Marine Science in Alaska: 2005 Symposium

January 24-26, 2005
Hilton Hotel
Anchorage, Alaska

Sponsored by:
***Exxon Valdez* Oil Spill Trustee Council, North Pacific Research Board, Alaska Ocean Observing System, NOAA Alaska Fisheries Science Center, Alaska SeaLife Center, Pollock Conservation Cooperative Research Center, Kachemak Bay Research Reserve, North Pacific Fishery Management Council, Prince William Sound Science Center, US Geological Survey, Alaska Sea Grant College Program, North Pacific Marine Science Foundation, and North Pacific Marine Universities Marine Mammal Research Consortium**

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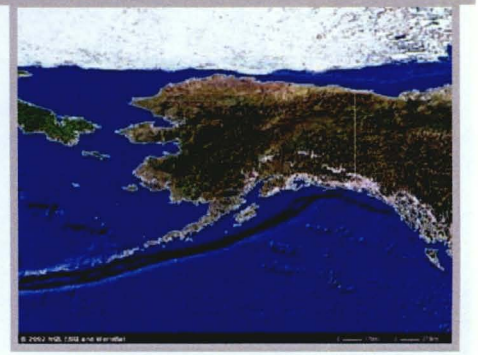
Monday, January 24th



9:00 am-9:15 am

Welcome to the Marine Science in Alaska 2005 Symposium
Clarence Pautzke, North Pacific Research Board

Welcome to Anchorage
Mayor Mark Begich □Municipality of Anchorage

9:15 am-10:00 am

Keynote Address: **Vice Admiral Conrad C. Lautenbacher, Jr., U.S. Navy (Ret.), Under Secretary of Commerce for Oceans and Atmosphere, NOAA Administrator**

SESSION 1
10:00 am-10:50 am

PROGRAM OVERVIEWS
Panel 1

North Pacific Research Board	Clarence Pautzke
NOAA Fisheries, Alaska Fisheries Science Center	Doug Demaster
Exxon Valdez Oil Spill Trustee Council□s Gulf of Alaska Ecosystem Monitoring and Research Program	Gail Phillips
Alaska Ocean Observing System	Molly McCammon
Alaska SeaLife Center	Tylan Schrock
US Geological Survey	Leslie Holland-Bartels
State of Alaska	Sue Aspelund (ADFG)

11:00 am-11:50 am

Panel 2

Alaska Sea Grant College Program	Brian Allee
Prince William Sound Science Center	Nancy Bird
Pollock Conservation Cooperative Research Center	Heather McCarty
Kachemak Bay National Estuarine Research Reserve	Judy Haner
NOAA, National Centers of Coastal Ocean Science	Gary Matlock
Minerals Management Service, Alaska Environmental Studies Program	Cleveland Cowles

11:50 am-1:00 pm

Lunch ***Keynote:*** **US Commission on Ocean Policy**
Frank Muller-Karger, University of South Florida

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1:00 pm-1:50 pm **Panel 3**

University of Alaska Fairbanks, School of Fisheries and Ocean Sciences	Denis Wiesenburg
North Pacific Marine Science Foundation, North Pacific Universities Marine Mammal Research Consortium	Andrew Trites
Alaska Native Science Commission	Patricia Cochran
Arctic-Yukon-Kuskokwim Sustainable Salmon Initiative	John White
Census of Marine Life	Vera Alexander
Northern Salmon Fund of the Pacific Salmon Commission	David Bedford

2:00 pm-2:50 pm **Panel 4**

Chair: Gail Phillips, *Exxon Valdez* Oil Spill Trustee Council□s Gulf of Alaska Ecosystem Monitoring and Research Program

Decision-Making, Science, and Politics — Members □To Be Announced

Note: Agencies and organizations represented in Panels 1, 2, and 3 will have a 2-page informational handout about their mission and activities in the registration packet.

2:50 pm-3:10 pm **Break**

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SESSION 2

OCEAN OBSERVING SYSTEMS AND CLIMATE CHANGE
Chair: Denis Wiesenburg, University of Alaska Fairbanks, School of Fisheries and Ocean Sciences

3:10 pm-3:45 pm	***Keynote:*** **An Overview of the Arctic Climate Impact Assessment** John Walsh, International Arctic Research Center, University of Alaska Fairbanks
3:45 pm-4:00 pm	**Poster Review**
4:00pm-4:15 pm	**The Alaska Ocean Observing System** Mark Johnson, Institute of Marine Science, University of Alaska Fairbanks
4:15 pm-4:30 pm	**Is the Bering Sea Stuck in a Warm Phase?** James Overland, NOAA Pacific Marine Environmental Laboratory
4:30 pm-4:45 pm	**A Decade of Measurements of the Southeastern Bering Sea Shelf** Phyllis Stabeno, NOAA Pacific Marine Environmental Laboratory
4:45 pm-5:00 pm	**GEM Biophysical Observations Aboard an Alaska State Ferry** Edward Cokelet, NOAA Pacific Marine Environmental Laboratory
5:00 pm-5:15 pm	**Developing a Permanent Continental-Scale Acoustic Tracking Array for Marine Fisheries Research: The Goal and the Strategy** David Welch, Pacific Ocean Shelf Tracking Project, Kintama Research
5:15 pm-5:30 pm	**Listening for Endangered Whales Offshore Alaska, 1999-2004** Sue Moore, Applied Physics Laboratory, University of Washington
5:30 pm-6:30 pm	**Poster Session**
6:30 pm-9:00 pm	**Reception**

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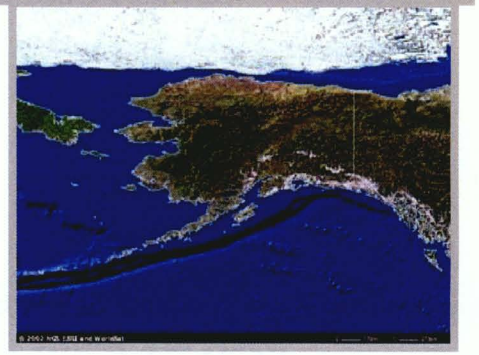

SESSION 3

PHYSICAL AND BIOLOGICAL OCEANOGRAPHY
Chair: Steve Okkonen, Institute of Marine Science, University of Alaska Fairbanks

8:00 am-8:30 am — ***Keynote:*** **Alaskan Oceanography: Past, Present, and Future □A Personal Perspective**
Tom Royer, Center for Coastal Physical Oceanography, Old Dominion University

8:30 am-8:45 am — **Poster Review**

8:45 am-9:00 am — **Drifters□Trajectories During the Lagrangian Field Experiment (Prince William Sound, 28 July to 10 August 2004)**
Claude Belanger, Prince William Sound Science Center

9:00 am-9:15 am — **Temporal Variability in Hydrographic Conditions in Lower Cook Inlet**
Scott Pegau, Kachemak Bay National Estuarine Research Reserve

9:15 am-9:30 am — **Tidal Mixing Effects on a Biological Model**
Meibing Jin, International Arctic Research Center, University of Alaska Fairbanks

9:30 am-9:45 am — **Modeling Environmental Hydrodynamic Fields of the Bering Sea: Toward a Coupled Ice-Ocean-Biological Model (CIOBM)**
Jia Wang, International Arctic Research Center, University of Alaska Fairbanks

9:45 am-10:00 am — **Reconstruction of the Summer Circulation in the Bering Sea**
Gleb Panteleev, International Arctic Research Center, University of Alaska Fairbanks

10:00 am-10:15 am — **Break**

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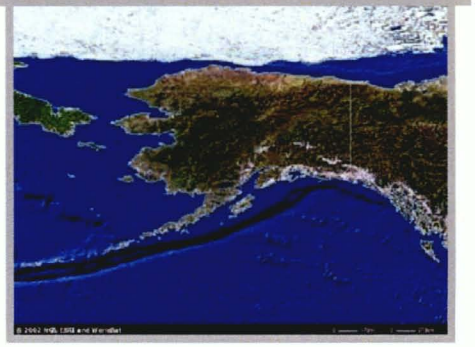

SESSION 4

FISHERIES OCEANOGRAPHY
Chair: Anne Hollowed, NOAA, Alaska Fisheries Science Center

10:15 am-10:30 am **Poster Review**

10:30 am-10:45 am **Alaskan Groundfish Feeding Ecology: An OBIS Information System**
Dale Kiefer, Systems Science Applications

10:45 am-11:00 am **Oceanic Carbon Subsidies Led to High Marine Survival and the Enormous Prince William Sound Pink Salmon Runs of 2003**
Thomas Kline, Prince William Sound Science Center

11:00 am-11:15 am **Forage Fishes in the Western Gulf of Alaska: Variation in Productivity**
Matt Wilson, NOAA, Alaska Fisheries Science Center

11:15 am-11:30 am **Does Climate-driven Variability in the Oceanographic Structure of the Gulf of Alaska Shelf Affect Fish Community Composition by Modulating the Degree of Interspecific Competition between Juvenile Pollock and Capelin?**
Elizabeth Logerwell, NOAA, Alaska Fisheries Science Center

11:30 am-11:45 pm **The Multispecies Statistical Model: Incorporating Predation Equations into a Statistical Catch-at-Age Model**
Jesus Jurado-Molina, School of Aquatic and Fishery Sciences, University of Washington

11:45 pm-1:00 pm **Lunch** ***Keynote:*** **Dr. William Hogarth, NOAA Assistant Administrator for Fisheries**

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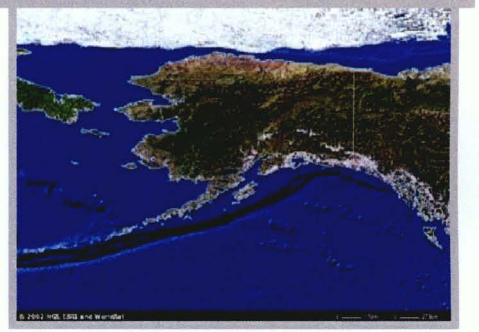

SESSION 5

BENTHIC HABITAT AND NEARSHORE ECOLOGY
Chair: Ginny Eckert, University of Alaska Fairbanks

1:00 pm-1:30 pm — ***Keynote:*** **Ecology of the Copper River Delta**
Sean Powers, Department of Marine Sciences, University of South Alabama
Mary Anne Bishop, Prince William Sound Science Center

1:30 pm-1:45 pm — **Poster Review**

1:45 pm-2:00 pm — **Bathymetric and Temporal Range, Spatial Extent, and Habitat Characteristics of Atka Mackerel Spawning and Nesting Habitat in the Aleutian Archipelago**
Robert Lauth, NOAA, Alaska Fisheries Science Center

2:00 pm-2:15 pm — **Coral and Sponge Habitat Mapping in the Central Aleutian Islands**
Jon Heifetz, NOAA, Auke Bay Laboratory

2:15 pm-2:30 pm — **Synergistic Serial Depletion of Nearshore Benthic Invertebrates Leads to a Recent Decline of a Keystone Grazer and the Alteration of a Coastal Ecosystem**
Anne Salomon, University of Washington

2:30 pm-2:45 pm — **Dynamics of Chemical Defenses: Dynamics of Chemical Defenses in Four Kachemak Bay Kelp Species as a Response to Gastropod Grazing Patterns**
Angela Dubois, Institute of Marine Science, University of Alaska Fairbanks

