod: We are currently investigating the correlative relationships between our indices of shrimp and fish abundance to the occurrence of the Pacific Decadal Oscillation, as shrimp abundance may be linked to the negative phase of the Pacific Decadal Oscillation (PDO) and fish abundance may be inked to the positive phase of the PDO.

Modeling habitat capability for invasive species using the ShoreZone mapping system

Jodi Harney, Coastal and Ocean Resources, jodi@coastalandoceans.com Linda Shaw, National Marine Fisheries Service Alaska Region, <u>linda.shaw@noaa.gov</u>

ShoreZone is a coastal habitat mapping and classification system in which low-altitude, georeferenced aerial imagery is collected specifically for the interpretation and integration of geological and biological features of the intertidal and nearshore environment. Mapped regions now include more than 16,000 km of coastline in the Gulf of Alaska and 45,000 km of coastline in British Columbia and Washington State. An additional 10,000 km of imagery was collected in Alaska in 2006. The mapping system (housed in ArcGIS and Access databases) provides a spatial framework for coastal and nearshore habitat assessment on local and regional scales. Physical and biological characteristics of discrete habitat units are mapped both along-shore and across-shore (including wave exposure, substrate type, sediment texture, intertidal organisms, subtidal algae, and some subtidal fauna). The coastal database is useful for habitat capability modeling in which mapped shorelines are examined to predict the distribution of habitats that would support a particular group or species of interest. A capability model developed for the European green crab (Carcinus maenas) appraises the sensitivity of mapped shorelines to colonization by this invasive species. The model employs the Delphi approach to compile green crab habitat attributes from the scientific literature and expert interviews. The ShoreZone database is then queried for these attributes to identify shorelines that meet the criteria for supporting green crab colonization. Identifying potential green crab habitat "hot spots" could provide a spatial basis for the planning and implementation of monitoring stations for species detection and early intervention efforts.

The Influence of Adult Salmon Carcasses on Energy Allocation in Dolly Varden Char

Ron Heintz NOAA ron.heintz@noaa.gov

The presence of salmon carcasses in fluvial habitats represents a potential energetic boon to stream residents, but little is known about how juvenile salmonids in those habitats exploit that energy. The objective of this report is to determine if the presence of carcasses influences the energy allocation strategies of juvenile Dolly Varden. This species was chosen as a model, because Dolly Varden commonly reside in streams that receive marine subsidies (and aromous streams) and in streams without subsidies (barriered streams). Two anadromous and two barriered streams were sampled for Dolly Varden between June and October of 2004. Observations collected from the fish included age, length, dry mass, lipid, protein and energy content. Fish from the anadromous streams grew more slowly, had higher protein content and dry mass (P < .034). Fish from the barriered streams had higher growth rates and lipid content (P = 0.012). Energy content was unaffected by stream type (P = 0.890), thus fish from anadromous streams allocate significantly more energy to protein than fish from barriered streams (P < 0.001). Other than alterations in fatty acid composition, the arrival of carcasses had no substantive effect on the energy allocation of Dolly Varden. Moreover, differences between stream types were unrelated to stream geomorphology. Energy allocation theory predicts that slower growing fish should favor growth over storage in order to maximize size prior to winter. Thus, reduced allocations of energy to lipid in Dolly Varden from anadromous streams likely results from reduced growth.

Polybrominated diphenyl ethers (PBDEs) in sediments and biota in a pristine Southeast Alaska watershed and near a municipal waste landfill, Juneau, Alaska

Lisa A. Hoferkamp, University of Alaska Southeast, jflh@uas.alaska.edu Sherry L. Tamone, University of Alaska Southeast, <u>sherry.tamone@uas.alaska.edu</u>

In an effort to identify and quantify PBDE contamination in Southeast Alaska, sediment and tissue samples of organisms inhabiting an estuary near a landfill in Southeast Alaska were collected and analyzed. PBDE levels found in samples proximal to the landfill were compared to levels found in samples (sediment and biota) obtained from a more pristine southeast Alaskan watershed. The estuarine environments of Alaska are important habitats for a large number of commercial fish species and their susceptibility to persistent organic pollutants such as PBDEs has not yet been demonstrated.

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Levels of polybrominated diphenyl ether (PBDE) were measured in biota and surficial sediments collected from two study sites in Southeast Alaska. One site encompassed a glacial stream draining into a large tidally influenced estuary and subject to leachate from an adjacent municipal solid waste landfill. The second site had similar hydrologic features but was removed from significant industrial or urban influence. Both biota and sediments from these study sites exhibited low PBDE levels compared to samples from highly industrialized areas. SE Alaska samples did however, show increased levels in biota compared to sediments suggesting bioaccumulation is occurring. The presence of detectable levels at the pristine site, suggest non-local sources of PBDEs and may be tied to atmospheric transport to sub-polar glaciers followed by physical transport to the receiving waters.

Nearshore Fish and Invertebrate Assemblages in Iniskin/Iliamna Bay, Lower Cook Inlet

Jon Houghton, Jim Starkes, Jason Stutes Pentec Environmental/Hart Crowser, Inc. jon@pentecenv.com

Fish and invertebrates in Iniskin and Iliamna bays on the west side of lower Cook Inlet are described based on field investigations conducted during 2004 - 2006. Nearshore habitats were sampled using two gear types: A 37-m beach seine was used to sample littoral habitats and a small otter trawl was used to sample demersal assemblages between 3 and 15 meters in depth. Within the study site, juvenile Pacific herring were numerically dominant despite reported declines in local spawning; young of the year appearing in June and they remained the most abundant species through September. Juvenile salmonids were also abundant with chum dominating in April and pinks dominating in May and remaining abundant through July. In deeper subtidal areas (otter trawl samples) vellowfin sole and snake prickleback were numerically dominant. There were strong seasonal differences in fish assemblages reflecting a spring influx of transient and anadromous species. Invertebrates (with the exception of mysids) tended to concentrate in deeper areas with over 60 species taken. Invertebrate abundances appeared to be less seasonal than were fish. Invertebrates were dominated by pandalid, hyppolytid, and crangonid shrimp. These groups also were important to the diet of dominant fish species within the study area.

Estimation of Temporal Variation in Maturity-at-age of Pacific herring (*Clupea pallasi*) in Sitka Sound, Alaska

Peter Hulson, UAF, p.hulson@uaf.edu Terry Quinn, UAF, Terry.Quinn@uaf.edu Sherri Dressell, ADF&G, <u>Sherri Dressel@fishgame.state.ak.us</u>

The status of the Pacific herring (*Clupea pallasi*) stock in Sitka Sound, Alaska, is currently estimated by the Alaska Department of Fish and Game (ADF&G) with an agestructured assessment model (ASA). Estimated parameters in the model include natural mortality, and the inflection age and slope for logistic functions that determine gear selectivity and maturity-at-age. The present form of the ASA in Sitka Sound assumes that natural mortality, gear selectivity, and maturity-at-age are constant over time. However, if there are temporal variations present in these estimates, there may be error in the temporal pattern of population abundance. Several model scenarios were considered that allowed for temporal estimation of maturity-at-age. All of these scenarios allowed for variation in the inflection age of maturity, or the age at which 50% of the cohort has reached sexual maturity. These scenarios include relationships with weight-at-age of the spawning population and large year classes in the spawning age composition, along with random and independent walks to describe temporal variations. Results of the analysis suggest that temporal variations can be estimated for maturity-at-age, although uncertainties in the parameter estimates in some scenarios are very large. Akaike information criteria (AIC) comparison between appropriate model scenarios compared to constant maturity-at-age over time shows that a number of scenarios do not reduce uncertainty enough to compensate for the increase in the number of parameters.

Integration of a Nearshore Fish Atlas in Alaska with ShoreZone Coastal Mapping: an Interactive Website

Scott W. Johnson, Mandy R. Lindeberg, A. Darcie Neff, and John F. Thedinga NOAA Fisheries, Alaska Fisheries Science Center, Auke Bay Laboratory, Juneau, AK <u>scott.johnson@noaa.gov; mandy.lindeberg@noaa.gov</u>

Nearshore waters of Alaska support a diverse and abundant community of fishes, many of commercial importance. Determining the distribution and fish use of coastal habitats is needed to target which habitats are essential and should be protected. To meet this objective, we have integrated a Nearshore Fishes of Alaska database with an existing Arc IMS ShoreZone coastal imagery and mapping website. About 28,000 km or nearly half of Alaska's coastline has been mapped using the ShoreZone classification system: the shoreline is photographed continuously on a minus tide, and the visual images are later analyzed for physical geomorphology and biological resource characteristics (e.g., eelgrass beds). The Fish Atlas database contains beach seine catch information on fish assemblages from 68 locations in southeastern Alaska, Prince William Sound, the Aleutian Islands, and the Arctic. At each location, up to four habitat types were sampled including sand or gravel beaches with no rooted vegetation, cobble beaches with understory kelps, soft bottom (sand, silt, mud) beaches with eelgrass, and steep bedrock outcrops. Nearly 600,000 fish representing 98 species have been captured in 841 beach seine hauls. The Fish Atlas/ShoreZone website is dynamic and will be updated as fish sampling and coastal mapping continues throughout the state. The integrated website provides valuable information on the distribution and habitat of nearshore fishes, and allows scientists and resource managers to query species, habitat, and site data over wide spatial scales in Alaska. Please visit our site at www.fakr.noaa.gov/habitat/fishatlas/.

Seasonal Distribution and Habitat Use of Forage Fish in Nearshore Waters of Prince William Sound

Scott W. Johnson, John F. Thedinga, A. Darcie Neff, Mandy R. Lindeberg and Pat M. Harris, NOAA Fisheries, Auke Bay Laboratory, Juneau, AK scott.johnson@noaa.gov

Nearshore fishes were sampled at 8 locations in western Prince William Sound (PWS) in April, July, and September 2006 to determine seasonal distribution and habitat use. At each location, fish were sampled with a beach seine in 3 shallow water (<5 m deep) habitats (eelgrass, kelp, bedrock outcrops) and with a small purse seine in 2 sites outside the effective depth range of the beach seine (6-20 m; mostly steep bedrock walls). A total of 17,788 fish representing 45 species were captured in 71 beach seine hauls, whereas 853 fish representing 8 species were captured in 32 purse seine hauls. Of the total catch of fish by beach seine, 49% were captured in kelp, 44% in eelgrass, and 7% in bedrock outcrops. Total catch by beach seine (all habitat types) increased seasonally (4,653 fish in April, 5,274 fish in July, 7,861 fish in September); this indicates that fish occupy shallow. nearshore waters for at least several months a year. More importantly, species composition changed with season: pink salmon dominated catches in April, saffron cod in July, and capelin in September. Larval or juvenile stages of pink salmon, capelin, saffron cod, and Pacific herring accounted for 87% of the total catch (beach and purse seine). For forage fish, catches of capelin and herring were highest in kelp and eelgrass, respectively. Nearshore vegetated areas provide juvenile habitat for capelin and herring, particularly in summer and early fall in western PWS.

Preliminary evaluation of geographic structure and cohort variation of Alaskan Pacific ocean perch (*Sebastes alutus*) from microsatellite variation

L. Kamin¹, K. Palof¹, C. Kondzela², J. Heifetz², and A.J. Gharrett¹

1. Fisheries Division, School of Fisheries and Ocean Sciences, University of Alaska Fairbanks, Juneau, AK; ffajg@uaf.edu

2. National Marine Fisheries Service, Auke Bay Laboratory, Juneau, AK

The genetic structure of a species mirrors its distribution and scale of productivity, knowledge crucial for effective management. Our objective is to characterize genetic structure of Alaskan Pacific ocean perch (POP: Sebastes alutus), and to evaluate their structure in the context of geographic and oceanographic features and life history. We are attempting to evaluate the population structure of POP, to estimate their dispersal, and to investigate the extent of sweepstakes effects. Because POP are long-lived (often > 100 years), severe sweepstakes effects likely influence the genetic composition of each cohort. If so, the age composition of each collection influences the genetic composition observed, independent of geographic distribution and dispersal rate. We do not know the locations of mating or parturition. We have examined adult POP collections from 6 geographically distinct areas along the Gulf of Alaska continental slope. There is strong population structure and a significant isolation-by-distance relationship, which suggest that geographic structure is an important component. We also analyzed data of young-ofthe-year (YOY) POP collected along transects in the Gulf of Alaska in 1998 and 2002. The YOY collections provide information about the magnitude of interannual (cohort) genetic differences. Comparisons of the genetic compositions of adult and YOY collections will lead to estimates the dispersion of juveniles and adults.