2:45 pm-3:00 pm — **NaGISA (Natural Geography in Shore Areas)**
Katrin Iken, Institute of Marine Science, University of Alaska Fairbanks

3:00 pm-3:15 pm — **Development of Techniques for Cultivation of Blue King Crab, *Paralithodes platypus***
Bradley Stevens, NOAA, Kodiak Fisheries Research Center

3:15 pm-3:30 pm — **Break**

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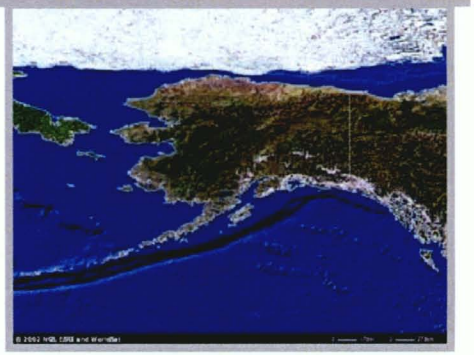

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SESSION 6

CONTAMINANTS, HARMFUL ALGAL BLOOMS, AND INVASIVE SPECIES
Chair: Peggy Krahn, NOAA, Northwest Alaska Fisheries Science Center

3:30 pm-4:00 pm — ***Keynote:*** **Vibrio Occurrence in Shellfish**
Ray Ralonde, Alaska Sea Grant College Program

4:00 pm-4:15 pm — **Poster Review**

4:15 pm-4:30 pm — **Application of the EPA Environmental Monitoring Assessment Program (EMAP) to Characterization of Alaska Coastal Marine Water Quality**
Doug Dasher, Alaska Department of Environmental Conservation
Ron Klein, Alaska Department of Environmental Conservation

4:30 pm-4:45 pm — **Bitter Crab Syndrome**
Frank Morado, NOAA, Alaska Fisheries Science Center

4:45 pm-5:00 pm — **Contaminants in North Pacific Basin Marine Mammals**
Shannon Atkinson, University of Alaska Fairbanks and Alaska SeaLife Center

5:00 pm-5:15 pm — **Organochlorine Contamination in Steller Sea Lion Pups from Four Russian Rookeries**
Matthew Myers, Alaska SeaLife Center

5:15 pm-5:30 pm — **Initiating an Invasive Species Program in Alaska**
Robert Piorkowski, Alaska Department of Fish and Game

5:30 pm-7:00 pm — **Posters and Dinner (on your own)**

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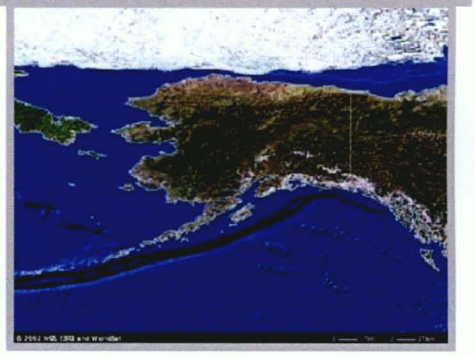

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SESSION 7

OIL IMPACTS
Chair: Craig Tillery, Alaska Department of Law

7:00 pm-7:30 pm — ***Keynote:*** **Settlement Overview**
Charlie Cole

7:30 pm-7:45 pm — **Update on the Status of Subsistence Uses**
James Fall, Alaska Department of Fish and Game

7:45 pm-8:00 pm — **2004/5 Assessment of Lingering Oil and Resource Injuries from the *Exxon Valdez* Oil Spill**
Lucinda Jacobs, Integral Consulting

8:00 pm-8:15 pm — **Persistence of Lingering Oil from the *Exxon Valdez***
Jeff Short, NOAA, Auke Bay Laboratory

8:15 pm-8:30 pm — **Restoration of *Exxon Valdez* Oil Contaminated Habitats by Sea Otters in Prince William Sound: Mechanisms and Consequences**
James Bodkin, US Geological Survey, Alaska Science Center

8:30 pm-8:45 pm — **Marine Bird Population Abundance of Prince William Sound, Alaska: Trends Following the *T/V Exxon Valdez* Oil Spill, 1989-2004**
David Irons, US Fish and Wildlife Service, Migratory Bird Management

8:45 pm-9:00 pm — **Oil, Salmon, and How Urbanization Decreases Population Productivity**
Ron Heintz, NOAA, Auke Bay Laboratory

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SESSION 8

SEABIRDS
Chair: Tuula Hollmen, University of Alaska Fairbanks and Alaska SeaLife Center

8:00 am-8:30 am — ***Keynote:*** **Surveying the Past: North Pacific Pelagic Seabird Database**
Gary Drew and John Piatt (Drew presenting), US Geological Survey

8:30 am-8:45 am — **Poster Review**

8:45 am-9:00 am — **Wings, Fins, and the Black Box: Management Implications of Marine Bird and Fish**
William Sydeman, PRBO

9:00 am □9:15 am — **Regime Forcing and Ecosystem Response in the Bering Sea (ReFER: Phase II)**
Alan Springer, Institute of Marine Science, University of Alaska Fairbanks

9:15 am-9:30 am — **First-passage Time Analysis and Identification of Marine Habitats Used by Short-tailed Albatrosses *(Phoebastria albatrus)* in the Northwest Pacific Ocean, Gulf of Alaska, and Bering Sea**
Robert Suryan, Oregon Cooperative Fish and Wildlife Research Unit, Department of Fisheries and Wildlife, Oregon State University

9:30 am-9:45 am — **Seabirds and Alaska Groundfish Fisheries: Efforts to Understand Seabird Interactions with these Fisheries and to Mitigate Incidental Mortality**
Shannon Fitzgerald, NOAA, Alaska Fisheries Science Center

9:45 am-10:00 am — **Break**

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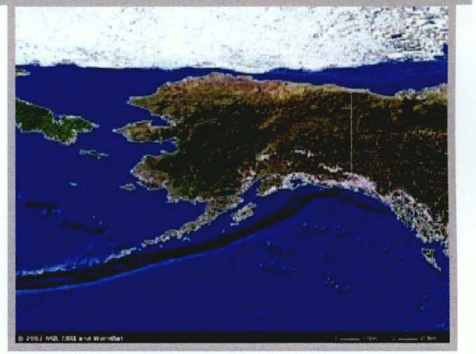

SESSION 9

MARINE MAMMALS
Chair: Andrew Trites, North Pacific Marine Science Foundation, North Pacific Universities Marine Mammal Research Consortium

10:00 am-10:30 am — ***Keynote:*** **Differences in Recent Trends in the Populations of Western Steller Sea Lions and Northern Fur Seals**
Lowell Fritz, NOAA, Alaska Fisheries Science Center

10:30 am-10:45 am — **Poster Review**

10:45 am-11:00 am — **Causes of Mortality for Northern Sea Otters**
Verena Gill, US Fish and Wildlife Service

11:00 am-11:15 am — **A Summary of Recent Killer Whale Studies in the Aleutian Islands, Bering Sea, and Western Gulf of Alaska**
Paul Wade, NOAA, Alaska Fisheries Science Center

11:15 am-11:30 am — **Harbor Seal Population Change in Alaska □The Big Picture**
Grey Pendleton, Alaska Department of Fish and Game

11:30 am-11:45 am — **Photographic Population Analysis of Killer Whales in the Coastal Waters of Southwest Alaska**
John Durban, NOAA, National Marine Mammal Laboratory

11:45 am-12:00 pm — **Ecosystem Analysis of Steller Sea Lion Dynamics, Their Prey, and Predators**
Sylvie GuØnette, Fisheries Centre, University of British Columbia

12:00 pm-1:15 pm — **Lunch**

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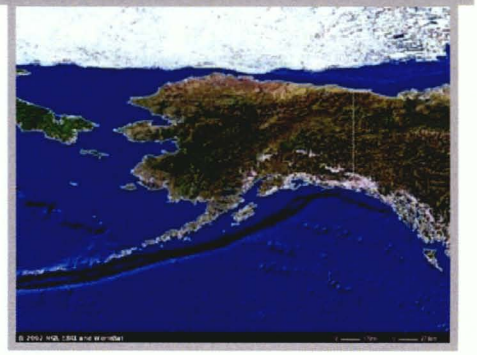

1:15 pm-1:30 pm **Physiological Answers to Ecosystem Questions: What We Have Learned from Laboratory Studies about the Decline of Steller Sea Lions in Alaska**
David Rosen, Marine Mammal Research Unit, University of British Columbia

1:30 pm-1:45 pm **Steller Sea Lion Abundance in Russia in 2004**
Vladimir Burkanov, Natural Resources Consultants

1:45 pm-2:00 pm **Sperm Whale Depredation**
Jan Straley, University of Alaska SE Sitka Campus, School of Fisheries and Ocean Sciences
Aaron Thode, Scripps Institution of Oceanography, University of California, San Diego

2:00 pm-2:15 pm **Tracking Critically Endangered North Pacific Right Whales *(Eubalaena japonica)* in Alaskan Waters Using Passive Acoustics**
Lisa Munger, University of California San Diego

2:15 pm-2:30 pm **Break**

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SESSION 10

FISHERIES SCIENCE AND MANAGEMENT
Chair: Bill Wilson, North Pacific Fishery Management Council

2:30 pm-3:00 pm — ***Keynote:*** **NOAA's Ecosystem Approach to Management**
Jack Dunnigan, Director of the Office of Sustainable Fisheries

3:00 pm-3:15 pm — **Poster Review**

3:15 pm-3:30 pm — **Corroboration and Application of a Bioenergetics Model to Estimate the Growth of Juvenile Walleye Pollock *(Theragra chalcogramma)* in the Western Gulf of Alaska**
Michael Mazur, NOAA, Alaska Fisheries Science Center

3:30 pm-3:45 pm — **Genetic Divergence, Phylogeography, and Recognition of Asian and North American Chinook Salmon Populations**
Anthony Gharrett, University of Alaska Fairbanks, School of Fisheries and Ocean Sciences

3:45 pm-4:00 pm — **Assessing Long-Term Viability of a Marine Reserve**
Sue Hazlett, University of Alaska Fairbanks

4:00 pm-4:15 pm — **A Conceptual Model Approach to Utilizing Traditional Knowledge in Resource Management**
Kimani Kimbrough, NOAA

4:15 pm-4:30 pm — **Size at Maturity of Bering Sea Walleye Pollock**
Gordon Kruse, University of Alaska Fairbanks, School of Fisheries and Ocean Sciences

4:30 pm-4:45 pm — **Further Developments from Acoustical Data Loggers on Pollock Vessels**
Terry Quinn, University of Alaska Fairbanks, School of Fisheries and Ocean Sciences

4:45 pm-5:00 pm — **Life History, Ecology, and Population Dynamics of Spiny Dogfish, *Squalus acanthias*, in Alaska**
Cindy Tribuzio, University of Alaska Fairbanks, School of Fisheries and Ocean Sciences

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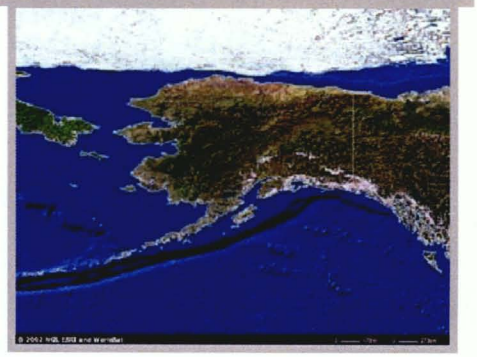


5:00 pm-5:15 pm **Implications of Environment Variability on Spawning and Management of Pacific Herring in Northern Bristol Bay, Alaska**
Naoki Tojo, University of Alaska Fairbanks School of Fisheries and Ocean Sciences

5:15 pm-5:20 pm **Closing Comments**
Clarence Pautzke, North Pacific Research Board

January 24-26, 2005
Anchorage Alaska

Marine Science in Alaska 2005 Symposium

COMMENT AND EVALUATION FORM

Did you find the symposium valuable overall?

Which of the sessions or papers was most valuable or interesting to you?

Do you have any suggestions for outstanding keynote speakers for future symposia?

How could the poster session be improved?

Should we allow posters for topics of marine research, other than just those listed as main sessions for the symposium?

Was the length of the symposium 3 days Okay?

Should the symposium be expanded to allow more sessions? What issues/topics would you like to see addressed at a future symposium?

Would you like to see the Symposium held in some other location than in Anchorage? If so, where? Would you support rotating its location?

Should there be a "proceedings" report published following each workshop?

Do you have any comments regarding the abstract book? Is it useful? Could it be made more useful?

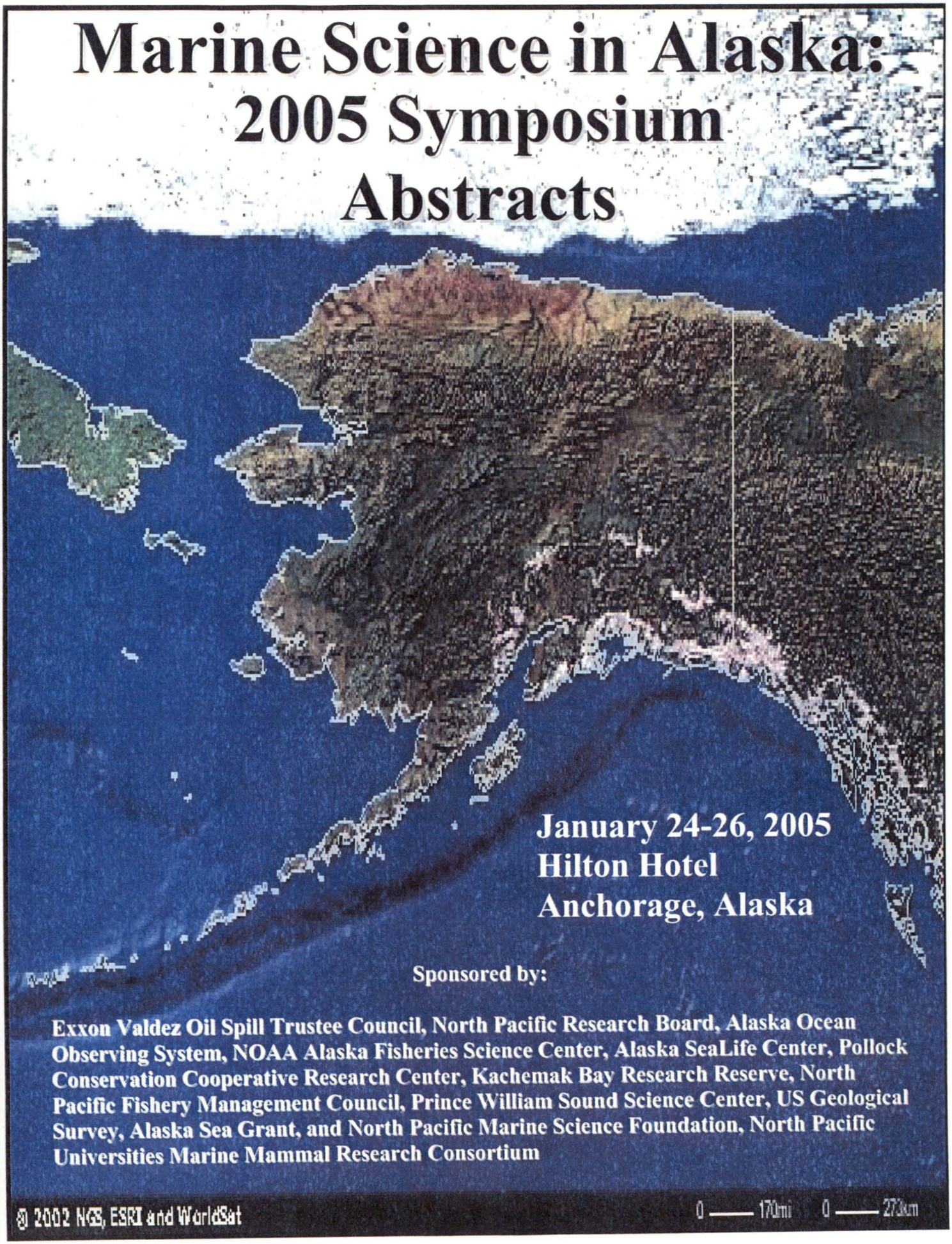
Do you have any comments regarding the content and or structure of the agenda/program?

Do you have any overall comments regarding the contents of the registration packet?

Please provide any additional comments on the symposium that might be helpful in planning future events.

This publication, was released by the *Exxon Valdez* Oil Spill Trustee Council, produced at a cost of $3.85 per copy, and was printed in Anchorage, Alaska.

Marine Science in Alaska: 2005 Symposium Abstracts



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Program Manager Panels

Monday, January 24, 2005 9 00 am – 2 50 pm

Welcome to the Marine Science in Alaska 2005 Symposium
Clarence Pautzke, North Pacific Research Board

Keynote Address Vice Admiral Conrad C Lautenbacher, Jr , U S Navy (Ret),
Under Secretary of Commerce for Oceans and Atmosphere, NOAA Administrator

Panel 1

North Pacific Research Board	Clarence Pautzke
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Lunch

Panel 3

University of Alaska Fairbanks, School of Fisheries and Ocean Sciences	Denis Wiesenburg
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Panel 4

Decision-making, Science and Politics	Members - To Be Announced

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Ocean Observing Systems and Climate Change

Monday, January 24, 2005 3 10 pm – 5 30 pm

Chair Denis Wiesenburg

Keynote **An Overview Of The Arctic Climate Impact Assessment**	John Walsh
The Alaska Ocean Observing System	Mark Johnson
Is the Bering Sea Stuck in a Warm Phase?	James Overland
A Decade of Measurements of the Southeastern Bering Sea Shelf	Phyllis Stabeno
GEM Biophysical Observations Aboard an Alaska State Ferry	Edward Cokelet
Developing a Permanent Continental-Scale Acoustic Tracking Array for Marine Fisheries Research The Goal and the Strategy	David Welch
Listening for Endangered Whales Offshore Alaska, 1999-2004	Sue Moore

POSTERS

Progress of the CPR-based Survey in the Gulf of Alaska	Sonia Batten
Exploring the Structure of the Oceanic Environment A Classification Approach	Karin Bodtker
U S Commission on Ocean Policy Recommendations and NOAA's National Status and Trends Program	Jawed Hameedi
Linking Science and Management In Kachemak Bay	Ruth Kelty
Rapid Climate Change Affects Function of the Hydrology, Biology, and Economics of Western River Systems	Jack Peterson
Understanding Changes in the Thermal State of the Bering and Chukchi Seas in the Second Half of the Twentieth Century	Igor Semiletov
The Alaska Marine Information System (AMIS) An Integrated Web-Based Information System For The North Pacific Research Board	Karen Stocks

An Overview Of The Arctic Climate Impact Assessment

J E Walsh[1] and R W Corell[2]

[1]University of Alaska Fairbanks, International Arctic Research Center, Fairbanks, AK 99775 United States
[2]American Meteorological Society, 1120 G Street, N W Suite 800, Washington, DC 20005 United States

The Arctic Climate Impact Assessment (ACIA), a four-year scientific assessment of climate change of the Arctic, was established and charged to (i) evaluate and synthesize knowledge on the impacts and consequences of climate variability and change and increased ultraviolet radiation across the Arctic region, and (ii) support decision and policy making processes for the eight Arctic countries and their residents This presentation will provide an overview of the key findings from the scientific aspects of the Assessment Past and present results are based on published data and information while the projections are based on five global climate models driven by the B2, and in some cases A2, IPCC scenarios Examples of the key findings are Arctic climate is changing rapidly Average Arctic temperature has risen by about 1°C in the past 100 years, nearly twice the global average, with the steepest increase in the last three decades Accelerating climate changes are projected The Arctic is very likely to warm an additional 3-9°C over the next 100 years, about twice the projected global average Further, precipitation is likely to increase by about 8% by mid-century and 20% by the end of the century Regional variations are observed and projected Some parts of the Arctic have warmed more than others (e g , some parts of Alaska have warmed at 5-10 times the global average over the past 30 years) while some have even cooled slightly Arctic processes amplify global change Melting of reflective Arctic snow and ice increases heat absorption of the exposed land and ocean, further warming the planet Increases in glacial melt, precipitation and river runoff bring more freshwater to the ocean, raising sea level globally Warming of Arctic soils and coastal oceans is likely to lead to increased release of carbon dioxide and methane Reduced sea ice will enhance shipping opportunities Sea ice retreat is very likely to seasonally open the Northeast and Northwest passages, making trans-Arctic shipping during summer possible within a few decades Permafrost thawing will impact infrastructure Climate change is likely to have significant impacts on existing buildings, roads, pipelines, and industrial facilities Transportation on land will increasingly be disrupted by the failure of ice roads and tundra to freeze sufficiently to permit travel Risks to many coastal areas will increase Coastal erosion will be a growing problem do to substantial reductions in coastal sea ice in the spring and fall, which allows higher storm surges to reach shore which when combined with thawing coastal permafrost adds to the vulnerability of these coastlines

Ocean Observing Systems and Climate Change

The Alaska Ocean Observing System

Mark Johnson

AOOS will provide quality observations from a permanent, statewide monitoring system that will lead to stakeholder-driven informational products derived from numerical forecast models and processed data Distributed, web-based information will span a hierarchy of nested spatial scales from local to basin to hemispheric, and range temporally from real-time to seasonal and longer AOOS will address sustainability of Alaska's marine resources, improve search and rescue, and help mitigate coastal erosion while meeting the needs of marine users including commercial, subsistence and sport fishermen, shipping interests, Alaska Natives, oil and gas developers, and researchers

Ocean Observing Systems and Climate Change

Is The Bering Sea Stuck In A Warm Phase?