Arrowtooth flounder (Atheresthes stomias) diet and prey consumption near Kodiak Island, Alaska

Brian Knoth, NOAA/NMFS/AFSC, Brian.Knoth@noaa.gov Robert Foy, University of Alaska Fairbanks, <u>foy@sfos.uaf.edu</u>

Arrowtooth flounder (Atheresthes stomias, or ATF) diet and prey consumption was studied to assess the predator-prey relationships of this key predator near Kodiak Island. Alaska. Interannual, within year, and ontogenetic diet trends were quantified from the analysis of 742 ATF stomachs sampled from annual bottom trawl surveys conducted in May and August from 2002 to 2004. Walleye pollock (Theragra chalcogramma) were the main prey in the diets of adult ATF (> 40 cm) in 2002 and 2003 while euphausiids and Pacific sand lance (Ammodytes hexapterus) were the dominant prey in 2004. In 2004, the importance of euphausiids in the ATF diets decreased significantly from May to August whereas the importance of capelin increased. Furthermore, smaller ATF (20-39 cm) consumed more euphausiids and capelin and displayed a higher feeding activity than larger cohorts (>40 cm). The dietary trends highlight the adaptable feeding behavior of ATF. A bioenergetics model was used to quantify ATF prey consumption over an 84 day period (May to August) in each study year (2002, 2003, and 2004). Within the area, the ATF population was dominated by large individuals (>50 cm) that accounted for > 75 % of the population's total prey biomass consumption in 2004. The nearshore ATF population consumed an estimated 339 t of fish prey and 222 t of invertebrate prey in 2004. Consumption estimates were largely influenced by spatial and temporal variations in the abundance of ATF and provided baseline data concerning the magnitude of ATF prey consumption near Kodiak Island, AK.

Restoration of Essential Fish Habitat in Coastal Alaska Using Artificial Reefs: A Demonstration Project

Brian Lance, brian.lance@noaa.gov, National Marine Fisheries Service, Anchorage Erika Ammann, erika.ammann@noaa.gov, NOAA Restoration Center, Anchorage Brad Reynolds bfreyno@yahoo.com, University of South Alabama,

Dauphin Island Sea Lab, Alabama

Mary Anne Bishop mbishop@pwssc.gen.ak.us, Prince William Sound Science Center, Cordova, Alaska

Sean Powers spowers@disl.org, University of South Alabama,

Dauphin Island Sea Lab, Alabama

Mark Schroeder mark.schroeder@mms.gov, Minerals Management Service, Anchorage

Alaska's coastal habitats are experiencing increasing development pressure from industry, recreation, and transportation. These development activities destroy or alter the function of marine coastal habitats, principally by removing habitat structure, including rocky reefs and aquatic vegetation. At present in Alaska, there are few restoration methods to mitigate for impacts to marine coastal fish habitat, and many habitat losses are permitted by regulatory agencies with no requirement for compensatory mitigation. Restoration and mitigation techniques from lower latitudes are not always appropriate options for Alaska due to factors such as: colder climate, differences in habitat, increased expense for restoration materials, and working in remote areas. In May of 2006 an experimental artificial reef was created in Smitty's Cove, Prince William Sound, Alaska. The purpose of this pilot project is to evaluate the potential of artificial reefs at enhancing lost essential fish habitat (EFH) in sub-Arctic marine waters. A series of questions will be examined in this project:

- Do reef structures create fish and invertebrate habitat comparable to native rocky reefs? What is the colonization time? What species and life stages utilize the habitat? What is residence time?
- What is colonization time for submerged aquatic vegetation in northern climes?
- Can reef structures enhance highly impacted marine habitats such as harbors?
- Can artificial reefs be an economically viable option for marine habitat mitigation in Alaska?

The results from this project will play a role in future decisions for restoration and mitigation for Alaska's coastal habitats.

Structure of nearshore fish assemblages in relation to varying levels of habitat complexity

Joel Markis, School of Fisheries and Ocean Sciences, University of Alaska Fairbanks, markis@sfos.uaf.edu

Brenda Konar, Global Undersea Research Unit, University of Alaska Fairbanks, bkonar@guru.uaf.edu

In temperate regions kelp can dominate hard-bottom nearshore communities, providing structure at the substrate and throughout the water column, which can be used by many invertebrates and fishes. Increasingly complex habitats can be beneficial to fish however how fish use these complex habitats is poorly understood in northern latitudes. particularly for juvenile fish. The potential effects of macroalgal density and substrate complexity on nearshore fish communities were examined in Kachemak Bay, Alaska, Fish were collected from multiple sand, understory only, and understory and canopy containing sites along with substrate and algal complexity measurements. SMURF's, light traps, shrimp pots, and SCUBA visual surveys were all employed in these collections. Fish abundance and composition varied temporally across habitat types. Adult fish communities were comparable among similar habitats, with younger fish assemblages being similar across macroalgal sites but distinctly separate from sandy sites. The dominant fish included gadids, pleuronectids, hexagrammids, and sebastids. Larger gadids were captured in all three habitats while smaller individuals were primarily encountered in macroalgal habitats. Pleuronectids were only captured in sandy sites. Adult hexagrammids were captured in both kelp habitats however juveniles were not encountered. Adult sebastids were only encountered in understory sites, while smaller sebastids were captured in all three habitats. Fish abundance varied more in macroalgal stands than in sandy areas suggesting some degree of linkage between fish and macroalgal habitats. This study indicates that different groups of fish may have different habitat preferences in Alaska's nearshore waters requiring different management strategies.

Update on ShoreZone Mapping in Alaska, British Columbia, and Washington

Mary Morris, Archipelago Marine Research Ltd., marym@archipelago.ca Jodi Harney, Coastal and Ocean Resources Inc., jodi@coastalandoceans.com John Harper, Coastal and Ocean Resources Inc., john@coastalandoceans.com Susan Saupe, Cook Inlet Regional Citizens Advisory Council, saupe@circac.org Mandy Lindeberg, NOAA/NMFS Auke Bay Lab, mandy.lindeberg@noaa.gov K Koski, The Nature Conservancy, <u>kkoski@tnc.org</u>

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The ShoreZone coastal habitat mapping system is based on the collection of low-tide videography and digital still imagery, with simultaneous commentary by coastal scientists. The imagery and commentary are used in the definition of discrete along-shore habitat units and the mapping of observed physical, geomorphic, sedimentary, and biological features within those units. In 2006, approximately 10,000 km of the Alaska shoreline was imaged, including Bristol Bay and areas of southeast Alaska near Ketchikan and Craig. To date, approximately 25,000 km of the Gulf of Alaska shoreline imagery has been collected and web-posted. Of this, 12,000 km has been processed, mapped, added to the database, and the data web-posted. Mapping of the remaining 13,000 km of imagery is currently in progress. Aerial surveys of 6,000 km of shoreline in Alaska is being planned for 2007, which will bring the length of mapped shoreline in the state to approximately 31,000 km. The shorelines of British Columbia (40,000 km) and Washington (5,000 km) have also been mapped using the ShoreZone technique, offering the opportunity to build a contiguous, integrated coastal resource database that extends from the Columbia River to Bristol Bay. ShoreZone coastal mapping data and imagery has proven useful in a number of research and practical applications, including: environmental hazard mitigation, natural resource planning, habitat capability modeling, ground station comparisons, and public use for recreation. This poster will include a large-format map illustrating the extent of ShoreZone imagery and data in the Pacific Northwest.

Effect of Habitat on Forage Fish Condition in Prince William Sound

Bonita Nelson, Ron Heintz, Scott Johnson

Auke Bay Laboratory, AK Fisheries Science Center, bonita.nelson@noaa.gov

Nearshore habitats are essential for early development of fish, however it is unclear how differences in habitat quality influence their performance. This project is part of a wider study aimed at relating nearshore habitat features to measures of estimating juvenile abundance, size and condition in western Prince William Sound. These data will help to define essential habitat for key forage species. Fish were sampled using beach seines in April, July and Sept of 2006 from three habitats: eel grass and kelp beds and bedrock beaches. Sampling will continue in 2007. Our study investigates the quality of habitat by comparing fish condition among habitats using: Fulton's condition factor, growth (RNA/DNA analysis) and lipid and energy content for the most abundant species sampled: crescent gunnels, saffron cod, walleye pollock and Pacific herring. In order to maximize the number of observations in each habitat were are employing bio-impedance analysis (BIA) to predict dry mass, lipid and energy content. Preliminary data analyses (for July only) indicate that there is no effect of habitat on the length adjusted dry mass of any of the species examined. However, for crescent gunnels Fulton's condition factor depended on habitat (P = 0.042). This suggests crescent gunnels take on water weight in bedrock habitats. Habitat type had no effect on Fulton's condition for the other species. Initial examination of BIA calibrations indicates that the relationship relating BIA response to dry mass is species specific.

Temporal Stability in the Fatty Acid Composition of Herring from Different Stocks

Ted Otis, ADFG ted_otis@fishgame.state.ak.us Ron Heintz, NOAA ron.heintz@noaa.gov Jacek Maselko, NOAA jacek.maselko@noaa.gov

Previously we identified stock-related differences in the fatty acid composition of hearts taken from Pacific herring (*Clupea pallasi*). We constructed discriminant functions describing the heart fatty acid compositions that correctly classified herring from Kodiak, Kamishak and Prince William Sound more than 85% of the time. Heart fatty acids are found in phospholipids, which comprise cell membranes. Consequently, the contribution of diet to these differences is likely minimal. In 2005, we began to examine the temporal stability of these functions. If these differences are consistent among years, then fatty acid analysis could potentially be developed into a stock separation tool. Between 2005 and 2006 we collected hearts from herring in eleven spawning locations throughout Alaska. Collections were duplicated in both years and the hearts, and examined for the presence of 42 fatty acids by gas chromatography and mass spectrometry. The preliminary analysis we present here compares the fatty acid compositions of herring collected in 2001 with those collected from Sitka Sound, Kamishak and Togiak Bays in 2005 and 2006.

In addition, we present analysis of similarity as a method for determining if fatty compositions differ. This nonparametric approach uses permutation analysis to detect differences in the fatty acid compositions. Application of this method to our 2001 data set largely supported the conclusions drawn from our discriminant function analysis. The development of a simple test for contrasting fatty acid data sets is likely to have wide application beyond that demonstrated here.

Hindcasting walleye pollock recruitment and examining pollock stock structure in the Gulf of Alaska using a biophysical model

Carolina Parada, UW/JISAO and NOAA/AFSC, carolina.parada@noaa.gov Sarah Hinckley, NOAA/AFSC, sarah.hinckley@noaa.gov John Horne, UW and NOAA/AFSC, john.horne@noaa.gov Al Hermann, UW/JISAO and NOAA/PMEL, albert.j.hermann@noaa.gov Bern Megrey, NOAA/AFSC, bern.megrey@noaa.gov Martin Dorn, NOAA/AFSC, martin.dorn@noaa.gov

A biophysical model was used to study processes underlying variability in recruitment for walleye pollock in the Gulf of Alaska. We used the model to generate a pre-recruit index, and also to study the relationship between spawning and nursery areas for this species. This work used a set of 3 coupled models: a hydrodynamic model, a nutrientphytoplankton-zooplankton model of pollock prey and an individual-based model of pollock early stages. We ran the biophysical model from 1978 to 2002 to obtain the prerecruit indices. We compared these to recruitment estimates generated by an independent stock assessment model. A poor correlation was seen between the model indices, and the stock assessment recruitment estimates for the whole period 1978 to 2002. A stronger correlation was observed between the model indices and stock assessment estimates from the late 1970s to the mid-1980s. These results are consistent with the concept of a shift in recruitment control in the mid-1980s from processes determining survival in the larval stage to processes determining age-0 juvenile survival (as processes controlling survival in the juvenile stage were incompletely modeled). Simulations performed to examine spawning-nursery area relationships will also be presented. We released particles from known pollock spawning regions in the GOA (past and present), and tracked their trajectories. From final destinations of these particles, we infer the locations of potential nursery sites for each spawning ground.

On the Use of Bycatch Data for Stock Assessment: A Case Study of Spiny Dogfish (Squalus acanthias) in Alaska

Joel S. Rice and Vincent F. Gallucci

University of Washington, School of Aquatic and Fishery Sciences Cindy A. Tribuzio and Gordon H. Kruse

University of Alaska Fairbanks, Juneau Center School of Fisheries and Ocean Science

In this study, we developed a preliminary stock assessment for spiny dogfish (Squalus acanthias) in the Gulf of Alaska. Data from commercial longline groundfish fisheries in the GOA were obtained from the NMFS observer database. Additional available data include incidental catches from surveys targeting other species, such as Pacific halibut and sablefish. All CPUE indices covered different periods of time, some beginning in 1979 and others beginning in 1997. CPUE trends from the observer database, the IPHC test fishery, and the NMFS sablefish longline survey were standardized via generalized linear models and used in surplus production models to estimate biomass, current depletion and other related stock assessment parameters. Bayesian state-space models were used to formally incorporate additional information about growth rate and carrying capacity in the form of priors. The results of these models were compared with maximum likelihood parameter estimates. The results of the stock assessment are still under development but preliminary results show that dogfish in the Gulf of Alaska are between 60-80% of carrying capacity. The assessment of spiny dogfish is particularly difficult owing to the brevity, variability, and divergent trends in dogfish by catch from the various data sources.