James Overland

Observations over the previous four years show persistent warm and ice-free conditions from late winter through summer, despite large variability in climate indices such as the Arctic Oscillation (AO) and the Pacific Decadal Oscillation (PDO) If such conditions continue, they will have a major effect on the ecosystem, as Arctic species seek colder waters and subarctic species become dominant On the southeast shelf (57 deg N) vertically-averaged, summer-mean ocean temperatures in 2001-2003 were 2 deg warmer than in 1995-1997, and sea ice is now nearly non-existent These conditions follow a major transformation around 1977 as part of the PDO, with a change from a predominantly cold Arctic climate at least back to the early 1900s to a warmer subarctic maritime climate, accompanied by a major reorganization of the marine ecosystem Over the last decade annual fisheries surveys indicate a continued decline in recruitment to cold water stocks such as Greenland turbot and snow crab However, walleye pollock, which prefer warmer waters, is characterized by a large, rather stable population We hypothesize that the overall climate change occurring in the Arctic is making the Bering Sea less sensitive to the intrinsic climate variability of the North Pacific Bering Sea indicators should be watched closely for the next five years to confirm or reject the hypothesis of the northward movement of the cold water curtain The alternate scenario, with a return to cold conditions, could produce rapid declines or shifts in the pelagic ecosystem

Ocean Observing Systems and Climate Change

A Decade Of Measurements On The Southeastern Bering Sea Shelf

Phyllis Stabeno, Jeff Napp and Terry Whitledge

For the last decade a series of biophysical moorings has been maintained at Site 2 (56 9°N, 164°W) on the Bering Sea shelf A second series of biophysical moorings has been deployed at Site 4 (57 9°N, 168 9°W) since 1995 (continuous since 2000) providing almost six years of more sporadic data Both moorings sites are in the middle domain at ~72m water depth In addition to these sites, water properties (temperature, salinity, nutrients, chlorophyll and zooplankton) have been collected around the moorings and along the 70-m isobath since 1995 These data quantify the marked changes that have occurred over the southeastern shelf in the last decade These shifts include a reduction in the southern extent of sea ice, a significant warming of the water column, a reduction in the size of the cold pool, and, a shift in the timing of the spring bloom at Site 2 In addition, there is some indication that there is slight shift in the currents at Site 4 The weak, onshelf flow at Site 4 likely is a source of nutrients for the central shelf Other parameters appear to have remained relatively unchanged For instance, winter salinity at Site 2 (before the arrival of ice) has remained relatively constant over the last several decades, indicating that nutrients supply may also have remained relatively constant over that time period Different zooplankton (e g *C marshalae*, *Pseudocalanus* spp) appear to respond differently to climate shifts We will use the zooplankton standing stock measurements from the semiannual groundtruth samples to index zooplankton biomass anomalies from the mean and relate this to physical changes in the ecosystem These long-term observations provide the critical component to understand the impact of climate on the Bering ecosystem

Ocean Observing Systems and Climate Change

GEM Biophysical Observations Aboard An Alaska State Ferry

Edward Cokelet

A goal for the *Exxon Valdez* Oil Spill Trustee Council's GEM program is to establish a long-term monitoring program to detect environmental change and to expand understanding of Gulf of Alaska ecosystems In FY2004 GEM's top priority was to initiate the process to collect basic physical and biological observations from an Alaska State ferry NOAA's Pacific Marine Environmental Laboratory and the Alaska Department of Fish and Game's Kachemak Bay Research Reserve began such a study aboard the Alaska Marine Highway System ferry, *Tustumena Tustumena* sails between Homer, Kodiak, Seward and Prince William Sound, AK, on a regular basis - crossing the Alaska Coastal Current over 280 times each year It makes less frequent trips to Dutch Harbor in the Aleutian Islands

Using off-the-shelf oceanographic instruments, we designed a system to make underway measurements at keel depth of (1) the basic physical variables (water temperature and salinity), (2) an essential nutrient (dissolved nitrate) necessary for phytoplankton production, (3) an indicator of phytoplankton concentration (chlorophyll fluorescence), (4) an indicator of terrestrial runoff (colored dissolved organic matter fluorescence), and (5) an indicator of the total suspended particle concentration (optical beam transmittance) These are referenced to the ship's position as measured with a Global Positioning System (GPS) satellite receiver The system is designed to operate remotely for days at a time When the ferry docks, it automatically backflushes with fresh water to clean filters and reduce marine fouling Data are collected and sent back daily to PMEL via an Iridium satellite modem Also, new instructions can be sent to the system via satellite to change its sampling criteria and rates Periodically, personnel from the Kachemak Bay Research Reserve come aboard in Homer, AK, to clean the sensors and take calibration samples

As part of our presentation, we will illustrate our system design, mention a few problems we have encountered in our prototype, and show maps of oceanographic measurements along the ship track

Ocean Observing Systems and Climate Change

Developing A Permanent Continental-Scale Acoustic Tracking Array For Marine Fisheries Research The Goal And The Strategy

David Welch

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The Census of Marine Life is helping to develop "POST", a permanent seabed acoustic array for tracking marine animals Current plans involve the deployment of 30 or more permanent cross-shelf monitoring lines spaced along the West Coast of North America, each consisting of autonomous seabed nodes spaced at roughly 1 km intervals, which would be capable of measuring direction, speed of movement, depth, and survival for tagged animals as small as 11 cm in length Nodes would be modular and use an acoustic modem to periodically communicate with an overhead ship, which would upload data and download new programming We are currently beginning a two-year demonstration phase for POST, involving tagging and tracking several thousand salmon smolts over a large-scale demonstration array I will provide an overview of the results from the 2004 field season The establishment of an acoustic array for fish tracking will also provide the data transmission and power supply backbone needed to host other ocean sensors For example, temperature and salinity sensors could be placed on the seabed nodes, providing detailed fields of the changes in bottom temperature and salinity over time, while upward looking ADCPs and seabed current meters could provide detailed data on changes in current structure These data could be meshed with the fish movement data to describe how animals move relative to changes in the three dimensional structure of the ocean The ability to develop such a coastal-GOOS capability is an important aspect of the development that we must plan for

Ocean Observing Systems and Climate Change

Listening For Endangered Whales Offshore Alaska, 1999-2004

Sue Moore

In 1999, a multi-year project to advance the use of passive acoustics for detection and assessment of endangered whales offshore Alaska was initiated by the NOAA's Pacific Marine Environmental Laboratory (PMEL) and National Marine Mammal Laboratory (NMML) The NMML collaborated with researchers at Scripps Institution of Oceanography (SIO) and Oregon State University (OSU) to leverage expertise in underwater acoustics in cetacean research Since 1999, multiple year-long deployments of autonomous recorders in the Gulf of Alaska (GOA), southeast Bering Sea, and the northwest Beaufort Sea have yielded unprecedented information on seasonal occurrence and calling behavior of endangered blue, fin, humpback, sperm, North Pacific right and bowhead whales For example, two blue whale call types were discovered, and sperm whale clicks were detected year-round, on recorders deployed in the GOA Calls from critically endangered North Pacific right whales were detected in the Bering Sea from May through November, and in regions of the western GOA where they have not been seen since the end of commercial whaling Fin and humpback whale calls were ubiquitous on nearly all instruments, suggesting these species may contribute significant top-down grazing pressure in some habitats Since 2003, recorders have been deployed in tandem with PMEL oceanographic moorings in the Bering Sea, thereby enhancing capability to model effects of environmental variables on cetacean call detection and seasonal occurrence Due to robust sampling capability and integration with oceanographic moorings, passive acoustics is a primary tool to enable incorporation of cetacean detection to upcoming Ocean Observing Systems and ecosystem modeling

POSTER Ocean Observing Systems and Climate Change

Progress Of The CPR-Based Survey In The Gulf of Alaska

Sonia Batten[1] and David Welch[2]

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[2] Department of Fisheries and Oceans, Canada, david welch@kintamaresearch org

Continuous Plankton Recorders (CPRs) have been regularly deployed from ships-of-opportunity (also known as Volunteer Observing Ships) crossing the Gulf of Alaska since 2000 The collection of seasonal plankton abundance and distribution data has been supported by the EVOS GEM program and by the NPRB We are now able to describe interannual and spatial variability in the quantity and composition of plankton across the Gulf of Alaska Collaborative projects have also been developed which sample the physical properties of the water (salinity, temperature) and higher trophic levels (marine birds and mammals) from the same ships Recent research to integrate these data, together with satellite information on surface circulation and water properties, has shown that an integrative multi-disciplinary approach provides useful ecosystem level information Furthermore, our data show that the Gulf of Alaska and southern Bering Sea can be divided into distinct regions or meso-scale ecosystems, which may have implications for the resources that forage in them This presentation will highlight some of the results obtained over the last year

POSTER Ocean Observing Systems and Climate Change

Exploring The Structure Of The Oceanic Environment A Classification Approach

Karin M Bodtker, Edward J Gregr, and Andrew W Trites

To support the move toward ecosystem-based management, we developed a method to identify and quantify structure in the oceanic environment We identified distinct oceanic regions in the North Pacific by applying image classification algorithms to physical oceanographic output from a ROMS model We pooled the ROMS output by four seasons and two time periods on either side of the 1976-1977 regime shift to investigate seasonal and long-term changes in these regions We found that regions identified for summer pre-1976 corresponded well to the classic upper zone domains identified in the North Pacific by Dodimead and co-authors in 1963 Spatial variability of ocean conditions was identified for each season-regime combination, and temporal patterns of change were noted that correspond to seasons and regime shifts Statistically comparing the oceanic regions showed that the pattern for any season was more similar to that for the same season in the opposite regime than it was for either consecutive season in the same regime Furthermore, the degree of change between consecutive seasons was inconsistent between regimes We tested the biological relevance of the regions we identified by statistically examining their relation to the distributions of species at top and bottom trophic levels (i e , chlorophyll-a distributions and known locations of Steller sea lion rookeries) Both tests supported our hypotheses that the regions are biologically distinct Our classification approach is flexible and allows temporal and spatial fluxes to be characterized at a range of scales This flexibility in identifying ecosystem boundaries makes it a powerful tool for managers of marine resources to explore and test hypotheses about ecosystem dynamics in the move towards ecosystem-based management

POSTER Ocean Observing Systems and Climate Change

U S Commission on Ocean Policy Recommendations and NOAA's National Status and Trends Program

M J Hameedi,

National Centers for Coastal Ocean Science, Center for Coastal Monitoring and Assessment, National Oceanic and Atmospheric Administration (NOAA), Silver Spring, Maryland

A set of recommendations of the United States Commission on Ocean Policy (September 2004) and a follow-up U S Ocean Action Plan (December 2004) provide a fresh, new approach and a framework for managing the Nation's coastal and marine resources In terms of environmental observations and water quality monitoring, the commission recommends establishment of a National Water Quality Monitoring Network, having explicit linkages with the Integrated Ocean Observing System (IOOS) and regional observing systems, relevance to coastal water pollution issues, and association with a revamped, modernistic data and information management system NOAA's National Status and Trends Program is the only nationwide monitoring program for toxic contaminants, many of which are environmentally persistent, bioaccumualtive and toxic Elements of this program along with those from other programs in NOAA (for example, the System Wide Monitoring Program of the National Estuarine Research Reserve System) and those in other federal agencies (for example, the National Water-Quality Assessment Program of the U S Geological Survey) could form the "federally funded backbone" of water quality monitoring networks and pertinent research programs Such a program could be formulated to assure relevance of monitoring data to coastal resource management issues, including impacts of natural and anthropogenic environmental stressors, and deliver interpretive reports and educational materials to improve public awareness and participation in stewardship of the coastal environment and resources The poster provides water and sediment quality data from coastal waters in Alaska, including results from long-term, fixed monitoring sites, regional assessments, and emerging contaminants of regional concern in the United States Arctic

POSTER Ocean Observing Systems and Climate Change

Linking Science And Management In Kachemak Bay

Ruth Kelty, Michelle Harmon and Gary Matlock

The condition of ecosystems, including Kachemak Bay, is determined by the interaction of pollution, land and resource use, climate change, invasive species, and extreme events (i e disease and harmful algal blooms) Resource managers are responsible for reducing or mitigating impacts of ecosystem stressors, while balancing environmental, social, and economic goals Achieving this balance requires an understanding of the stressors to ecosystems and the ability to predict how these systems will respond to natural and anthropogenic changes, including the management strategies implemented NCCOS is committed to providing managers science that is credible, relevant, and timely In Alaska, scientists from the National Centers for Coastal Ocean Science (NCCOS) have been providing sound science to enable effective ecosystem-based management by identifying the stressors affecting ecosystem condition, determining the processes by which they act, identifying their short- and long-term impacts, and forecasting future ecosystem conditions with and without management intervention For example, the NCCOS-administered U S Global Ocean Ecosystem Dynamics (GLOBEC) program has improved the understanding of the factors controlling the major fisheries in the Gulf of Alaska to improve NMFS' ability to manage these major fisheries NCCOS research showing that littleneck clams, an important commercial and recreational fishery in Alaska, rely heavily on microscopic algae growing on tidal flats for growth (rather than phytoplankton) is being used to better predict consequences of oil spills and climate change on food webs in Alaskan coastal ecosystems Other results are applied to habitat restoration, predicting fisheries response to exploitation, and biological productivity and cycling of contaminants

POSTER Ocean Observing Systems and Climate Change

Rapid Climate Change Affects Function Of The Hydrology, Biology, And Economics Of Western River Systems

Jack Peterson

Rapid climate change, evidenced by observed shifts in the timing of precipitation and hydrologic events and their associated biological systems in mid to high latitude river basins, is triggering a cascade of consequences for natural and human systems These observed changes, from the Sierra Nevada and Great Basin, to the Northern Rockies and Alaska, are occurring on a human, rather than a geologic, time scale They include increased seasonal temperatures, a significant forward shift in seasonal events, reduced precipitation, higher elevation mountain freezing levels, reduced snow packs, increased rain-on-snow events, earlier snowmelt, and a shift forward in river system hydrology The Great Basin, Colorado Plateau, and Northern Rockies are in their seventh year of extreme to exceptional drought Changes in river basin functions, evidenced by shifts in climate and river hydrographs, have already upset engineered water storage and delivery systems, including irrigated agriculture, hydroelectric generation, and municipal water supplies throughout the American West These climate changes will also result in changes in the salinity, temperature, biology and circulation of receiving salt water estuaries, bays, sounds, and seas, with economic consequences that we do not yet understand The rapid onset and long duration of current climate change events appear to mirror earlier historic and paleo-climate events The paper is based on an analysis of research published by the Desert Research Laboratory of USGS, Scripps Institution, Lamont Doherty Lab at Columbia University, Goddard Space Flight Center, and Arctic Climate Impact Assessment It also draws on work at the U of Texas at Austin, U of Arizona, U of Washington, and U of Alaska at Fairbanks

POSTER Ocean Observing Systems and Climate Change

Understanding Changes In The Thermal State Of The Bering And Chukchi Seas In The Second Half Of The Twentieth Century

Semiletov I, Luchin V , and G Weller

We examine the long-range variability in the oceanographic regimes of the Bering and Chukchi Seas during the second half of the twentieth century using the largest T-S data set available, containing about 120,000 stations

POSTER Ocean Observing Systems and Climate Change

The Alaska Marine Information System (AMIS) An Integrated Web-Based Information System For The North Pacific Research Board

Karen Stocks and Frances Michaelis

The Alaska Marine Information System (AMIS) is a web-based information system that was started in August 2004, commissioned by the North Pacific Research Board AMIS covers the North Pacific Ocean, including the Gulf of Alaska and the Bering Sea as well as the Arctic Ocean Two components of the in-progress system will be demonstrated (1) the Alaskan portal to the Ocean Biogeographic Information System (OBIS), which allows users to search for species distribution data from the Alaskan region, and, (2) web pages that allow users to navigate through content related to NPRB in particular and Alaskan marine ecosystem in general, such as websites, project descriptions, and publications

Physical and Biological Oceanography

Tuesday, January 25, 2005 8 00 am – 10 00 am

Chair Steve Okkonen

Keynote **Alaskan Oceanography Past, Present and Future – A Personal Perspective**	Tom Royer
Drifters' Trajectories During the Lagrangian Field Experiment (Prince William Sound, 28 July to 10 August 2004)	Claude Belanger
Temporal Variability in Hydrographic Conditions in Lower Cook Inlet	Scott Pegau
Tidal Mixing Effects on a Biological Model	Meibing Jin
Modeling Environmental Hydrodynamic Fields of the Bering Sea Toward a Coupled Ice-Ocean-Biological Model (CIOBM)	Jia Wang
Reconstruction of the Summer Circulation in the Bering Sea	Gleb Panteleev

POSTERS

Phytoplankton Taxonomic Variations Estimated by Chlorophyll a Size-fractionation During Summer in Glacier Bay, Alaska	Lisa Eisner
Oceanographic Conditions within Alternative Sites for the Disposal of Fish Offal in Orca Inlet, Cordova, Alaska	Shelton Gay
An Update of Temperature, Salinity, and Fluorescence Fields in the Northern Gulf of Alaska	Steve Okkonen
Alternative Methods for Seafood Waste Discharge in Cordova	Richard Thorne
Modeling Shelf-Basin Interaction in the Nearshore Beaufort Sea Ice Using A Nested Ice-Ocean-Oil Spill Model	Jia Wang
Freshwater Variability In The Alaska Coastal Current	Thomas Weingartner

Physical and Biological Oceanography

Alaskan Oceanography Past, Present And Future – A Personal Perspective

Thomas Royer

Center for Coastal Physical Oceanography, Old Dominion University, Norfolk, VA 23508

Knowledge of ocean processes in the northern North Pacific, Bering Sea and Arctic Ocean has been accumulating since the ice ages We are fortunate to be able to stand on the shoulders of our predecessors but we also must take care to strengthen our understanding of the marine environment with our own observations and studies and to provide a climate for continued scientific investigations

Recent studies reveal dramatic changes in the physical properties of Alaskan waters with increases in water temperatures of nearly 1° C over 30 years along with changes in stratification Improved estimates of freshwater flow through the Bering Straits suggest a 50% increase over prior estimates Climate change implications have been predicted to be first and largest at high latitudes and these changes are now being observed Frequent observations of potential changes be continued for decades to be certain of these changes or their absence Fortunately, some new programs and techniques are available for cost effective measurement of some parameters such as upper layer temperature and salinity over the deep ocean, sea level, waves and winds Unfortunately, many of the federal programs that support marine science studies in Alaska are suffering from reduced budgets

With the declining federal support of Alaskan marine science, other avenues of support and organization are needed The infrastructure needs to be established and maintained for the funding of observations, data archiving and management, analysis, modeling and synthesis Coordination is needed between the activities of the various interested regional marine agencies such as NPRB, AOOS, EVOS and others

Drifters' Trajectories During The Lagrangian Field Experiment (Prince William Sound, 28 July To 10 August 2004)

Claude Belanger

The Lagrangian Field Experiment held in Prince William Sound from 28 July to 10 August 2004 encompassed the deployment of 20 drifters at a central location in the central basin, 10 drifters being surface buoys designed to track oil floating on the water, and 10 drifters being buoys equipped with a drogue centered at 10 m below the surface The surface drifters were rapidly leaving the central basin area, so they were recovered and re-deployed twice for a total of three deployments That was not necessary for the 10-m drifters Both the surface drifters and the 10-m drifters described trajectories revealing the presence of a cyclonic gyre in the central basin during the experiment Despite relatively weak winds compared to average conditions for this time of the year, short wind events appeared to influence the trajectories of the surface drifters For example, they either left the cyclonic gyre concurrently with a strong east wind event, or did not describe circular trajectories when a strong east wind event occurred early after deployment Regarding the surface drifters, it was also observed that a small distance between two drifters (as small as 0 5 km) could result in quite different trajectories Although most of the 10-m drifters finally had escaped the gyre area toward the end of the experiment, their period of residence in the central Sound area was much longer than what was observed for the surface drifters (roughly 7 times longer considering the simultaneously deployed surface drifters) This suggests that should dispersants be used following an oil spill in central Prince William Sound, the trajectory and fate of the subsurface oil would likely differ considerably from the trajectory and fate of untreated surface oil

Physical and Biological Oceanography

Temporal Variability In Hydrographic Conditions In Lower Cook Inlet

W Scott Pegau, Steve Okkonen, Susan Saupe, and Mark Willette

Two programs routinely measured hydrographic conditions in Lower Cook Inlet during 2004 An EVOS/GEM project conducted a survey each day in July along a line between Anchor Point and Red River The survey measurements include CTD casts at six stations, a towed CTD, and a towed ADCP This dataset is used to examine the short-term variability in hydrographic properties A second program conducted CTD casts along four lines enclosing Lower Cook Inlet, including one co-located with the GEM project This larger survey was conducted six times from April through September 2004 This data is used to provide an indication of seasonal variability in hydrographic conditions

Physical and Biological Oceanography

Tidal Mixing Effects On A Biological Model

Meibing Jin

Tidal mixing is one of the very important processes influencing the spring phytoplankton bloom in the southeastern Bering Sea middle shelf Parameterization of tidal current into a 1-D coupled physical-biological model was developed, and the results showed improved thermohaline structures and biological profiles at a multi-year biophysical mooring site The biological model has eight compartments including two phytoplankton, two zooplankton, three nutrients and detritus The physical model has a second-order turbulence closure model

The model was found to produce unrealistic vertical temperature profile under the surface mixed layer if forced only by surface heat and salt flux, wind The tide forcing is computed from idealized shallow water equations using the tidal current harmonic constants derived from mooring ADCP data Sensitivity studies reveal that tidal forcing is crucial to produce realistic vertical temperature and diffusion coefficients profile, especially in the bottom mixed layer Tidal mixing is also important to maintain the heat content of the water column, and the heat exchange with the atmosphere during an annual cycle The timing and magnitudes of the spring and post-spring phytoplankton bloom was well produced

Physical and Biological Oceanography

Modeling Environmental Hydrodynamic Fields Of The Bering Sea Toward A Coupled Ice-Ocean-Biological Model (CIOBM)

Jia Wang

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To study marine ecosystem of the Bering Sea with a 3-D coupled ice-ocean-biogeochemical model (CIOBM), the environmental hydrodynamics should be simulated correctly We simulated the tides and tidal current with the Princeton Ocean Model (POM) The simulated M2 and K1 co-tidal charts are consistent with previous studies When comparing the vertical current structure of the M2 and K1, It shows that the M2 tidal current has stronger vertical shear structures than the K1 tide The reason seems to be the horizontal current velocity difference The calculated Eulerian tidal residual current, Stokes' drift current, and the combined tidal residual current of the M2 tide has a weak anticyclonic circulation along the deep Bering Sea, while in the shallow shelf, the tidal residual current of 2-3 cm/s is northward or northwestward, which has a long-term effect on material (such as nutrients) transport By contrast with the tidal modeling, we simulated the ocean circulation step-by-step 1)The simulated diagnostic barotropic circulation shows a main Alaskan Stream (AS), nevertheless, the Bering Sea shelf current is very weak, and there is no Bering Slope Current (BSC) or Kamchatka Current (KC) 2)The simulated diagnostic baroclinic circulation shows that the AS flows into the Bering Sea mainly from Unimak Strait and the neighboring passages/straits, the western boundary KC flows along the western side of the basin, the eastward BSC flows along the northern Aleutian Islands, the BSC is evident northwestward along the 1000-m isobath, the Bering Sea shelf current is northward All these features from simulations are consistent with available observations When monthly wind field is applied, although the AS and BSC have not much change, the KC and the shelf current become much stronger This indicates that wind field is very important to the western boundary KC and shelf circulation in the Bering Sea 3)-The simulated prognostic baroclinic circulation with wind forcing is much the same as the diagnostic baroclinic circulations with wind forcing We are simulating the combined tidal, wind-driven and density-driven circulation simultaneously, which will be the ultimate environmental dynamic fields more likely in the real ocean, and driving the ecosystem dynamics in the Bering Sea