Characterizing Trawlable and Untrawlable Substrate Using Single Beam Echo Sounder Data to Improve Estimation of Commercial Groundfish Abundance

Chris Rooper, Alaska Fisheries Science Center, Chris.Rooper@noaa.gov Mark Zimmermann, Alaska Fisheries Science Center, <u>Mark.Zimmermann@noaa.gov</u>

Biennial trawl surveys conducted in the Gulf of Alaska by the National Marine Fisheries Service (NMFS) are a primary data source for estimation of commercial groundfish abundance. A perennial problem in the accurate estimation of groundfish biomass using trawl surveys is the unknown (but presumed large) amount of the continental shelf that is not fishable. Therefore a method for estimating the area of untrawlable seafloor is needed for Alaska. We examined single beam echo sounder data collected from a NMFS bottom trawl survey vessel along four transects previously classified as trawlable or untrawlable using video-tape from a towed camera sled. Three simple models estimated the shape of the echo sounder seafloor reflection by measuring the slope, the peak amplitude and tail characteristics. A classification-tree model was fit to the data from three transects, and the resulting model was fit to data collected at the fourth transect as a test. The classification tree model was able to predict accurately whether the seafloor was trawlable or untrawlable in 90% of the original data set. It was able to predict trawlable or untrawlable 75% of the time in the test data set. This approach, combined with ancillary data collected from the echo sounder (such as local slope and rugosity), holds promise for increasing our knowledge of the amount of trawlable and untrawlable seafloor within Alaska ecosystems, as well as providing a low-cost method of mapping the region.

Moving toward a process-based understanding of essential fish habitat in juvenile flatfish nurseries

Clifford Ryer, Fisheries Behavioral Ecology Program, RACE/AFSC/NOAA Fisheries, cliff.ryer@noaa.gov

Allan Stoner, Fisheries Behavioral Ecology Program, RACE/AFSC/NOAA Fisheries, al.stoner@noaa.gov

Alisa Abookire, Kodiak Lab, RACE/AFSC/NOAA Fisheries, alisa.abookire@noaa.gov

Essential fish habitat is typically inferred from fish distribution relative to habitat, often without consideration of underlying ecological processes that can change over time. For juvenile flatfish (e.g. Pacific halibut and northern rock sole), sediment is considered the principle seafloor characteristic influencing habitat quality. But juveniles also associate with emergent structures (e.g., algae, shell, macro-invertebrates), and models incorporating such structures explain more variance than models based solely on sediment, depth and temperature. The emergent structure association is 1) behavioral, 2) partially attributable to lower predation vulnerability in some structurally complex habitats. and 3) responsive to other habitat parameters (e.g. ambient illumination, localized predator risk, density-dependent interactions). Within nurseries, abundance of juvenile flatfish is best predicted by the density of ampharetid polychaetes (i.e., worm tubes), and the structure their tubes impart. Juvenile flatfish are most abundant at low/moderate worm densities, possibly because fish feed upon and seek refuge in them. Counter-intuitively, juveniles are nearly absent where high tube density forms a 'turf'. This turf likely interferes with burial; a flatfish's first line of defense. On a larger scale, nurseries differ in quality, leading to difference in flatfish growth which may be related to predator abundance. Supporting this hypothesis, lab studies indicate juvenile flatfish growth can be suppressed by chronic predator exposure. Taken as a whole, these studies suggest that juvenile flatfish habitat quality is dynamic, varying spatially and annually as habitat structure, predator abundance and resultant ecological processes change.

Preliminary results of a demographic analysis of spiny dogfish in the Gulf of Alaska

Cindy A Tribuzio, UAF, ftcat@uaf.edu Gordon H Kruse, UAF, gordon.kruse@uaf.edu Joel R Rice, UW, joelrice@u.washington.edu Vincent F Gallucci, UW, <u>vgalluc@u.washington.edu</u>

We present preliminary results of a demographic analysis of spiny dogfish (*Squalus acanthias*) in the Gulf of Alaska. This analysis is part of a larger study including diet (presented last year), age and growth, reproduction and population abundance trends. A relationship between age and ring counts of spines was used to estimate fish ages from sampled dogfish. Spines were analyzed by the aging laboratory at the Washington Department of Fish and Wildlife. Age estimates and measurements of fish length were used to estimate von Bertalanffy growth parameters (Linf=101.5 cm, Winf=4.8 kg and k=0.06). Natural mortality was estimated using thirteen indirect approaches, which utilize life history and growth parameters from the vB analysis. Early results indicated that natural mortality for the population is about 0.097. Age specific natural mortality ranges from 0.064-1.033. Results presented here are preliminary; a more detailed final analysis is expected within a year.

An Analysis of Larval Survival Rates and Maternal Parameters for the Deepwater Rockfish Species Pacific Ocean Perch, *Sebastes alutus*, in the Gulf of Alaska

Emily Waschak, Scott Heppell, Selina Heppell, and Doug Markle

Department of Fisheries and Wildlife, Oregon State University, Corvallis, OR Paul Spencer, Alaska Fisheries Science Center, NOAA Fisheries, Seattle, WA

Older and larger female Pacific Ocean perch may produce more fit and viable larvae due to greater lipid contribution to larvae. Larvae from older and larger females grow more than three times faster, survive starvation more than twice as long, and are able to withstand varying environmental conditions present at birth better than larvae from younger and smaller females. For this study, Pacific Ocean perch larvae were collected in the Gulf of Alaska and reared at the Alaska Department Fish &Game/Alaska Fisheries Science Center Kodiak Laboratory Seawater Facilities. Larval survival rates were measured for 30 days and evaluated against the maternal parameters of age and length at time of parturition. If maternal age and length impact larval survival rates, such findings may prove vital to Pacific Ocean perch maternal effects research. The North Pacific Fisheries Management Council and the National Oceanic and Atmospheric Administration's Fisheries Agency can utilize this information to create management actions to protect a proportion of older age Pacific Ocean perch in the Gulf of Alaska from commercial fishing.

Improving Preseason Forecasts of Kenai River Sockeye Salmon Runs through Salmon Smolt Monitoring: Technology Development

Mark Willette, Alaska Dept. Fish and Game, mark_willette@fishgame.state.ak.us Bob Decino, Alaska Dept. Fish and Game, <u>robert_decino@fishgame.state.ak.us</u>

This project was initiated in 2005 to develop and implement a smolt-monitoring program for Kenai River sockeye salmon as a tool for improving preseason forecast accuracy for the largest and most accessible salmon stock in Upper Cook Inlet. The project is using two independent methods (mark-recapture and acoustics) to estimate the population size of sockeye salmon smolt emigrating from the Kenai River watershed. The project is expected to contribute to improved preseason forecast accuracy, because current forecasts are based in part on the fall abundance of juvenile sockeye salmon rearing in Kenai and Skilak Lakes. Errors in fall-fry model forecasts likely result from variable over-winter survival caused by the relatively small size and poor condition of juveniles rearing in Skilak Lake. We are developing a bioenergetic model to predict over-winter mortality of juvenile sockeye salmon rearing in this system. The smolt-monitoring program is needed to validate bioenergetic model predictions of over-winter mortality.

Testing the feasibility of walleye pollock live-capture for tagging surveys

Andreas Winter, Robert Foy and Michael Trussell

Fishery Industrial Technology Center, University of Alaska Fairbanks, ffagw@uaf.edu

To improve stock assessment and management of walleye pollock, models are required that incorporate seasonal and environmentally forced movements of the fish. Estimates of pollock movement could be cost-effectively provided through tagging surveys, using coded-wire tags that are detectable by scanners installed at commercial processing plants. An important constraint on implementing such surveys is the capacity to capture pollock alive, in sufficient numbers, and return them to sea in healthy condition after tagging. Captured pollock are vulnerable to barotrauma and injuries from crushing in a net. Injuries may not be immediately lethal, but interfere with normal behavior for schooling and predator evasion. We are testing the use of an experimental codend for live-capture. designed to maintain a rigid enclosure and hold water until the net is brought on deck. A small (1.20 m diameter) version of this codend was fished from a trawler on spawning pollock aggregations near Kodiak Island. Live pollock were transferred to seawater holding tanks. Observations at capture indicated that success of the codend depends on controlling the number of fish entering the net. However, even when the codend 'pool' overfilled, back pressure from its tarpaulin bottom helped to maintain lower densities and enabled a significant proportion of fish to be recovered alive. Observations in the holding tanks indicated that chronic viability of the captured pollock relates to size, with larger fish surviving longer. Most mortality occurred within the first 48 hours. We present our results together with recommendations for future application of the experimental codend.

Gulf of Alaska Seabirds & Marine Mammals

Wednesday, 24 January 2007 2:15 - 5:00 PM Session Chair and Poster Review: Peter Boveng

TALKS

Speaker	Title
Briana Witteveen	Investigation of foraging habits and prey selection by humpback whales
	(Megaptera novaeangliae) using acoustic tags and concurrent fish surveys
Edward Gregr	Multi-scale predictions of right whale (Eubalaena japonica) habitat in the
	North Pacific and Bering Sea
Craig Matkin	Killer whales in the Northern Gulf of Alaska: Status, Trends, and Tagging
Greg O'Corry-	Genetic indicators of metapopulation boundaries and dynamics in Steller
Crowe	sea lions: implications for recovery of an endangered species
Andreas Fahlman	Open Water Steller Sea Lion Research Station provides new insights into
	the real costs of diving for food
Jamie Womble	Linking seasonal distribution patterns with prey availability in a central-
	place forager, the Steller sea lion
Elizabeth Mathews	The role of predation by Steller sea lions in the population decline of
	harbor seals in Glacier Bay National Park, Alaska
Peter Boveng	Strong Seasonal Dynamics of Harbor Seals, an Upper-Trophic Predator in
	Cook Inlet
Caroline Jezierski	Impact of ecotourism on Harbor seal (Phoca vitulina) behavior in
	Pedersen Lake, Kenai Fjords National Park

POSTERS

First Author	Title
Lisa Baraff	Distribution and habitat characteristics of fin and humpback whales off
	northeast Kodiak Island during summer, 2002 and 2003
Gail Blundell	Remote Monitoring of Vital Rates in Harbor Seals (Phoca vitulina)
Carrie Beck	Changes in the foraging behaviour and physiology of young Steller sea
Eischens	lions, Eumetopias jubatus, over their first winter
Kathrin Hülck	Persistent organic pollutants in Steller sea lions
K David Hyrenbach	Monitoring changes in the distribution and abundance of warm-water
	gadfly petrels (Pterodroma spp.) in the subarctic North Pacific using
	vessels of opportunity (2002 - 2006)
Shawna Karpovich	Identifying regional variation in harbor seal fatty acid signatures using
	analysis of similarity (ANOSIM)
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Gulf of Alaska Seabirds & Marine Mammals

POSTERS (continued)

First Author	Title
Allen Marquette	Rearticulation of an orca from Prince William Sound, Alaska
Jane McKenzie	Regional and seasonal variation in the diet of Steller sea lions in the
	Kodiak Archipelago, 1999-2005.
Sarah Norberg	Assessing the effects of nutritional stress on lactating female Steller sea
	lions (Eumetopias jubatus) and their pups in temporary captivity
Julia Parrish	What's Washed In: What Beached Birds Can Say About the Ocean
Lori Polasek	Growth and Condition of Captive Harbor Seals on a Low Lipid Diet
Jill Prewitt	Seasonal correlations of muscle biochemistry and body condition in adult
	harbor seals in Glacier Bay, Alaska
Lorrie Rea	Got milk? Assembling physiological indices of weaning for Steller sea
	lions
Janice Straley	Recommended deterrents and fine scale behavioral observations of sperm
	whales near longline fishing vessels in the Gulf of Alaska
Cody Strathe	Isotopic and Osteometric Evidence of Temporal Ecosystem Change in the
	Shelikof Strait from Archaeologically Deposited Harbor seal (Phoca
	vitulina) Remains.
Johanna	Spring-Spawning Eulachon: A "Window of Opportunity" for Steller Sea
Vollenweider	Lions
Dongli Wang	Prenatal Exposure of Harbor Seals to Persistent Organic Pollutants
Briana Witteveen	Using Stable Isotopes to Assess Population Structure and Feeding
	Ecology of North Pacific Humpback Whales (Megaptera novaeangliae)

Investigation of foraging habits and prey selection by humpback whales (Megaptera novaeangliae) using acoustic tags and concurrent fish surveys

Briana H. Witteveen, Robert J. Foy and Kate M. Wynne

University of Alaska Fairbanks, School of Fisheries and Ocean Sciences, Kodiak bwitteveen@sfos.uaf.edu

Yann Tremblay, University of California Santa Cruz, Long Marine Laboratory tremblay@biology.ucsc.edu 95060-5730

Tags containing acoustic time-depth transmitters (ATDT) were attached to four freeswimming humpback whales near Kodiak, Alaska. The ATDTs allowed for whale dive depths to be recorded in real-time. Acoustic and mid-water trawl surveys were conducted concurrent with tagging efforts within the study area to quantify available fish resources and describe potential prey selection by humpback whales. Recorded dives were grouped using two-step cluster analysis. Dives in one cluster characterized likely foraging behavior and occurred at a mean maximum depth of 100.4 m (SD = 18.75) with 51% of dives occurring between 102 m and 120 m. Acoustic backscatter from fish surveys was attributed to potential prey, including capelin, eulachon, and pollock <30 cm based on known target strength values and 10 net tows. Mean capelin abundance was greatest at depths exceeding 82 m with maximum abundance between 102 and 120 m. Minimal densities of juvenile pollock and eulachon were found at depths exceeding 82 m. Four tagged humpbacks were found foraging in areas with greatest capelin densities but bypassed or avoided areas of high age-0 pollock abundance. The location and diving behavior of tagged whales suggested that whales were favoring capelin over pollock as a prey source during this study.