Physical and Biological Oceanography

Reconstruction Of The Summer Circulation In The Bering Sea

G G Panteleev, V Luchin, D A Nechaev and Ikeda Motoushi

An estimate of the summer Bering Sea circulation is constructed as a 4-dimensional variational inverse of the monthly hydrographic and atmospheric climatologies The reconstructed evolution of temperature, salinity, and velocity fields provides the best fit to climatological data and satisfies dynamic and kinematic constraints of a primitive equations model of the ocean circulation The data-optimized Bering Sea state is in general agreement with the existing schemes of circulation in the region This utilized technique allows us to optimize surface heat and salt fluxes, which are in good agreement with available data This approach is developed in order to serve as a basis for further monitoring systems of the region

POSTER Physical and Biological Oceanography

Phytoplankton Taxonomic Variations Estimated By Chlorophyll a Size-Fractionation During Summer In Glacier Bay, Alaska

Lisa Eisner

As part of joint projects with the US Geological Survey (USGS), discrete water samples for chlorophyll a (total and size fractionated for > 10 m) and conductivity-temperature-depth (CTD) profiles were collected throughout Glacier Bay during the summers of 2002 and 2004 This study compares size-fractionated chlorophyll a (indicating the relative percentage of large and small phytoplankton taxa), total chlorophyll a along with in situ chlorophyll a fluorescence readings (indicating total phytoplankton biomass) and water mass characteristics including temperature, salinity and nutrients Results presented here provide information on the spatial variations of physical factors and associated phytoplankton taxa and biomass In addition, these findings will help to characterize the abiotic and biotic marine habitat for higher trophic level organisms in Glacier Bay

POSTER Physical and Biological Oceanography

Oceanographic Conditions Within Alternative Sites For The Disposal Of Fish Offal In Orca Inlet, Cordova, Alaska

Shelton Gay

www pwssc gen ak us

During the summer of 2004, the Prince William Sound Science Center (PWSSC), in collaboration with the Copper River Watershed Project and the Alaska Department of Environmental Conservation, began a study of two alternative sites to be used for the disposal of fish offal from Cordova's seafood processors As part of this project, baseline oceanographic conditions were surveyed, including currents, using an Acoustic Doppler Current Profiler over one semi-diurnal tide cycle (i e sequential ebb and flood tides ~ 14 hrs) and temperature and salinity profiles taken at least four times over the tidal cycle To measure the extremes in flow, data were collected during both neap and spring tides, which occurred in July and early September respectively The two regions investigated differed significantly in both hydrography and circulation due to a number of factors, including variation in bottom depths, basin geometry, sources of freshwater input, and the strength and pattern of the tidal currents The northern site (Salmo Point to North Island) is characterized by high freshwater input due to glacial runoff from the Rude River, and a deep inflow of cold, saline water from within Orca Bay This region is therefore highly stratified in the summer, and the tidal currents are very complex, fluctuating in velocities over depth during the course of the tidal cycle (i e baroclinic) The surface currents also exhibit significant spatial variation, ranging from < 5 to 50 cm/sec due to the development of fronts caused by the estuarine input In contrast, the southern site (Mid Orca Inlet) is influenced by stronger barotrophic flows (> 100 cm/sec), and due to turbulent mixing, all inputs of heat and freshwater (including glacial sources advected from the north) rapidly dissipate creating a more uniform local physical environment Both locations would potentially serve as fish offal discharge sites if maximum dispersion were the goal The northern site, however, may achieve better results due to its deeper basin and the baroclinic nature of the currents The higher population of groundfish in this region would also benefit more from disposal of offal at this site

POSTER Physical and Biological Oceanography

An Update Of Temperature, Salinity, And Fluorescence Fields In The Northern Gulf Of Alaska

Stephen Okkonen

www ims uaf edu/tsg/

Near-surface measurements of temperature and salinity acquired by a thermosalinograph installed on the T/V Polar Alaska reveal prominent fronts at the shelf break, Hinchinbrook Entrance, and in northern Prince William Sound The strength of these fronts follows the seasonal cycle of freshwater in the northern Gulf of Alaska Concurrent satellite imagery indicates that 1) the shelf break front is maintained by Alaska Coastal Current waters originating east of Kayak Island, 2) the Hinchinbrook Entrance front is maintained by the Copper River, and 3) the northern Prince William Sound front is maintained by freshwater discharges from Port Valdez and Columbia glacier

POSTER Physical and Biological Oceanography

Alternative Methods for Seafood Waste Discharge in Cordova

Richard Thorne, Mary Anne Bishop, Kenwyn George and Shelton Gay

In 1975 EPA produced effluent discharge guidelines for the seafood processor industry that required wastes to be ground to ½ in any dimension prior to discharge Subsequently, there were noticeable decreases in crab and halibut harvests around Cordova and a substantial increase in numbers of Glaucous-winged gulls, which has reached nuisance levels We hypothesize that the change in discharge guidelines removed a food source for the large bottom oriented animals and increased availability to the surface-oriented gulls We have developed a conceptual model that examines both the physical and biological mechanisms of seafood waste dispersal, and a plan to examine the potential fisheries enhancement associated with alternative discharge methods The study, supported by EVOS TC, will compare local impacts of the ½ ground discharge with that of heads and carcasses over a two-year period

POSTER Physical and Biological Oceanography

Modeling Shelf-Basin Interaction In The Nearshore Beaufort Sea Ice Using A Nested Ice-Ocean-Oil Spill Model

Jia Wang, Qinzheng Liu and Meibing Jin

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This study is to validate a high-resolution coupled ice-ocean model using available observations and to investigate the fine structure of the ice and ocean motion, and in the near future to provide a precise prediction of ice-ocean-oil spill system During the first year of this three-year project, a nested ocean model (3 7km) was set up (Wang et al 2002) Numerical experiments were conducted to test the ice-ocean model sensitivity

To validate the model, we focused on model-data comparison during the second year We found that the modeled circulation revealed the observed Beaufort Sea coastal current and the Beaufort Gyre Vertical temperature and salinity profile revealed the observed dense water sinking process on shelf areas The model reproduces reasonable seasonal cycle in sea-ice concentration, temperature, salinity, water masses, and other variables The nested model reproduces mesoscale eddies, consistent with satellite images taken in the same region Some important processes such as winter halocline ventilation, dense water formation are well captured in the model The towed ADCP and CTD data from JAMSTEC and other investigators are used for the validation

During the third year, we implemented the proposed oil spill model to the ice-ocean model to establish a stand-alone ice-ocean-oil spill modeling system The trajectory model uses a 3-D random walk model Numerical experiments were conducted for the following topics 1) surface oil spills with water in summer, and with ice in winter, and 2) coastal dense water formation during winter The modeling system is ready for a further application to a nowcast/forecast operational forecast

POSTER Physical and Biological Oceanography

Freshwater Variability In The Alaska Coastal Current

Thomas Weingartner, Seth Danielson, Thomas Royer

We constructed an annual climatology of the baroclinic, geostrophic component of the mass and freshwater transports and freshwater content (FWC) in the Gulf of Alaska's Alaska Coastal Current (ACC) from historical and recent CTD data to assess the processes controlling the freshwater budget of the ACC In most months the coastal freshwater discharge is balanced by the along-shelf freshwater transport (FWT) Freshwater is trapped to the ACC because offshore eddy freshwater fluxes appear balanced by onshore Ekman transport of low salinity surface waters due to the mean cyclonic wind stress On annual average the FWT is 880 km3 yr-1, which compares favorably with the annually averaged runoff of 760 km3 yr^{-1} The barotropic component of the ACC might transport an additional 380 km3 yr-1 of freshwater, but the resulting imbalance may be due to underestimates in runoff or neglect of the freshwater influx from the British Columbian shelf The mean FWC is 542 km^3 so that the freshwater flushing time over the 1500 km portion of the ACC considered is <1 year These conclusions are tentative because of uncertainties surrounding discharge estimates, the structures of the cross-shelf flow field and along-shelf winds, the use of a parameterized eddy flux, neglect of flow-topography interactions, and the seasonal magnitude of the barotropic component of the flow If correct, our results imply that the ACC is an important freshwater source for the eastern Bering Sea shelf A comparison between the 1997-98 El Niño and the 1998-99 La Niña illustrates the large interannual variability in freshwater conditions expected for this shelf Mass transports and FWT in late winter 1998 were nearly twice as large as in winter 1999, and the springtime onset of stratification was earlier in 1998 than in 1999 The differences were due to the fall-winter of 1997-98 being subject to anomalously large runoff and strong downwelling over the coastal Northeast Pacific Ocean The comparison suggests that climate changes leading to rainier winters might advance the onset of springtime stratification, which could affect biological production November - May monthly discharge anomalies are significantly correlated with ACC mass transport, FWT, and FWC Based on the significant correlation between the Ketchikan-Seward atmospheric sea level pressure gradient and runoff we extended Royer's [1982] runoff time series from 1930 to 1900 The extended runoff time series indicates that the wettest (driest) decade during the 20th century was the 1920s (1900s) and it is correlated with the Pacific Decadal Oscillation index, although the latter explains <25% of the runoff variability Although the runoff time series can be used for retrospective studies, coastal measurements of salinity and/or dynamic height are significantly better predictors of these ACC variables Gulf-wide monitoring of these variables can be cost-effectively achieved using only a few coastal stations

Fisheries Oceanography

Tuesday, January 25, 2005 10 15 am – 11 45 pm

Chair Anne Hollowed

Alaskan Groundfish Feeding Ecology An OBIS Information System	Dale Kiefer
Oceanic Carbon Subsidies Led to High Marine Survival and the Enormous Prince William Sound Pink Salmon Runs of 2003	Thomas Kline
Forage Fishes in the Western Gulf of Alaska Variation in Productivity	Matt Wilson
Does Climate-driven Variability in the Oceanographic Structure of the Gulf of Alaska Shelf Affect Fish Community Composition by Modulating the Degree of Interspecific Competition Between Juvenile Pollock and Capelin?	Elizabeth Logerwell
The Multispecies Statistical Model Incorporating Predation Equations into a Statistical Catch-at-Age Model	Jesus Jurado-Molina

POSTER

Ken Adams

Fisheries Oceanography

Alaskan Groundfish Feeding Ecology An OBIS Information System

Dale Kiefer

The presentation summarizes efforts to develop a web-based information system containing information characterizing the distribution and feeding ecology of Alaskan groundfish in relation to environmental parameters This GIS will archive, analyze, and provide a means to distribute, via the Internet, information on the spatial and temporal distribution of a large number of groundfish and associated prey species sampled in the Gulf of Alaska, Aleutian Island waters, and the Bering Sea by the NMFS Alaska Fisheries Science Center (AFSC) This biogeographic information system will include data on the gut contents of specimens, as well as environmental information characterizing the habitats of the species These datasets provide a biogeographic description of groundfish distribution and dynamics in relation to habitat structure and environmental variability They also provide a detailed account of interspecific and environmental interactions that are integral to ecosystem-based fisheries assessment and management
approaches Biological databases used in this project will derive from AFSC, while environmental information will come from databases at the Pacific Marine Ecological Laboratory, AFSC and other sources, such as the Institute of Marine Science, University of Alaska Fairbanks Datasets employed are diverse in nature, and will include satellite imagery, hydrographic and fishery surveys data The information system will address the problem of integrating multivariate data that has been collected on differing spatial and temporal scales It will also provide GIS tools to analyze, visualize and disseminate information according to OBIS technical protocols Our goal is to develop a pilot system that will not only augment OBIS, but also characterize the habitat and behavior of Alaskan groundfish, and provide a model of how the integration of environmental information can aid in the assessment of marine
resources

Fisheries Oceanography

Oceanic Carbon Subsidies Led To High Marine Survival And The Enormous Prince William Sound Pink Salmon Runs Of 2003

Thomas Kline

Differences in the relative amount of oceanic and coastal carbon assimilated by early marine pink salmon rearing in Prince William Sound (PWS), and on the inner Gulf of Alaska (GOA) shelf each year from 1998 to 2003, were determined using stable isotope analysis (SIA) SIA of *Neocalanus* copepods sampled from PWS and the adjacent northern GOA from 1994 to 2004 suggested that carbon of low C-13 content was diagnostic for oceanic carbon Conversely, copepods from PWS, which were used to characterize coastal carbon, were consistently C-13 enriched The Alaska Coastal Current formed the boundary separating coastal and oceanic carbon most of the time However, there were occasions when coastal carbon extended seaward onto the inner continental shelf near Resurrection Bay and immediately south of Hinchinbrook Entrance The exceptionally large pink salmon *(Oncorhynchus gorbuscha)* runs that returned to PWS in 2003 were released from hatcheries or emerged from the gravel during the Spring of 2002, the year when juveniles were the most dependent on oceanic carbon Conversely, the highest
dependency on coastal carbon by juveniles occurred in 2001, these returned in very low numbers in 2002 Oceanic subsidies in the form of zooplankton, which were more abundant in 2002 compared to 2001, are hypothesized to have enhanced survival in two ways One, oceanic plankton from the Gulf augmented that available in the Sound and accelerated salmon growth, reducing the time when they were most vulnerable to predation Two, oceanic plankton from the Gulf augmented that available in the Sound such that concentrations were above threshold levels, enabling potential salmon predators to switch to zooplankton Whereas present SIA data show that oceanic carbon drove salmon production in 2002, SIA data supporting oceanic origin for the large pulse of euphausiids observed in PWS that year still need to be generated Nevertheless, the high correlation between euphausiid numbers and salmon run size supports prey switching by salmon predators because euphausiids were not important for salmon early marine diets, but can be important for salmon predators That low C-13 content carbon was associated with higher salmon returns to PWS contradicts a hypothesis that high C-13 reflects higher system capacity Zooplankton recruitment processes, particularly advection, may play a greater role for salmon
survival than productivity per se

Fisheries Oceanography

Forage Fishes In The Western Gulf Of Alaska Variation In Productivity

Matt Wilson

The Alaska Coastal Current (ACC) may influence productivity of capelin (*Mallotus villosus*), eulachon (*Thaleicthys pacificus*), and juvenile walleye pollock (*Theragra chalcogramma*) in the coastal Gulf of Alaska (GOA) The hypothesis is that the ACC provides prey-rich water and, thereby, influences fish distribution of abundance and size This on-going study is based on physical and biological data collected within the GOA walleye pollock nursery A grid of 44 predetermined station locations was occupied day and night between the Shumagin and Shelikof sea valleys during September 2000, 2001, and 2003 Salinity and model-derived estimates of current velocity were used to identify grid sub-areas most influenced by the ACC Results from parallel, on-going diet studies were used to identify the five most prevalent prey categories larvaceans, thecosomate pteropods, small copepods, large copepods, and euphausiids Analysis of variance indicated that the geographic strata most influenced by the ACC were often associated with enriched zooplankton abundance The influence of the ACC on the fish, however, was less pronounced Possible explanations for the lack of a significant relationship include decreased statistical power, absence of prey limitation, and relaxation of physical-biological coupling

Does Climate-Driven Variability In The Oceanographic Structure Of The Gulf Of Alaska Shelf Affect Fish Community Composition By Modulating The Degree Of Interspecific Competition Between Juvenile Pollock And Capelin?

Elizabeth Logerwell, Anne Hollowed, Christopher Wilson, Phyllis Stabeno

The results of AFSC and PMEL research during 2000-2002 off Kodiak Island in the Gulf of Alaska indicate that ocean conditions affect the cross-shelf distribution of juvenile walleye pollock and capelin Pollock were found in warmer waters inshore of a mid-shelf hydrographic front, whereas capelin were found offshore in cool waters advected from the slope Although this pattern was consistent among years, there was intra-annual variability in the location of the front A weakening of the front over the course of approximately 10 days in 2002 resulted in an expansion of warm nearshore water towards the outer shelf Juvenile pollock distribution similarly extended towards the outer shelf Coincident with the change in pollock distribution, the abundance of capelin declined in the outer shelf region These changes in fish distribution are consistent with competitive exclusion of capelin by juvenile pollock We hypothesize that the intra-annual dynamics in water mass properties and fish distributions are a model of the larger scale processes that resulted in the apparent community re-organization on the Gulf of Alaska shelf following the late 1970's regime shift Patterns in the oceanography and fish distributions during the 2004 survey off Kodiak Island will be examined in light of this hypothesis There are several mechanisms by which climate variability could influence physical structure off Kodiak Island We will discuss the linkages between large-scale climate and local physical structure on the Gulf of Alaska shelf as well as the need for further understanding of the potential for competition between pollock and capelin

Fisheries Oceanography

The Multispecies Statistical Model Incorporating Predation Equations Into A Statistical Catch-At-Age Model

Jesus Jurado-Molina and Patricia A Livingston

The Bering Sea is rich in biological resources, including at least 450 species of fish, crustaceans and mollusks It also has economic importance due to its contribution of 25% to the total US harvest, affecting the economy of the Pacific coast states Current management in the Bering Sea is single-species based, however groundfish populations are connected through the food web as predators and prey and are subject to environmental variability affecting their survival and recruitment Therefore, managers are interested in the evaluation of potential impacts of their decisions on the ecosystem due to predator-prey interactions and climate uncertainty The technology available to carry out this task includes the multispecies virtual population model MSVPA, and the multispecies forecasting model MSFOR, which are deterministic models A multispecies statistical model is being developed by incorporating the predation equations from
MSVPA into a catch-at-age model using a two species system (walleye pollock and Pacific cod) from the Bering Sea Preliminary results suggest that MSM reproduced most of the suitability coefficients and predation mortalities estimated by MSVPA, and the adult population estimates from the single-species stock assessment The MSM also provides a measure of the uncertainty associated with the model parameters, which are not available with the current MSVPA technologies MSM also provides a convenient framework to carry out decision analysis to explore the consequences of future levels of fishing mortality and its indirect effects between target species in a statistical framework MSM is an important advancement in providing advice to fisheries managers because it incorporates the current tools used in stock assessment, such as Bayesian methods and decision analysis, into a multispecies context, helping to establish useful scenarios for management in the eastern Bering Sea

POSTER Fisheries Oceanography

Ken Adams and Ross Mullins

During the development of the Gulf Ecosystem Monitoring program (GEM), the *Exxon Valdez* Oil Spill Trustee Council (EVOSTC) received input from a wide range of individuals and organizations In 2002, the National Research Council (NRC) released its final review of the GEM science plan, including its recommendations on how best to achieve a robust, wide ranging, and scientifically sound study We'd like to report on an EVOSTC supported project that is maximally responsive to NRC's recommendations In 2002, two fishermen from Cordova, in collaboration with several science advisors, began seeking the application of research results from the Sound Ecosystem Assessment (SEA) program for the benefit of the Prince William Sound (PWS) resource-dependent communities The SEA program was funded by EVOSTC from 1994 to 1999 and although research results were synthesized, published and acclaimed (Fisheries Oceanography, Vol 10, Supplement 1, 2001), few if any of the ecosystem insights affecting survival of juvenile pink salmon and herring were applied for improved fisheries management and/or other uses The process to resolve this dilemma began in 2002 with the initiation of the Prince William Sound Fisheries Research Application and Planning (PWSFRAP) program Since that time, our project continuum has included a series of community workshops for needs identification, extensive planning, follow up workshops and requests for funding responsive to community needs We are currently planning the implementation of the SEA pink salmon fry survival model, and anticipate the submission of proposals to GEM for a three-year pilot plan to begin in FY06

Our project continues to provide an extensive and substantive means for community involvement within the GEM program as recommended by the NRC Further, the NRC identified the importance of numerical modeling within GEM as a complement to GEM's long-term monitoring activities The planning for and implementation of the pink salmon fry survival model, with EVOSTC support, is directly responsive to NRC's recommendations and the EVOSTC's support for our 'bridging' project had provided the means for spanning the gap between the resource-dependent community, marine scientists and their work, and potential funding organizations Further, PWSFRAP has aided the process of stakeholder participation in the developing state and regional ocean observing systems to ensure that information products are truly responsive to stakeholder needs

Benthic Habitat and Nearshore Ecology

Tuesday, January 25, 2005 1 00 pm – 3 15 pm

Chair Ginny Eckert

Keynote **Ecology of the Copper River Delta**	Sean Powers and Mary Anne Bishop
Bathymetric and Temporal Range, Spatial Extent, and Habitat Characteristics of Atka Mackerel Spawning and Nesting Habitat in the Aleutian Archipelago	Robert Lauth
Coral and Sponge Habitat Mapping in the Central Aleutian Islands	Jon Heifetz
Synergistic Serial Depletion of Nearshore Benthic Invertebrates Leads to a Recent Decline of a Keystone Grazer and the Alteration of a Coastal Ecosystem	Anne Salomon
Dynamics of Chemical Defenses Dynamics of Chemical Defenses in Four Kachemak Bay Kelp Species as a Response to Gastropod Grazing Patterns	Angela Dubois
NaGISA (Natural Geography in Shore Areas)	Katrin Iken
Development of Techniques for Cultivation of Blue King Crab, *Paralithodes platypus*	Bradley Stevens

POSTERS

Estuarine Residence of Coho and Sockeye Smolts on the Copper River Delta	Mary Anne Bishop
Preferential Assimilation of Resuspended Benthic Microalgae by Intertidal Bivalves in Kachemak Bay, Alaska	Carolyn Currin
Alternative Sampling Designs for Monitoring in the Nearshore	Thomas Dean
A Synthesis of Natural Variability in the Nearshore Can We Detect Change?	Ginny Eckert
The Gulf of Alaska Shorezone Website	John Harper
Rhodolith Beds, a New Nearshore Habitat in the North Pacific	Brenda Konar
Biogeography and Cryptic Diversity in *Mastocarpus*	Sandra Lindstrom
Mapping and Evaluating Juvenile Pacific Ocean Perch Habitat in the Aleutian Islands	Chris Rooper
Youth Area Watch Students Watch Weather	Sheryl Salasky
Communities and Nearshore Monitoring	Marilyn Sigman