(Please note that the project described in this abstract has been submitted for publication in Marine Mammal Science and is currently under review.)

Multi-scale predictions of right whale (*Eubalaena japonica*) habitat in the North Pacific and Bering Sea

Edward J. Gregr, SciTech Consulting, ed@scitechconsulting.com John K.B. Ford, Fisheries and Oceans Canada, fordjo@pac.dfo-mpo.gc.ca Randall Reeves, Okapi Wildlife Associates, rrreeves@total.net Robert Brownell, Southwest Fisheries Science Center, Robert.Brownell@noaa.gov Phil Clapham, Alaska Fisheries Science Center, <u>Phillip.Clapham@noaa.gov</u>

Right whales (*Eubalaena japonica*) are listed as endangered in both the US and Canada. While the majority of recent sightings have occurred in the southeastern Bering Sea. historic catches show that the species ranged throughout the North Pacific. Characterizing the spatial distribution of potentially suitable habitat as well as occupied (realized) habitat is essential to understanding right whale ecology and to supporting the recovery of the species. We plan to describe potential habitat at three spatial scales. First, we will describe historic hotspots for the entire North Pacific by analyzing historic whaling records in combination with bathymetric features and long-term climatologies built from oceanographic circulation model output. These historic hotspots will serve as boundary conditions for the inter-annual study, where we will use circulation model hindcasts to investigate inter-annual variation in habitat using sightings from the 1950s and 1960s. Finally, we will combine the circulation model output with remote sensing data to investigate seasonal variation in potential habitat in recent years. The inter-annual model will provide the boundary conditions for the seasonal analysis, which will be conducted at a higher spatial and temporal resolution, at 2-3 focal sites in the North Pacific and Bering Sea, including recently designated Critical Habitat. The final, cross-scale model will be validated using contemporary plankton data collected in the Bering Sea, and in the Gulf of Alaska off British Columbia. In this presentation, we will describe the multiscale approach, and the available biological and physical data.

Killer whales in the Northern Gulf of Alaska: Status, Trends, and Tagging

Craig Matkin, NGOS, cmatkin@acsalaska.net Eva Saulitis, NGOS, saulitis@pobox.xyz.net Graeme Ellis, Pacific Biological Station, ellisG@pac.dfo-mpo.gc.ca Russ Andrews, ASLC, russ_andrews@alaskasealife.org John Durban, NOAA/NMML john.durban@noaa.gov

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Since 1984, we have monitored three sympatric killer whale lineages, residents, transients, and offshores, which occur in the northern Gulf of Alaska. Offshore killer whales have been observed on only 4 occasions, but some identified individuals have also been photographed in British Columbia, California and the Eastern Aleutians. Resident killer whales, except for AB pod, have averaged an annual rate of increase of 3.4%. However, AB pod, which numbered 36 whales in 1988, lost 13 individuals following the oil spill and split into two sub-pods; one now travels with AJ pod. AB pod, which currently numbers 29 whales, has not recovered to pre-spill numbers due to subsequent mortalities and loss of reproductive and juvenile females. In 2006, individuals from three resident pods (AK1, AJ21, and AB11) were tagged with SPOT satellite tags that remained on the whales for 26 to 55 days. Movements of AB pod suggested important feeding areas in Montague Strait in mid-late September and near Kayak Island off the Copper River/Bering River in October. The 22 member AT1 transient population lost 9 individuals following the spill and now contains 7 whales. Harbor seals, a primary prey species, declined to low levels following the spill but are recently increasing. Markrecapture population analysis indicates the poorly known GOA transients, which consume Steller sea lions, have also declined over the past decade. Although re-sampling suggests CB levels may be slowly declining in killer whales, both AT1 and GOA transients have very high levels of chlorinated hydrocarbons.

Genetic indicators of metapopulation boundaries and dynamics in Steller sea lions: Implications for recovery of an endangered species

Greg O'Corry-Crowe, Southwest Fisheries Science Center,

greg.o'corry-crowe@noaa.gov

Carolina Bonin, Southwest Fisheries Science Center, carolin.bonin@noaa.gov Tom Gelatt, National Marine Mammal Laboratory, tom.gelatt@noaa.gov Ken Pitcher, Alaska Department of Fish and Game, ken_pitcher@fishgame.state.ak.us Tom Loughlin, TRL Wildlife Consulting, trlwc@comcast.net John Bickham, Purdue University, bickham@purdue.edu Barbara Taylor, Southwest Fisheries Science Center, barbara.taylor@noaa.gov Douglas DeMaster, Alaska Fisheries Science Center,douglas.demaster@noaa.gov

Documenting breeding and dispersal behavior at individual and local levels, including the (re)colonization of breeding sites, is central to resolving subdivision and understanding the dynamics of metapopulations. Intensive genetic surveys can provide such insight. We examined variation within a longer segment of the mtDNA control region (531bp) and within more microsatellite loci (n=16) in greater numbers of individuals (n=1,654) from across Alaska than earlier investigations to investigate fine-scale dispersal, gene flow and population dynamics in Steller sea lions. Significant differentiation was found within the current Western stock. Rookeries in the Gulf of Alaska, eastern Bering Sea and eastern Aleutians were demographically distinct from rookeries in the central and western Aleutians (Fst = 0.021, P<0.0001; Fst = 0.017, P<0.0001). The location of this split coincides with an oceanographic divergence between continental shelf and ocean basin waters, and with differences in sea lion foraging ecology and population trends, invoking ecosystem-based subdivision within this stock. Within the Eastern stock, new rookeries were colonized by females from both the declined (endangered) Western stock and the increasing Eastern Stock. Further, this is likely a rare event as colonists dispersed across a strong boundary at an evolutionary scale. Density-dependence is implicated in both cases of individual transfer. Limits to migration distance and conspecific attraction influenced the sequence of rookery colonization. In addition to reducing birth and increasing death rates, this study demonstrates that resource limitation may trigger an exodus of breeding animals from declining populations, with substantial impacts on distribution and patterns of genetic variation.

Open Water Steller Sea Lion Research Station provides new insights into the real costs of diving for food

Andreas Fahlman, Marine Mammal Research Unit, University British Columbia,

Vancouver, BC. V6T 1Z4, Canada, fahlman@zoology.ubc.ca Gordon Hastie, Sea Mammal Research Unit, St. Andrews Scotland David A.S. Rosen, Marine Mammal Research Unit, University British Columbia,

Vancouver, BC. V6T 1Z4, Canada

Andrew W.. Trites1. Marine Mammal Research Unit, University British Columbia, Vancouver, BC. V6T 1Z4, Canada

Three Steller sea lions were trained to participate in free-swimming open-ocean experiments designed to estimate the energetic cost of finding prey and the implications for sea lions that are forced to seek prey at deeper depths. Animals were trained to dive to fixed depths of 5-50 m, and re-surface inside a floating dome to measure energy expenditure via gas exchange. Results to date have shown that 1) sea lions use more energy (i.e., consume oxygen at a higher rate) as swimming distance increases; 2) diving metabolic rate decreases exponentially with dive duration; 3) Steller sea lions glide passively as they descend beyond 5 m, but swim actively (and burn more energy) during the entire ascent; 4) deeper dives are energetically more expensive than shallow dives of the same duration; 5) seasonal fluctuations in buoyancy (body fat) does not appear to affect the energetic cost of diving; 6) dive depth and swimming distance have a greater effect on metabolism than environmental factors such as water temperature. These results provide the first estimates of the energetics costs of foraging and suggest an adult Steller sea lion requires between 8 to 18 kg of food per day. These data have important implications for interpretations of diving behavior in the wild, and for predicting the effects of fishing and regime shifts on the foraging strategy of wild sea lions and the overall health of their populations. (Support: North Pacific Marine Science Foundation and NOAA).

Linking seasonal distribution patterns with prey availability in a central-place forager, the Steller sea lion

Jamie N. Womble, National Park Service, Coastal Program, Glacier Bay Field Station, Jamie_Womble@nps.gov Michael F. Sigler, NOAA Fisheries Alaska Fisheries Science Center,

Auke Bay Laboratory, Mike.Sigler@noaa.gov Mary F. Willson, School of Fisheries and Ocean Sciences, University of Alaska Fairbanks, mwillson@gci.net

Seasonal movements of predators to foraging areas are driven chiefly by the spatial and temporal distribution and predictability of food; however, prey yields may vary from season to season, with predators adjusting their foraging effort accordingly. We assessed changes in the temporal and spatial distribution of Steller sea lions at haulouts in southeastern Alaska. Specifically, our objectives were to (1) classify seasonal distribution patterns of sea lions and (2) determine to what extent the seasonal distribution of sea lions is explained by seasonal concentrations of prey. Sea lions were counted monthly by aerial survey at 24 terrestrial sites from 2001-2004. Hierarchical cluster analysis (HCA) and principal component analysis (PCA) were used to classify seasonal distribution patterns of sea lions. HCA and PCA revealed four distinct patterns. During December, 55% of the sea lions in the study area were located near overwintering herring aggregations (Type I sites). During May, 56% of sea lions were located near aggregations of spring-spawning forage fish (Type II sites). In July, 78% of sea lions were located near summer migratory corridors of salmon (Type III sites). During September, 44% of sea lions were located near fall migratory corridors of salmon (Type IV sites). Seasonal attendance patterns of sea lions were associated with the seasonal availability of prey near haulouts and reflected seasonal foraging strategies of sea lions. Given the central-place foraging strategy of sea lions, it is necessary for sea lions to move among several haulouts throughout their annual cycle to exploit seasonally available prey resources.

The role of predation by Steller sea lions in the population decline of harbor seals in Glacier Bay National Park, Alaska

Elizabeth A. Mathews, University of Alaska Southeast, Natural Sciences Department, Juneau, Beth.Mathews@uas.alaska.edu

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Milo Adkison, University of Alaska Fairbanks, Juneau Center of Fisheries and Ocean Science, Juneau

Direct observations of predation by top-level carnivores on marine mammals are usually rare, sometimes leaving researchers to assume that their occurrence is also rare. However, upon quantification this predation may be found to be important. From 1992-2002, harbor seal numbers in Glacier Bay declined by 65%, from 7,200 down to 2,500. Increased predation by Steller sea lions is one hypothesis proposed for this large decline. Steller sea lions were first observed preying on seals in Glacier Bay in 1995; since then 13 predatory attacks have been directly observed. We developed a model to evaluate the likelihood that sea lion predation was a factor in the population decline using a range of assumptions from realistic to conservative. We conducted this analysis on two scales: one of a large haulout area where long-term seal studies had been conducted (Spider Island complex), and the other for Glacier Bay based on three independent sets of observer data. At the Spider Island complex, estimates of mortality from sea lion predation ranged from 26 to 62 seals per year and in 4 of 7 years after 1995 our realistic model accounted for the entirety of annual pup production. The probability that similar levels of predation had been occurring before 1995 was low (Spider Island) to very low (all of Glacier Bay). We conclude that increased predation by Steller sea lions beginning around the mid-1990s is a factor in the population decline of harbor seals.

Strong Seasonal Dynamics of Harbor Seals, An Upper-Trophic Predator in Cook Inlet

Peter L. Boveng, Josh M. London, and Robert A. Montgomery NOAA Alaska Fisheries Science Center, National Marine Mammal Laboratory

During a three-year field study of harbor seals in Cook Inlet, Alaska, we observed strong seasonal changes in numbers of seals ashore, the extent of foraging movements, and marine habitat use. We conducted aerial surveys of seals ashore in June, August, October, and April, beginning in June, 2003 and concluding in October, 2005. We deployed satellite-linked dive recorders (SDRs) on a total of 76 seals in September, 2004, May and September, 2005, and May, 2006, to record movements, diving, and time spent ashore. The counts of seals ashore were highest in June and August, reflecting this species' well-known propensity to spend time ashore during the pupping and molting periods, respectively. During October and April, when the seals were not constrained by those shore-based life history events, the numbers ashore were only about 35% of the summer peak. These patterns were consistent with the behavior of the seals tagged with SDRs. The tagged seals spent less time ashore, and ranged much more widely at sea during the fall and winter months than during the spring and summer. The foraging areas used most intensively by the tagged seals varied among individuals, some of which made several trips out of Cook Inlet to the Gulf of Alaska and Shelikof Strait. These seasonal changes in distribution and behavior have fundamental implications for the seals' predator-prey interactions and for management considerations, such as the risk of impacts from industrial activities and the assessment of impacts on local seal populations from mortality incidental to commercial fisheries.

Impact of ecotourism on Harbor seal (*Phoca vitulina*) behavior in Pedersen Lake, Kenai Fjords National Park

Caroline Jezierski^{1,3}, Brenda Norcross² and Anne Hoover-Miller³

- 1. School of Fisheries and Ocean Science, University of Alaska, Fairbanks, caroline jezierski@alaskasealife.org
- 2. Institute for Marine Science, University of Alaska Fairbanks
- 3. Alaska SeaLife Center

As marine ecotourism expands, assessments of its impacts on wildlife and ecosystems are needed. Kenai Fjords National Park was established in 1980 and has increased in popularity for both large tour vessels and sea kayakers. The population of harbor seals (Phoca vitulina) in the Aialik Bay area has experienced more than an eighty percent decline during the past 25 years. Since 2002, a network of remotely operated cameras has been used near Aialik and Pedersen glaciers to monitor the number of seals in this population and their responses to vessels. In the summer of 2005 an in-depth study on the impacts of sea kayak tourism on harbor seals in Pedersen Lake was initiated after increasing numbers of sea kayakers were observed in this secluded haulout. The objectives of this study are to quantify whether seal activity level increases the presence of humans (sea kayaking or walking along the shore) and to determine if inter-annual variability in harbor seal behavior is evident. Seal behavior was recorded during the molt from July through September (2004-2006) via the remotely controlled video camera system and by direct field observation (2005-2006). Results indicate the mean activity level of harbor seals is significantly higher in the presence of sea kayakers and walkers than when human influence is absent and behavior results from all years are significantly related although conditions in the lake have varied throughout the years. Preliminary results suggest that seals exhibit a tiered, but widespread, response to sea kayakers and walkers.

Distribution and habitat characteristics of fin and humpback whales off northeast Kodiak Island during summer, 2002 and 2003

Lisa Baraff, School of Fisheries and Ocean Sciences, University of Alaska Fairbanks, Fairbanks, <u>fslsb1@uaf.edu</u>

Kate Wynne and Robert Foy, Fishery Industrial Technology Center, School of Fisheries and Ocean Sciences, University of Alaska Fairbanks, Kodiak

Summer distributions of fin (Balaenoptera physalus) and humpback (Megaptera novaeangliae) whales were examined relative to bathymetry, oceanography, and zooplankton composition and density in Marmot and Chiniak Bays (Kodiak Island, AK) during 2002 and 2003. Habitat use and habitat partitioning were assessed using Monte Carlo and randomization tests, logistic regression analyses, and kernel density probability contours of high-use areas. Fin whales associated with deeper, cooler waters near areas of maximum slope and consistently used Marmot Bay. Fin whale spatial-temporal distribution likely coincided with *Neocalanus* copepod concentrations during early summer and adult euphausiids later in summer. Fin whale associations with Pseudocalanus copepods may relate more to that copepods' prevalence than to relevance as prey. Humpback whale site fidelity and association with shallow waters was evident in 2002, but not in 2003. Variability in humpback whale distribution was likely related to their exploitation of forage fish aggregations and threshold foraging needs. High densities of adult euphausiids may promote spatial overlap and shared resource use by fin and humpback whales. This mesoscale snapshot of a dynamic nearshore marine environment and the whales foraging there is an integral step toward identifying and characterizing important habitats for endangered fin and humpback whales.

Remote Monitoring of Vital Rates in Harbor Seals (Phoca vitulina)

Gail Blundell, Grey Pendleton and Tom Straugh

Alaska Dept. of Fish and Game gail blundell@fishgame.state.ak.us

Harbor seals (*Phoca vitulina*) declined by >63% in Prince William Sound (PWS) since ~1980 and continue declining at 2.4%/yr (1990-2005). Declining populations can be evaluated by estimating long-term survival and reproduction and quantifying effects of proximate factors on those vital rates. In 2003, we initiated a vital rates study in PWS; 122 harbor seals (70.5% females, 61.5% <1 year old) received subcutaneously-implanted 5-yr VHF transmitters with mortality sensors. We conduct a comparable study (155 5-yr VHF implants) in the rapidly declining seal population in Glacier Bay (GLBA). At capture/tagging we collect samples to assess age, genetics, body condition and health, diet, immunocompetency, reproductive condition, disease status and contaminant load. In 2005, with NPRB funding, we established six remote-monitoring stations in PWS that transmit presence/survival data from radio-tagged harbor seals via GOES. Survival data from VHF implants paired with health-related data for those individuals may identify variables that differentiate between seals that survive and non-surviving/censored seals; potentially elucidating factors contributing to seal declines. Code was written to automatically download GOES-transmitted data and sort/filter data. eliminating false positives (~25% of data). Preliminary results (log-linear models) for telemetry-resight data from remote stations indicate that resight rate was highest in year tagged, with possible age*mark*year effects. Both sexes had equal resight probability. Area comparison (females only) showed weak evidence of higher resight probability in GLBA; pups were less likely to be resigned in subsequent years. Estimates of survival rates and multivariate analysis of health data, relative to survival, will be conducted in the future.

Changes in the foraging behavior and physiology of young Steller sea lions, Eumetopias jubatus, over their first winter

Carrie Beck Eischens, Michael Rehberg and Cheryl Clark Alaska Department of Fish & Game, Anchorage Lorrie Rea, Alaska Department of Fish & Game, Fairbanks

In young air-breathing marine vertebrates, the transition to independent foraging requires balancing at-surface oxygen uptake with underwater nutrient acquisition. Foraging in young animals is expected to be limited by low aerobic capacity and small body size which physiologically limits diving ability. Understanding how diving behavior develops in relation to total body oxygen (TBO) and how nutrient source impacts diving behavior are critical to understanding the transition to independent foraging. In a longitudinal study we examined the foraging behavior of eight Steller sea lions over their first winter using archival time depth recorders. We also examined changes in TBO and correlated behavioral information with nutritional source. Nutritional source was categorized as 'maternally dependent' if the animal was re-sighted suckling or if milk was obtained from gastric sampling at recapture. Animals for which maternal dependence could not be verified were classified as being of 'unknown' nutritional source. Diving behavior changed over time with significant increases in dive duration (p=0.035) and effort (p=0.003) and a significant decrease in time at surface between dives (p=0.049). Animals that were still maternally dependent spent longer periods of time at the surface between dives (p=0.017) and performed fewer dives/day (p=0.016) than animals whose nutritional source was unknown. Mass and TBO increased over time (p<0.001 and p=0.045) but did not differ significantly between nutritional source groups (p=0.577 and p=0.233). Thus, differences in diving behavior may be more strongly influenced by nutritional sources than by physiological ability.

Persistent organic pollutants in Steller sea lions

Kathrin Hülck, Su-Meong Hong, Dongli Wang, Qing X. Li

Department of Molecular Biosciences and Bioengineering, University of Hawaii, Honolulu, HI, qingl@hawaii.edu

Shannon Atkinson, University of Alaska Fairbanks, School of Fisheries and Ocean Sciences Fairbanks and Alaska SeaLife Center

Steller sea lion (Eumetopias jubatus) are endemic to the Northern Pacific Ocean, where they habit the eastern and western coasts. The western stock has declined by ~80% over the past 30 years, which led to its listing as 'endangered' in 1997. Pollution is one of the suspected causes of this decline. Large body-lipid reserves and their position in the food chain make Steller sea lions highly susceptible to bioaccumulation of persistent organic pollutants (POPs) such as polychlorinated biphenyls (PCBs) and organochlorine pesticides (OCPs). In the Arctic, Steller sea lion are hunted by the aboriginal community to enrich their diet. POPs have shown adverse effects, e.g., immune impairment and reproduction failure on mammals. Despite abundant documentation of pollution in marine mammals, data for Steller sea lion are rare. Blubber samples of male Steller sea lion from Tatitlek, St. Paul and Olutorsky Gulf were analyzed for PCB and OCP content. Total PCB concentrations for all animals ranged from 612-2994 ng/g dw. PCB-153 and 138 were the abundant congeners. Among 13 dioxin-like PCBs, only congeners 105, 118, 170 and 180 were detected in all blubber samples. The most toxic dioxin-like PCB 126 was not detected in any of the samples. Nine fresh placentae were found on rookeries on the Aleutian Islands and from Hokkaido, Japan. Average concentrations of total PCBs in the placentae were 860 ng/g lw. PCB-118 was the dominant congener followed by PCB-153. PCBs-90/101, 118 and 153 accounted for 32% of total PCBs.

Monitoring changes in the distribution and abundance of warm-water gadfly petrels (*Pterodroma* spp.) in the subarctic North Pacific using vessels of opportunity (2002 - 2006)

David Hyrenbach, Duke University Marine Lab., khyrenba@duke.edu Ken Morgan, Environment Canada Mike Henry, University of British Columbia Chris Rintoul, PRBO Conservation Science Gary Drew, U.S. Geological Survey - Alaska Science Center John Piatt, U.S. Geological Survey - Alaska Science Center William Sydeman, PRBO Conservation Science

Gadfly Petrels (*Pterodroma* spp.) are medium-sized (< 1m wingspan) surface-feeding tubenose seabirds (Procellariiformes), which disperse widely across the Pacific Ocean. While the marine ranges of many North Pacific petrels are poorly understood, these species often inhabit specific oceanographic domains. Thus, shifts in their distributions are indicative of changing water mass distributions. For instance, increases in warmwater petrel sightings off North America's west coast have been ascribed to warmer ocean conditions.

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In 2002, we initiated a monitoring program to survey marine birds and mammals from British Columbia (Canada) to Hokkaido (Japan) using the bulk-cargo carrier Skaubryn as a platform of opportunity. This project supported by the North Pacific Research Board, documents spatial patterns and temporal fluctuations in upper-trophic predator community structure across the subarctic North Pacific Ocean and the southern Bering Sea. Herein, we summarize seasonal (spring, summer, fall) and interannual (2002-2006) petrel sightings across our study area. In particular, we focus on the occurrence of several subtropical species in the Gulf of Alaska. We compare their contemporary distribution and abundance with historical (1980s) surveys in the North Pacific Pelagic Seabird Database (NPPSD), archived by USGS and USFWS. Recent surveys have documented sightings of eight gadfly petrel species: Bonin, Cook's, Hawaiian, Herald, Juan Fernandez, Mottled, Murphy's and Solander's. Perhaps the most striking result is the presence of Murphy's petrels (Pterodroma ultima) during all three survey seasons. This baseline information, coupled with historical datasets and future surveys, will allow researchers to assess changes in the biogeography of the subarctic North Pacific.

Identifying regional variation in harbor seal fatty acid signatures using analysis of similarity (ANOSIM)

Shawna Karpovich, Alaska Department of Fish and Game,

shawna karpovich@fishgame.state.ak.us

John R. Moran, AFSC/Auke Bay Laboratory, NOAA Fisheries, John Moran@noaa.gov

A decline in prey availability and quality is a common hypothesis proffered to explain declines in several marine mammal populations. We used analysis of similarity (ANOSIM) to compare blubber fatty acid (FA) signatures from 350 harbor seals in five regions of Alaska with differing population trends: Glacier Bay (GB) which is decreasing rapidly (-14.7% 1992-2005); Prince William Sound (PWS) which is stabilizing with an increasing short-term trend (-2.4% 1990-2005; +9.0% 2000-2005); Southeast (SE) which is stable (+0.6% Sitka, 1984-2005) or increasing (+5.0% Ketchikan, 1983-2003); Bristol Bay (BB) which is increasing (+7.0% 1995-2005); and Tugidak Island (Tug), which is increasing (+7.5% Kodiak, 1993-2004). Dietary fatty acid composition influences the composition of blubber, thus, the FA composition, or signatures from blubber can be used to indicate variations in harbor seal diets. We found significant differences in FA signatures between all five regions. PWS and GB were most similar (ANOSIM R = 0.355, p<0.001) and both had decreasing population trends when blubber was collected (1997-2001). We found the greatest difference in fatty acid signatures when comparing Tug to GB (ANOSIM R = 0.826, p<0.001) and Tug to PWS (ANOSIM R = 0.837, p<0.001); regions with opposite population trends during sampling. Our analysis indicates that harbor seals from these five sites differ in diet composition, which may support the hypothesis that prey availability or quality influences population trends. Further investigation on other factors that may differ among populations is required.

Rearticulation of an orca from Prince William Sound, Alaska

Allen Marquette, Prince William Sound Science Center, allen@pwssc.gen.ak.us

On July 11, 2000, an orca whale beached and subsequently died in Hartney Bay, five miles southwest of Cordova, in Prince William Sound. The whale was later identified as Eyak, a member of the transient AT1 group, also referred to as the Prince William Sound transients. When news of the stranded whale reached the Science Center and U.S. Forest Service, an attempt was made to help him through the low tide cycle. Despite rescue efforts, he died around 4:30 that afternoon. It was quickly decided the skeleton of the whale should be salvaged and re-articulated for educational purposes. In a collaborative effort of the PWSSC, the Native Village of Eyak, the U.S. Forest Service and many of Cordova's residents, the process of cleaning and rearticulating the skeleton began. After five years of work, the rearticulated skeleton of Eyak was completed and displayed in the Ilanka Cultural Center in Cordova, Alaska.

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Regional and seasonal variation in the diet of Steller sea lions in the Kodiak Archipelago, 1999-2005.

Jane McKenzie and Kate Wynne

School of Fisheries and Ocean Sciences, University of Alaska Fairbanks, Kodiak

The shelf, coastal and inside waters of the Kodiak archipelago present a mosaic of marine habitats. Productivity and biodiversity in the region is also influenced by two main current systems; the Alaskan Coastal current which passes to the west of Kodiak through the Shelikof Strait, and the Alaskan Stream which passes along the northeastern coast. Steller sea lions (Eumetopias jubatus) utilise a number of terrestrial haulouts throughout the Kodiak archipelago and, as central-place foragers, are likely to be influenced by availability of prey at a local level. Spatial and temporal variation in the diet of sea lions in the Kodiak area was investigated using scats (fecal samples) collected from 10 sites from 1999 to 2005. Over 2,700 scats with identifiable prey were collected from the north, east and western side of Kodiak Island. Of the 76 prey taxa identified the most important species in term of frequency of occurrence and numerical abundance were: Pacific sand lance, walleye pollock, arrowtooth flounder, Pacific cod, Pacific salmon, and Pacific herring. Significant differences in prey composition were found among regions, seasons and years. Pacific herring dominated the diet on the west coast and accounted for most of the differences in regional diet in spring and winter. Similarity between regions in prey consumed was greatest in fall and winter and lowest in spring. Annual variation in diet was relatively low in winter, while spring and fall diets varied from year-to-year, with regional-specific shift in dominant prey.

Assessing the effects of nutritional stress on lactating female Steller sea lions (*Eumetopias jubatus*) and their pups in temporary captivity

Sarah E. Norberg, Alaska SeaLife Center, Seward, sarah_norberg@alaskasealife.org Vladimir N. Burkanov, National Marine Mammal Laboratory, Seattle, and

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Kamchatka Branch of the Pacific Institute of Geography, RAS, Petropavlovsk-Kamchatsky, Russia, vladimir.burkanov@noaa.gov

Russel D. Andrews, Alaska SeaLife Center, Seward, and School of Fisheries and Ocean Sciences, University of Alaska Fairbanks, russ andrews@alaskasealife.org

Steller sea lion (SSL) populations in Alaska and Russia have declined dramatically over the last 30 years. Although nutritional stress has been implicated in these declines, the mechanisms linking foraging success to reproductive success are unclear. We conducted this study to explore the feasibility of capturing and holding mother/pup pairs in temporary captivity to determine how reduced energy intake affects the lactating female's ability to meet the energy requirements of a growing pup and future reproduction. In July 2005, three mother/pup pairs were captured on Lovushki Island, in the Kuril Islands where SSL populations have been increasing for 15 years. They were held at a temporary facility on Paramushir Island for 34 days. Females were fed a diet of herring. All 3 lost mass with a mean daily percent mass loss of 0.75, 0.30, and 0.16%. Pups nursed consistently throughout the study period and displayed an increase in mass (average daily gain of 0.14 to 0.36 kg d⁻¹) correlated to the condition of their mothers. All blood chemistry parameters except blood urea nitrogen (BUN) were unexceptional. BUN levels decreased over time demonstrating the typical protein-sparing response of a fasting adapted animal exposed to negative energy balance (NEB). Pup BUN values were within the normal reported range. Changes in nutrient composition of milk varied between females depending on food intake. Despite one month of NEB, the female in the poorest body condition returned to the rookery to successfully give birth one year later.

What's Washed In: What Beached Birds Can Say about the Ocean

Julia K. Parrish¹, Nicholas Bond², Hannah Nevins³, Kate Litle¹, Andre Punt¹, Nathan Mantua^{1,2}, Robert Loeffel⁴, James T. Harvey³

- 1. School of Aquatic and Fishery Sciences, University of Washington, Seattle
- 2. Joint Institute for the Study of the Atmosphere and Ocean, University of Washington, Seattle
- 3. Moss Landing Marine Laboratories, Moss Landing, CA
- 4. 9626 SE Cedar St., South Beach, OR 97366

Seabirds have long been touted as environmental indicators, because of their collective potential to integrate top-down, bottom-up, and anthropogenic signals. But long-term data on live birds is difficult to collect. Beached bird programs offer a relatively inexpensive alternative dataset, as programs are largely manned by volunteers. Once a baseline is established, beached bird patterns may indicate evidence of climate change/impact, presence of avian flu, impact of oil pollution, fisheries interactions, or shifts in food webs. Large-scale die-offs of seabirds, known as wrecks, may indicate particular combinations of environmental conditions. This talk presents a model program: COASST - the Coastal Observation and Seabird Survey Team. Started in the Pacific Northwest, COASST is a citizen science program that trains local residents to walk their beach, collecting independently verifiable data on beached marine life. At present over 350 volunteers staff more than 200 sites from Humboldt County in northern California to the Pribilof Islands in the Bering Sea. COASST data have been used to explore (1) climate impacts and (2) oiling impacts in the lower 48, both of potential relevance to Alaskan environmental health. (1) We used data from three volunteer-based beached bird datasets collected within the California Current System (BeachCOMBERS in Monterey Bay, CA; R. Loeffel in Newport, OR; COASST in northern Oregon and the outer coast of Washington) to explore the level of response to anomalous ocean conditions in 2005. During the winter, wrecks of Cassin's Auklets and Rhinoceros Auklets occurred in California. By spring, anomalous die-offs of Brandt's Cormorants and Common Murres occurred throughout the central and northern CCS. Increased beaching rates of piscivorous birds were associated with weaker winter and spring upwelling, winter storminess, and poleward transport of coastal surface waters, all forces that would create poor foraging conditions and/or drive carcasses towards shore. (2) COASST data, specifically, have been used to create a contemporary baseline against which the effects of oil spills can be hindcast. Cluster analysis indicated that the species distribution of carcasses immediately following three large oil spills in Washington and Oregon were significantly different from the 'normal' species distribution patterns, suggesting some species were at high risk of oiling (e.g. murres, scoters) whereas others were at lower risk than normal (e.g., fulmars). More generally, these analyses shown that citizen-staffed beach surveys are an obvious way to gather high quality, high relevance data over a large spatio-temporal scale at little cost.

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Growth and Condition of Captive Harbor Seals on a Low Lipid Diet

Lori Polasek, Alaska SeaLife Center and Univerity of Alaska Fairbanks, <u>lori_polasek@alaskasealife.org</u> Anne Hoover Miller, Alaska SeaLife, <u>AnneH@alaskasealife.org</u>

A change in prey abundance or availability has been proposed to explain diminished numbers of marine mammals in the Gulf of Alaska. To investigate long-term health consequences associated with diet of harbor seals, we captured 8 female pups in two cohorts (2004 and 2005) to participate in long-term research on the nutritional physiology of young harbor seals. Each seal was assigned to one of two dietary groups. Both groups received an identical base diet including species with < 4% fat (pollock, squid, capelin) for dietary balance. The remainder of their diet is herring - either high fat ($\sim 16\%$ lipids) for Group A seals or low fat (<6% lipids) for Group B seals. Group A were fed to trainable satiation. Group B seals receive the same diet as a proportion of their weight. except that low fat herring is substituted for high fat herring. Every 6 weeks condition parameters were measured including percent body fat, blubber thickness, mass and morphometrics. During the first 9 months to a year the seals showed similar growth rates, fluctuations in body mass, and percent body fat regardless of their diet. Differences in growth parameters were associated with weaning mass. The smallest seals on the high fat diet (Group B) showed little progress in weight gain and lost blubber depth. Conversely, the largest seal showed little fluctuation in mass or percent fat despite being on a low fat diet. Dietary influence appears to take effect as the animals' transition into their second year of life.

Seasonal correlations of muscle biochemistry and body condition in adult harbor seals in Glacier Bay, Alaska

Jill S. Prewitt¹, Jennifer M. Burns¹, Gail M. Blundell²

- 1. Dept. of Biological Sciences, University of Alaska Anchorage
- 2. Statewide Marine Mammal Program, Harbor Seal Research, Alaska Dept. of Fish and Game

Phocid seals' muscles display a suite of physiological adaptations that allow them to function during dives when oxygen is not freely available: high myoglobin concentrations [Mb], high densities of Type I (slow oxidative) and Type IIa (fast oxidative-glycolytic) fibers, and high aerobic and anaerobic enzyme activities. Phocid seals also show large seasonal shifts in body composition that are associated with shifts in diet and/or life history events such as reproduction and molt. In terrestrial species, changes in diet and body condition are known to impact fiber type densities, fiber diameters, lipid droplet densities, and enzyme activities. For diving seals, such changes could impact their ability to dive, and therefore forage efficiently. To determine if muscle biochemistry changes seasonally in association with shifts in body condition, we measured body condition (% lipid, via deuterium labeled water) and collected muscle biopsies from adult harbor seals (Phoca vitulina) in Glacier Bay, Alaska across different seasons (Fall n=15; Spring n=15). We examined the correlation between body condition, muscle enzyme activities (LDH, CS, HOAD), and [Mb]. We found that, despite increases in body condition from fall to spring, there were no significant differences in enzyme activities between the two seasons. This suggests that muscles do not rely more heavily on lipid based metabolism during periods where body condition is increasing. Future research will include determining muscle fiber types, lipid and glycogen stores, mitochondrial densities, and capillary densities using light and transmission electron microscopy.

Got milk? Assembling physiological indices of weaning for Steller sea lions

Lorrie Rea, Alaska Department of Fish and Game, Division of Wildlife Conservation, Lorrie Rea@fishgame.state.ak.us

Carrie Beck Eischens, Alaska Department of Fish and Game, Division of Wildlife Conservation, Charlotte_Eischens@fishgame.state.ak.us

Vicki Stegall, Alaska Department of Fish and Game, Division of Wildlife Conservation, Vicki Stegall@fishgame.state.ak.us

Sean Farley, Alaska Department of Fish and Game, Division of Wildlife Conservation, Sean Farley@fishgame.state.ak.us

Kimberlee Beckmen Alaska Department of Fish and Game, Division of Wildlife Conservation, Kimberlee Beckmen@fishgame.state.ak.us and

Kenneth Pitcher, Alaska Department of Fish and Game, Division of Wildlife Conservation, <u>Ken_Pitcher@fishgame.state.ak.us</u>

It is difficult to define weaning in sea lions, and even more difficult to determine when and how it occurs. Our approach with Steller sea lions (SSL) has been to assemble a number of physiological indices that each contribute to our understanding of how a young animal is making its living; whether individuals are ingesting milk, ingesting living prey, or both at the time of capture and when and how abruptly this nutritional transition occurs. Presence of milk in the stomach provides positive identification of nursing animals (n=75). Presence of particular parasites which require a fish intermediary host imply at least minimal prey ingestion. High blubber or serum levels of specific fatty acids which are typically underrepresented in milk production identify young sea lions which are ingesting prey high in these fatty acids (n=477). Changes in the levels of stable isotopes of carbon and nitrogen deposited in the vibrissae indicate that a diet lower in trophic signature than milk has been ingested, in addition to or replacing the milk diet (n=87). In juvenile SSL peak nursing ¹⁵N values (20.0 +/- $0.1^{\circ}/_{00}$) were followed by decreases of 2.3 to $5.0^{\circ}/_{\circ\circ}$ towards the root, suggesting a dietary switch. Each of these indices by itself cannot discretely identify the source of nutrition (milk, prey or both), but in combination can be used with other biochemical markers and behavioral observations to build a case identifying where each individual is along the continuum to nutritional independence.

Recommended deterrents and fine scale behavioral observations of sperm whales near longline fishing vessels in the Gulf of Alaska

Janice Straley, University of Alaska Southeast, Sitka; Jan.Straley@uas.alaska.edu
Aaron Thode, Marine Physical Laboratory, Scripps Institution of Oceanography,
San Diego athode@ucsd.edu
Victoria O'Connell, Alaska Department of Fish and Game, Sitka
victoria_oconnell@fishgame.state.ak.us
Linda Behnken, Alaska Longline Fishermen's Association, Sitka,
alfafish@ptialaska.net
Sarah Mesnick, Southwest Fisheries Science Center, NOAA Fisheries, La Jolla, CA
Sarah.Mesnick@noaa.gov
Joe Liddle, University of Alaska Southeast, Sitka,
Joe.Liddle@uas.alaska.edu

Since 2003, the NPRB has funded a collaborative study among fishermen, scientists and managers to collect quantitative data on depredation of sablefish demersal longline gear by sperm whales. The goal is to characterize the whales involved, determine mechanics of depredation, and recommend changes in fishing behavior to reduce depredation.

We collected fishing and whale behavioral, genetic and photographic data. The number of whales near a vessel ranged from one to ten. Whales were present at a third of the hauls and evidence of depredation was noted for 71% of these sets (n=124). Genetics determined the whales (n=16) were male and 81 were individually photo-identified. Bayesian mark-recapture analysis estimated 96 (64, 134; 95% credible interval) whales in the study area off Sitka.

Passive acoustic recorders attached to longline gear permitted continuous monitoring of the underwater noise environment, including sperm whale activity, before and during a longline recovery. We found evidence that cavitation noise from engines is correlated with changes in acoustic activity of sperm whales, while activation of vessel hydraulics or cable strum was not.

We successfully tested three passive deterrents: decoy anchorlines; hydrophones for passive acoustic monitoring and minimizing engine cycling during the haul. We determined there were fewer interactions and whales were less likely to follow a vessel using one or more of these strategies. Finally, to observe how animals depredate on individual fish, we attached a DVCAM on a longline during a haul and recorded video and audio of two sperm whales interacting with the line.

Isotopic and Osteometric Evidence of Temporal Ecosystem Change in the Shelikof Strait from Archaeologically Deposited Harbor seal (*Phoca vitulina*) Remains

Cody Strathe, University of Alaksa Fairbanks, ftcjs@uaf.edu Maribeth Murray, University of Alaska Fairbanks, <u>ffmsm@uaf.edu</u>

The Gulf of Alaska ecosystem has experienced dynamic variability over the past 6500 years. Prehistoric humans and their subsistence resources have been greatly affected by ecosystem change. These archaeological sites have left a wealth of faunal data in stratified datable layers. Examining isotopic and osteometric data from these archaeologically deposited faunal remains provides a high resolution view of cultural and ecological change at large temporal scales. Harbor seal (*Phoca vitulina*) remains from the Mink Island Archaeological Site in Shelikof Strait have been analyzed for ¹³C and ¹⁵N to produce a proxy of ecosystem productivity over the past 6500 years. The ¹³C values illustrate patterns of variability in productivity from the mid-Holocene to present. The ¹⁵N values illustrate shifts in trophic levels. Other faunal data, such as osteometrics, are compared with this proxy to analyze variability in the ecosystem and its affects on harbor seal and human populations as exhibited in the Mink Island Archaeological site.

Spring-Spawning Eulachon: A 'Window of Opportunity' for Steller Sea Lions

Johanna J. Vollenweider, Jamie N. Womble, David J. Csepp, and Ron A. Heintz NOAA Fisheries-Alaska Fisheries Science Center, Auke Bay Laboratory Juneau; Johanna.Vollenweider@noaa.gov

Variation in prey consumption patterns suggests Steller sea lions forage on seasonally abundant and densely aggregated prey; however, several species are only aggregated for brief periods during spawning seasons. Eulachon are an energy-rich and densely aggregated prey resource which spawns during spring, an energetically demanding time for sea lions. We assessed the response of sea lions to pre-spawning aggregations of eulachon by conducting (1) hydro-acoustic prey surveys to estimate fish availability, (2) proximate analysis of eulachon to estimate energy content, and (3) aerial surveys to assess the numerical response of sea lions to eulachon. Weekly surveys were conducted at 5 eulachon spawning sites (Taku, Berners, Chilkat, Lutak, Taiya) in southeastern Alaska between April and May 2006. Eulachon began to aggregate on April 10 at Taku, the most southerly site; however, spawning aggregations were detected as late as May 7 at Taiva, the most northerly site. Sea lion abundance varied across sites reflecting availability of eulachon, with peaks in sea lion abundance as high as ~400 individuals at Lutak. Lipid content of eulachon varied among spawning sites as a result of variability in fish size; however, on a relative basis, % lipid was similar. Although eulachon are available throughout the year to sea lions, the density of eulachon at spawning sites appears to elicit an aggregated response by sea lions during spring. The 'window of opportunity' for sea lions to exploit aggregated eulachon may span three months with numerous eulachon runs available for exploitation by individual sea lions in southeastern Alaska.

Prenatal Exposure of Harbor Seals to Persistent Organic Pollutants

Dongli Wang and Qing X. Li, Department of Molecular Biosciences and

Bioengineering, University of Hawaii, Honolulu, HI; qingl@hawaii.edu Shannon Atkinson and Anne Hoover-Miller

Alaska SeaLife Center, Seward

The population decline or inhibitory recovery of Alaskan harbor seals (*Phoca vitulina*) is of great concern. Exposure to persistent organic pollutants (POPs) has been proposed being a suspected factor to cause their poor survival and reproduction. In this study, tissue samples including liver, blubber, brain, and placenta in pregnant Alaskan harbor seals and the fetuses were collected for the analysis of organochlorine pesticides (OCPs), polychlorinated biphenyls (PCBs), polychlorinated naphthalenes (PCNs) and polybrominated diphenyl ethers (PBDEs) by using gas chromatography-ion trap mass spectrometry. The results showed that a quantity of POPs in mother harbor seals was transferred to fetus during pregnancy and distributed among the liver, brain and blubber of the fetus. HCH congeners, hexachlorobenzene, PCB, PCN and PBDE congeners with lower halogen substitutions were selectively transferred to fetuses, and DDE and the highly halogenated PCB, PCN and PBDE congeners were retained in mother harbor seals. Transfer of the POPs from mother to pup harbor seals can pose a threat on the critical early development of seal pups.

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Using Stable Isotopes to Assess Population Structure and Feeding Ecology of North Pacific Humpback Whales (*Megaptera novaeangliae*)

Briana H. Witteveen^{1,2}, Graham A.J. Worthy² and Kate M. Wynne¹

- 1. University of Alaska Fairbanks, Fishery Industrial Technology Center, Kodiak
- 2. University of Central Florida, Department of Biology, Physiological Ecology and Behavior Laboratory, Orlando, FL

Stable isotope analysis has proved to be a valuable technique for providing information on trophic position, diet, and feeding origins of many species of migratory animals. The North Pacific humpback whale represents an important migratory species for which stable isotope ecology studies are ideal. Skin from biopsy samples collected as a part of the Structure of Populations, Levels of Abundance and Status of Humpback whales (SPLASH) project from both seasonal feeding and breeding areas throughout the North Pacific are being analyzed for nitrogen $({}^{15}N/{}^{14}N)$ and carbon $({}^{13}C/{}^{12}C)$ isotope ratios. Results from broad and fine-scale analyses will provide a powerful tool in determining migratory movements, population structure, habitat usage and foraging ecology of North Pacific humpback whales. To date, samples from four feeding regions (Gulf of Alaska (GOA; n = 37), southeast Alaska (SEAK; n = 19), Washington (n = 12), and California (n= 19) have been analyzed for carbon and nitrogen ratios. One-way ANOVAs were significant for both carbon and nitrogen indicating mean ratio values for whales from these regions in the North Pacific are not the same. Pairwise comparisons were significant for all combinations with the exception of carbon and nitrogen between California and Washington and nitrogen between GOA and SEAK. These results suggest a similarity in trophic positions and prey choices for humpback whales feeding in California and Washington and for humpback whales feeding in GOA and SEAK. Analysis of an additional 1,500 samples collected from all breeding and feeding grounds in the North Pacific is currently underway.

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Contaminant Monitoring in Alaska by the National Status and Trends Mussel Watch Project

Dennis Apeti, Kimani Kimbrough and Gunnar Lauenstein NOAA National Ocean Service, Silver Spring, MD, dennis.apeti@noaa.gov

The National Oceanic and Atmospheric Administration initiated the Mussel Watch Project (MWP) in 1986 to assess the status and trends of priority pollutants in coastal waters and the Great Lakes. With a total of 300, MWP represents the longest running continuous contaminant monitoring program in U.S. Over 100 organic contaminants and trace metals are measured in bivalve mollusks nationwide. Monitoring activities are designed to quantify and assess spatial and temporal trends in coastal contamination, and to provide a baseline data to assess impacts of anthropogenic and natural events, including chemical spills, tropical storms, and hurricanes. Measurements from five longterm MWP sites in the Gulf of Alaska are used to describe the status and trends of local contamination. In response to the Exxon Valdez Oil Spill, a one time assessment was performed in conjunction with the Prince William Sound Regional Citizens' Advisory Council at six sites. Additional assessments were conducted using bivalve molluscs from St. Paul Island. The majority of the chemical contaminants measurements from Alaskan sites have relatively low concentrations. However, at some sites, concentrations of arsenic, cadmium and selenium are among the highest in the nation. Mercury concentrations were lower than the Federal Food and Drug Administration prescribed action level, but it was the only contaminant with a significant trend. Mercury exhibited an increasing trend at one site in Alaska.

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Monitoring the Mussel Minima: LTEMP Hits New Lows

William Driskell, bdriskell@comcast.net James Payne, PECI, jrpayne@sbcglobal.net Jeff Short, NMFS Auke Bay Laboratory, jeff.short@noaa.gov Marie Larsen, NMFS AUke Bay Laboratory, marie.larsen@noaa.gov Lisa Ka'aihue, PWS RCAC, <u>kaaihue@pwsrcac.org</u>

The Long Term Environmental Monitoring Program (LTEMP) has been sampling mussels (and some sediments) twice annually at ten sites in Port Valdez, Prince William Sound, and nearby Gulf of Alaska sites since 1993. Samples are analyzed primarily for polycyclic aromatic and saturated hydrocarbons (PAH and SHC). New indices have been developed to quantify the proportions of a hydrocarbon signal into dissolved, particulate/oil, and pyrogenic phases. After 1999, a decreasing trend appears in total PAH (TPAH) with current values below 100 ng/g dry weight (and many below 50 ng/g). Most currently measured samples reflect a predominantly dissolved-phase signal. This new low in TPAH likely represents ambient background levels. Furthermore, peaks and lows in total PAH trends and the similarities of the hydrocarbon signatures portray regional-scale dynamics. The five inner Prince William Sound sites have similar composition and behave similarly and yet are different from the three Gulf of Alaska sites. The two Port Valdez sites are primarily influenced by the treated ballast water discharge from the Alyeska Marine Terminal. An unreported diesel spill was detected in 2004 at Gold Creek, Port Valdez.

Scientists and Oyster Farmers Partner to Monitor Coastal Conditions

Kris Holderied, NOAA Kasitsna Bay Laboratory, <u>kris.holderied@noaa.gov</u> Scott Pegau, Kachemak Bay National Estuarine Research Reserve, scott pegau@fishgame.state.ak.us

Kaitlin Schott, University of Wisconsin at Madison, <u>kmschott@wisc.edu</u> Simeon Smith, Kachemak Bay National Estuarine Research Reserve, simeon <u>smith@fishgame.state.ak.us</u>

Ori Badajos, Kachemak Bay National Estuarine Research Reserve, ori badajos@fishgame.state.ak.us

Science-based resource management and efficient mariculture operation both require understanding of variability in coastal conditions, and an agency-industry partnership to obtain such information has been developed in southcentral Alaska. The Kachemak Bay National Estuarine Research Reserve (KBNERR) and the NOAA Kasitsna Bay Laboratory (KBL) are working with oyster farmers in Kachemak Bay to monitor ocean conditions, including temperature and plankton measurements. Recently observed water temperature increases in coastal Alaska pose a potential risk to the seafood industry from the accelerated growth of Vibrio parahaemolyticus, a cholera-like bacteria in shellfish that has limited growth in cold waters. Near-shore monitoring of temperature is also needed to help KBNERR and KBL scientists understand how large-scale changes in the North Pacific Ocean may affect local areas. The oyster farms provide a stable platform for temperature sensors, and the resulting data are being used to assess potential Vibrio risks, optimize farm operations, help target sites for long-term monitoring efforts, and provide information for other resource management needs. Oyster farmers also identified an operational need for plankton information, particularly on the distribution and settlement of larval barnacles and mussels. Since plankton abundance and distribution information is also needed by KBL and KBNERR for research supporting ecosystembased management, a cooperative plankton monitoring program was developed. Plankton monitoring protocols were created to facilitate consistent data collection by a wide range of users, with sampling conducted primarily by oyster farmers trained in these protocols and sample analysis and data management handled by the KBNERR.

Functioning in the Fjords: What does ice have to offer?

Anne Hoover-Miller, Alaska SeaLife Center, anneh@alaskasealife.org Shannon Atkinson, University of Alaska Fairbanks, shannon_atkinson@alaskasealife.org Peter Armato, Ocean Alaska Science and Learning Center, National Park Service Peter_armato.nps.gov

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John Maniscalco, Alaska SeaLife Center, John Maniscalco@alaskasealife.org

Glacial fords influenced by tidewater glaciers have been diminishing since the end of the 'little ice age' in the late 1800s. Tidewater glaciers provide distinct, dynamic marine environments. Cold, fresh, silt-laden meltwater and floating ice create a turbid estuarine environment that hosts unique assemblages of organisms. Understanding glacial ice environments requires differentiating direct effects of tidewater glaciers from the influences of fjord topography and marine circulation. High trophic organisms such as seabirds and marine mammals have proved to be tractable indicators of environmental change that are sensitive to temporal and regional flux. Nevertheless, distinguishing changes associated with glacial ice dynamics from regional, coastal conditions requires the concurrent collection of data on marine and atmospheric features within and outside glacial ice environments. At the Alaska SeaLife Center, remote video monitoring used in Ajalik Bay and on Chiswell Island measures change over time in physical and biological parameters at the head of a tidewater glacial fjord and on islands extending approximately 7 km south of the fjord. Biweekly, oceanographic profiles and vertical plankton tows are taken during the summer at stations extending the length of Aialik Bay; aerial surveys are conducted along 250 km coastline that includes seven glacial ice habitats. These data are complemented by data sets collected through the University of Alaska, National Weather Service, National Ocean Service, National Park Service, US Fish and Wildlife Service, Alaska Department of Fish and Game, US Geological Survey, the Smithsonian Institute to provide contemporary and historical information on ecosystem changes within the fjords.

Quantification of Anadromous Salmon Derived Ecological Subsidies Using Stable Isotopes of Nitrogen, Sulfur, and Carbon in Coastal Alaskan Watersheds

Thomas Kline, Prince William Sound Science Center, tkline@pwssc.gen.ak.us

Nitrogen, sulfur, and carbon stable isotope analysis (SIA) of maturing and juvenile sockeye and coho salmon, and periphyton in two Copper River delta watersheds of southcentral Alaska was used to quantify anadromous salmon derived ecological subsidies (ASDES) during 2003-2005.Maturing salmon were isotopically enriched relative to alternate freshwater N, S, and C sources as expected, with differences consistent with species trophic level differences, and minor system, sex, and year-to-year differences. Periphyton from and near spawning sites was relatively S-34 and N-15 enriched, and at all freshwater sites was relatively C-13 depleted. S-34 and N-15 was generally depleted at sites with low salmon abundance. S-34 was depleted enough at some sites to be suggestive of sulfate reduction. No one particular isotope was found to be superior for determining the relative importance of ASDES in juvenile salmon, which ranged from relatively high to relatively low. At high ASDES, S-34 SIA may be the more quantitative, whereas at high ASDES, N-15 SIA may be the more quantitative.

A demonstration of the Alaska Ocean Observing System in Prince William Sound

Molly McCammon and G. Carl Schoch Alaska Ocean Observing System <u>mccammon@aoos.org</u>, <u>cschoch@aoos.org</u>

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The Alaska Ocean Observing System (AOOS) offers the first coordinated effort to help regional stakeholders cope with a multitude of environmental changes. By combining long-term monitoring with short-term hypothesis-driven process studies we can improve the understanding of mechanisms underlying regional ecosystem dynamics. This will provide a scientific foundation for addressing fisheries and ecosystem management needs related to long term oceanic and climatic variability. New high-resolution wind, wave and ocean current models will provide improved forecast products to recreational and commercial vessel and aircraft operators and enhance the safety of maritime traffic. Improved ecological forecasts will enable resources managers (e.g., fish hatchery and commercial fishing organizations) to make informed and scientifically sound management decisions on food supply, predation, and human activities such as commercial and recreational fishing. Infrastructure expansion plans for the observing system include improving the consistency and data quality of the existing array of meteorological sensors, deploying precipitation gauges in the surrounding watersheds, deploying telemetered stream gauges and developing a synoptic wave model to predict wave heights, nearshore currents, and wave-induced turbulence. A major new program will begin to better understand the mechanisms and exchange rates of waters between the Gulf of Alaska and coastal embayments using moored subsurface observations together with HF radar. To ensure the success of AOOS, support is being contributed by a host of partner organizations including the Prince William Sound Science Center, the Cook Inlet Regional Citizens Advisory Council, the Alaska SeaLife Center, and the University of Alaska (in Fairbanks, Anchorage and Juneau).

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The Exxon Valdez Oil Spill Trustee Council Hydrocarbon Database

Bonita Nelson and Jeff Short, Auke Bay Laboratory, NOAA AK Fisheries Science Center, <u>bonita.nelson@noaa.gov</u>

The Auke Bay Laboratory provides data and sample archiving services for all samples collected for hydrocarbon analysis in support of the Exxon Valdez Trustee Council projects. These data represent samples collected since the oil spill in 1989 to the present and include environmental and laboratory Response and Restoration data as well as subsistence information. As the hydrocarbon information is analyzed through the chemistry lab and quality controlled it is added to the public release version of the database. A public version of the analyzed environmental samples was released in 1996 (Exxon Valdez Oil Spill of 1989: State/Federal Trustee Council Hydrocarbon Database 1989 B 1995 / EVTHD) and is updated annually. We also provide interpretive services for the hydrocarbon analyses designed specifically for investigators and managers and FOIA response which include: (1) identification of new hydrocarbon data for evidence of systematic bias, (3) hydrocarbon data editing according to consistent criteria.

Allometric Scaling of Marine Macrophytes in Coastal Alaska

Gayle Neufeld and C. Peter McRoy, Inst. Marine Science, University of Alaska Fairbanks, gnuefeld@sfos.uaf.edu, gnuefeld@sfos.uaf.edu

Scaling relationships in plants reflect the response of size and performance of individuals in a population to limiting resources in the ecosystem. The new Metabolic Theory of Ecology (MTE) from Brown et al. (2004) offers the promise of a framework for understanding of marine populations and ecosystems that is based on first principles. Derived from work on the relationship between body mass and metabolism in marine and terrestrial organisms that scales across some 27 orders of magnitude, MTE provides a theoretical basis for predictions of functional responses of individuals, communities and ecosystems that can be incorporated into management. We made observations of size and mass on two marine macrophytes species, the kelp Alaria marginata and the seagrass Zostera marina, in a few locations to begin a study of scaling in these communities. MTE assumes that plants grow until limited by resources and under such conditions metabolism and biomass scale to the â€"3/4 power or variants of 1/4 power for other parameters. Our test of this relationship yields variation in the scaling factors between species and habitats. Z. marina in Kachemak Bay yielded scaling relationships between leaf length and leaf thickness near the 1/4 power, while those in Kotzebue Sound were closer to 0.18. In Kachemak Bay A. marginata thallus length and stipe diameter scaled as variants of 1/4 power in two populations, but were intermediate in a third. We attribute the variations from the MTE predictions to resource limitation and/or environmental stress.

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The Use of Citizen Observations in Coastal Monitoring

Marylin Sigman, Center for Alaskan Coastal Studies, cacs@xyz.net Steve Baird, Kachemak Bay Research Reserve, <u>steve_baird@fishgame.state.ak.us</u>

Citizen observations along Alaska's shoreline can provide the means for scientists to extend the spatial and temporal depth of specific datasets and for residents of coastal communities to contribute and communicate observations related to an area of importance to them. However, ensuring the reliability and consistency of citizen-collected data can be difficult. This poster presents an example of a program to ensure the quality and utility of citizen-collected data, including an independent review of an existing 20-year data set.

Spatial variation of environmental factors in kelp bed communities of Kachemak Bay

Tania Spurkland and Katrin Iken School Fisheries and Ocean Sciences, University of Alaska Fairbanks tspurk@sfos.uaf.edu, iken@ims .uaf.edu

Kelp bed communities are influenced by a variety of environmental factors. These factors are changing due to global climate change. These changes may be threatening kelp bed habitat structure and biota. The goal of this study was to assess the spatial variation of environmental factors in kelp beds on the north and south shores of Kachemak Bay. The north shore is impacted by melting coastal glaciers and was used as a proxy for an area stressed by global climate change, while the south shore was used as one not stressed by such influences. During the summer of 2006 the following environmental factors were monitored using SCUBA at three sites on each shore: salinity, light intensity, temperature, nutrients, suspended sediments, biweekly sediment loads, and the abrasion of clod cards. Significant differences between shores were noted for all factors except temperature, nitrite and ammonia. Differences were particularly strong for salinity, light intensity, and inorganic sedimentation. The sea-surface salinity was lower ($\mu = 24$ psu) on the north shore compared to the south shore ($\mu = 33$). Lower light intensity ($\mu = 1.34$ log (Lum/sqm/day)) and higher inorganic sediment loads ($\mu = 0.1$ g/day) predominate on the north shore and higher light intensity ($\mu = 1.74 \log (Lum/sqm/day)$) and lower inorganic sediment loads ($\mu = 0.02 \text{ g/day}$) on the south shore. These results will be used to determine the impact that such stressful environmental factors have on kelp bed community structure and chemical defense levels of organisms.

TBT Contamination, Imposex, and Factors Affecting Recolonization by an Intertidal Snail

David Tallmon, University of Alaska Southeast, UAF Juneau Center School of Fisheries and Aquatic Sciences, and UAF Institute for Arctic Biology, david.tallmon@uas.alaska.edu

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Lisa Hoferkamp, University of Alaska Southeast, <u>lisa.hoferkamp@uas.alaska.edu</u> Sarah Wood, Humboldt State University, <u>nolimitsforlife@gmail.com</u>

For many years, antifouling paints containing tributyltin (TBT) were used on boat hulls, causing non-target effects that included reproductive dysfunction and local extinctions of intertidal snails in seaports worldwide. In response to these non-target impacts, TBTcontaining paints have been banned throughout much of the world. In the 1980s, studies showed that TBT appeared to have caused local extinctions and high frequency of imposex (imposition of male sexual characteristics on females) in file dogwinkle (Nucella lima) populations inhabiting Auke Bay, Alaska. We investigated current TBT contamination, the frequency of imposex in existing dogwinkle populations, and studied factors that may be limiting dogwinkle recolonization success using mark-recapture experiments and models. Our results suggest that TBT contamination is a persistent threat in Auke Bay, although the distribution of TBT has shifted and declined overall. In accordance with this, imposex frequency in dogwinkles has generally decreased, but still affects populations near a large boat dock. Failure of dogwinkles to recolonize areas no longer contaminated by TBT is not due to lower survival of adult snails in formerly contaminated areas. In Alaskan seaports, TBT contamination may be a persistent threat to the intertidal community, mariculture, and subsistence use of marine resources.

Impacts of Seafood Waste Discharge in Orca Inlet, PWS

Richard Thorne, Prince William Sound Science Center, thorne@pwssc.gen.ak.us Mary Anne Bishop, Prince William Sound Science Center, mbishop@pwssc.gen.ak.us Richard Crawford, Prince William Sound Science Center, rcrawford@pwssc.gen.ak.us Kenwyn George, Alaska Department of Environmental Conservation,

Kenwyn George@dec.state.ak.us

Gary Thomas, Rosentiel School of Marine and Atmospheric Sciences,

GThomas@rsmas.miami.edu

Shelton Gay, Prince William Sound Science Center, smg3ak@earthlink.net James Thorne, Prince William Sound Science Center, james@pwssc.gen.ak.us Signe Fritsch, Prince William Sound Science Center, <u>signe@pwssc.gen.ak.us</u>

In 1975 EPA produced effluent discharge guidelines for the seafood processor industry that required wastes to be ground to less than 1.27 cm in any dimension prior to discharge. Subsequently, several negative impacts were observed around Cordova, Alaska, including noticeable decreases in crab and halibut harvests and a substantial increase in numbers of Glaucous-winged gulls. We hypothesized that the change in discharge guidelines removed a food source for the large bottom-oriented animals and increased availability to the surface-oriented gulls. In 2004, we began a three year study to examine impacts of seafood waste discharge into Orca Inlet, including evaluation of alternative discharge and disposal methods that could be beneficial to fishermen, the processors and the community. The study included model development and controltreatment experiments. We developed a dispersal model that incorporated both physical and biological transport mechanisms. The model predicted that sea lions, adult fish and crabs could assimilate and transport a substantial amount of fish wastes over a much larger area than physical processes alone. We dumped 300,000 lbs of salmon heads and carcasses at an experimental site and monitored the biotic response. Survey methodologies included underwater cameras, traps, fishing with hand lines, stomach content analysis, acoustic tags attached to salmon heads and visual surveys of birds and marine mammals. The results show that the heads and carcasses disperse rapidly and are efficiently incorporated into the food chain with no negative consequences, a very favorable contrast to the current EPA-mandated practice.

Steller Sea Lions in Alaska: Direct Mortality by Humans

Mike Turek, Alaska Department of Fish & Game, mike turek@fishgame.state.ak.us

The goal of this project is to examine contemporary direct mortality by humans on the western distinct population segment of Steller sea lions in Alaska. The project will be conducted in two phases to describe common activities and practices related to direct mortality of Steller sea lions associated with commercial fishing since the 1950s. During the first phase, we systematically collected information from active and retired commercial fishers, and began collecting information from written documents. The project will investigate the role direct mortality by humans, from shooting and fishing gear bycatch, may have played in the critical periods between 1975 and 1990, and up to the present time. This is the period when the western population segment of Steller sea lions in Alaska suffered a significant decline. The first phase focuses on gathering information from commercial fishers and summarizing other direct mortality, such as harvests for traditional uses by Alaskans. The second phase will provide contextual and specific information from written documents on reported direct mortality to evaluate hypotheses about the contribution of direct mortality on the western stock population.

TEK and the Alaska Native Hunters' Guide to Steller Sea Lion Biosampling

Donna Willoya, The Alaska Sea Otter And Steller Sea Lion Commission dwilloya@seaotter-sealion.org

Past and present cultural/ecological knowledge (TEK) of Steller sea lions was collected by 6 coastal Alaska Native Tribes and analyzed by The Alaska Sea Otter and Steller Sea Lion Commission (TASSC). The results indicated that out of 75 total interviews, over half of the respondents (43) felt hunter sea lion biosampling should occur. Subsistence users of sea lions wanted to contribute samples to those investigating the health and status of the species. TASSC felt and understood that this desire can not be taken lightly any more. Notably, we learned that many hunters had a variety of sea lion data sheets from previous research projects. Some hunters had five different requests for sea lion biosamples, all with varying levels of sample requests. We learned that the hunters needed a standardized guide for sea lion biosampling. Enter the Alaska Native Hunters Guide to Steller Sea Lion Biosampling or the Guide. In this talk we further describe the genesis of the Guide and how the Guide will 1) archive biosamples for future nutrient/contaminant analysis as a human health assessment, and 2) contribute to those that investigate the health of the species or western scientific research.