Ecology Of The Copper River Delta Evaluating The Relative Importance Of Bottom-Up And Top Down Processes In A Marine Soft-Sediment Community

Sean Powers[1] and Mary Anne Bishop[2]

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Nearshore habitats are an integral component of the Gulf of Alaska ecosystem serving as essential nursery and feeding grounds for numerous marine, avian and terrestrial species Intertidal and subtidal sand/mud bottom represents one of the dominant nearshore habitats along the southcentral Alaska coastline The rich abundance of benthic invertebrates residing within the sediments of these sand/mud flats provide a significant prey resource for numerous species of fish, crabs, birds, and marine mammals One of the largest expanses of intertidal mud/sand flats within the GEM study area occurs in the Copper River Delta and southeastern Prince William Sound (Orca Inlet) In 2003, we initiated a large-scale field study designed to examine the physical/chemical and biological factors that limit and/or regulate invertebrate community dynamics The program, funded by EVOS-GEM and OSRI, includes investigations of both 'bottom-up' (physical/chemical parameters - primary production - invertebrate production) and 'top-down' (demersal and avian predators - invertebrate prey) factors that may structure the central invertebrate prey community Results of the 2003 and 2004 field seasons, combined with additional data from 2000-2002, document a highly productive benthic invertebrate community that serves as prey for millions of shorebirds and several species of commercially and recreationally important fish At the base of the foodweb, benthic and water column chlorophyll a (a measure of phytoplankton and algae biomass), as well as benthic macroalgae, increase as distance from the highly turbid waters of the Copper River Delta increases Diversity and production of benthic invertebrates demonstrate a similar pattern with increases in both metrics as distance from the Copper River increases Abundances of demersal fish (e g , flatfish, lingcod, sculpins) generally increase with increasing proximity to the Copper River Delta, a pattern opposite that of their key prey items, benthic invertebrates Physical/chemical measurements collected monthly from March through October as part of the field project, demonstrate that the Copper River is the principal source of nitrogen into nearshore areas Further, based on salinity measurements, it is evident that the influence of the freshwater discharge of the Copper River extends into both Prince William Sound and the Gulf of Alaska The results of this ongoing project clearly demonstrate the strong influence of the Copper River on nearshore areas surrounding the Delta and southeastern Prince William Sound The vast expanse of intertidal and subtidal sand/mud flats nourished by the high suspended sediment load of the Copper River Delta represents an important nearshore habitat within the GEM study area At the conclusion of the field study in 2006, a long-term monitoring program will be developed

Bathymetric And Temporal Range, Spatial Extent, And Habitat Characteristics Of Atka Mackerel Spawning And Nesting Habitat In The Aleutian Archipelago

Robert Lauth

Atka mackerel support a multi-million dollar commercial trawl fishery in Alaska, and they play a key role in the marine ecosystem as an important food source for marine birds, fishes and mammals Rocky substrate is vital to Atka mackerel as reproductive habitat, but very little is known about their spawning and nesting except for a few locations in Russia The objective of this study was to determine the bathymetric and temporal range, spatial extent, and habitat characteristics of Atka mackerel spawning and nesting habitat in Alaska To develop prudent harvest management strategies, more research is needed on the reproductive ecology of Atka mackerel A portable winch and video drop camera system was devised by the Alaska Fisheries Science Center to locate and characterize nesting and spawning habitat in Alaska Nesting sites were identified by the presence of aggregations of males in spawning color exhibiting nesting behavior From June to October 2004, there were 126 camera drops done between Stalemate Bank and the Kenai Peninsula Depth and water temperature were monitored using a data logger attached to the camera frame The location and depth range of nesting sites found in Alaska differed from what was observed in Russia, sites were not immediately adjacent to the coastline and extended much deeper than 32 m Videotapes will be analyzed for information about the physical and biological habitat of nesting sites Events will include presence of a nester (i e , guardian male), a female or school of females, or other noteworthy activities relating to Atka mackerel reproductive ecology Marine plants and animals will be identified to the extent possible, as well as the percent of invertebrate coverage GIS will be used to investigate the relation of nesting sites to other major geographic and bathymetric features of the Aleutian archipelago and Alaska shelf Temporality of spawning and nesting will be examined using underwater time-lapse videography and collections of egg clutches from different nesting sites using scuba diving and bottom trawls Field samples of egg clutches will be staged in the laboratory using a dissecting microscope and a developmental series produced by research at the Alaska SeaLife Center The age of egg clutches will be compared within and between nesting sites to investigate differences in the duration and frequency of spawning, and the duration of nesting

Benthic Habitat and Nearshore Ecology

Coral And Sponge Habitat Mapping In The Central Aleutian Islands

Jon Heifetz , R Stone, D Woodby, J Reynolds, D Carlile, and G Greene

A joint project between the National Marine Fisheries Service, the Alaska Department of Fish and Game, and the University of Alaska began in 2003 to provide the first detailed mapping of coral and sponge habitats for the Aleutian Islands Coral gardens were first discovered in the central Aleutian Islands in 2002, and the conservation of coral and sponge habitats in this area has become a key issue for federal and state fisheries managers due to incidental mortality in fisheries using bottom contact gear Bottom substrates were mapped using multibeam echosounding and backscatter data in a systematic sample of 17 sites between 50m and 3000m depth in swaths averaging about 5 km wide A series of transects were sampled at most of these sites using the Delta submersible and the Jason II, a remotely operated vehicle, to estimate densities and distribution of coral, sponges, various other invertebrates, and fish This presentation will provide highlights of some of the observations and a status report of work in progress Final results, expected in 2006, are to include a predictive model of coral and sponge distribution as a function of measurable environmental characteristics, estimates of the relative abundance of corals and sponges, their importance to commercially valuable fish and invertebrates, and the degree to which these living substrates have been disturbed, including disturbance by fishing gear Funding for this research is provided by the North Pacific Research Board, NOAA's Undersea Research Program, and the National Marine Fisheries Service

Synergistic Serial Depletion Of Nearshore Benthic Invertebrates Leads To A Recent Decline Of A Keystone Grazer And The Alteration Of A Coastal Ecosystem

Anne K Salomon, Nick Tanape Sr , Jennifer L Ruesink, Elizabeth Villarreal, Henry P Huntington

We investigated the relative roles of natural factors and shoreline harvest leading to localized declines of the black chiton, *Katharina tunicata* Known locally as 'bidarki' by Alaskan natives, this chiton is a primary subsistence shellfish resource and a recognized keystone grazer Small scale experiments, in collaboration with village residents, revealed that the absence of this dominant consumer can increase primary production by two orders of magnitude and species diversity by 50% yet reduce the growth and survival of other benthic grazers These manipulations convincingly illustrate the ecological role of *K tunicata* and possible ecosystem level consequences of its harvest Based on interviews with village elders, localized declines can be attributed to a change in social and biological dynamics Historical subsistence harvest differed in several ways from today's practices harvest was less spatially concentrated because communities shifted among seasonal camps and diets included a wider range of invertebrates, such as crab, urchins, and clams These resources are now scarce, likely due to intensified consumption by an increasing sea otter population and historical human harvest Sequential prey switching by both humans and sea otters and a resulting restriction in prey species breadth may have lead to intensified harvest of *K tunicata* Therefore, the recent localized depletion of this keystone grazer and its subsequent ecosystem-level effects may reflect a concentration in the spatial distribution of harvest pressure and the synergistic serial depletion of various nearshore benthic invertebrates

Dynamics Of Chemical Defenses Dynamics Of Chemical Defenses In Four Kachemak Bay Kelp Species As A Response To Gastropod Grazing Patterns

Angela Dubois

The health and diversity of Alaska's coastal ecosystems rely largely on the abundance of spawning and foraging habitat provided by kelp forests Large macroalgae also offer three dimensional space that is frequently occupied by mesoinvertebrate grazers Canopy-forming species like *Nereocystis luetkeana*, and bed-forming species such as *Agarum clathratum*, *Laminaria bongardiana* and *Laminaria saccharina*, are often detrimentally affected by herbivory Consequently, tissue damage caused by grazers may result in decreased fitness of kelp along the Alaskan coast This study addresses the role of the herbivorous gastropods, *Lacuna vincta* and *Calliostoma ligatum*, on defensive chemical production in the four mentioned kelp species Study locations within Kachemak Bay, Alaska, were sampled on a monthly basis beginning in May 2004, using SCUBA techniques to observe temporal variation in abundance and distribution of grazers Tissue segments from differing regions of kelp thalli were analyzed for total phlorotannin concentration, the defensive class of compound commonly present in brown algae Laboratory palatability assays utilizing all study organisms independently assessed differences in feeding behavior based on availability of two meristematic tissue types Results indicate that *L vincta* demonstrate peak abundance in mid-July, preferentially reside on *N luetkeana* blades, and are capable of consuming approximately 1/3 of blade wet weight of this canopy-former within 72-hour assays *C ligatum* occur with a constant but decreased frequency and demonstrate negligible grazing on all algal species in laboratory experiments *C ligatum* behavior may be explained by a propensity to graze on detrital material and diatoms from cohorts' shells

Benthic Habitat and Nearshore Ecology

NaGISA (Natural Geography In Shore Areas)

Katrin Iken and Brenda Konar

Coastal marine biodiversity is a concern in the protection and monitoring of marine resources and ecosystem functioning NaGISA is a field project of the Census of Marine Life (CoML) focusing on nearshore biodiversity in macroalgal and seagrass communities The three-dimensional structure of these habitats makes them especially important for many associated species These shallow water coastal areas also are the areas most impacted by humans, resulting in potential severe effects on nearshore biodiversity NaGISA is a global project where the same sampling protocols are used in all areas to allow later comparisons on various spatial scales The hierarchical structure of the NaGISA standard protocols target large core areas and replicate sample sites within these core areas In Alaska, NaGISA sampling was done in the summer of 2003 and 2004 with the assistance of local communities and university classes Within each of the larger core areas of Prince William Sound, Kodiak Island, and Kachemak Bay, three hard bottom macroalgal sites were sampled quantitatively The results so far show differences in diversity of selected taxa between sites within a core area as well as between different core areas The species lists for macroalgae, polychaetes and mollusks, and abundance and biomass data for selected higher taxon groups produced from this quantitative NaGISA sampling are excellent tools to assist in the site selection for longterm monitoring

Benthic Habitat and Nearshore Ecology

Development Of Techniques For Cultivation Of Blue King Crab, *Paralithodes platypus*

Bradley G Stevens, Sara Persselin, and Julie A Matweyou

NOAA-NMFS, Kodiak Fisheries Research Center

The blue king crab (BKC, *Paralithodes platypus*) was a valuable commercial fishery species in the Bering Sea until populations declined to low levels in the late 1990's, stimulating interest in their early life history Prior to conducting research on juvenile crab biology, it was necessary to develop techniques for cultivating them in the laboratory In this experiment, we tested the effects of diet, temperature, and rearing density on survival of larvae to the first crab stage Four different diets were tested including UNFED zoea were not fed in order to determine if they could survive on stored yolk (lecithotrophic), THAL treatment was fed with *Artemia nauplii* enriched by feeding with diatoms *Thalassiosira nordenskioeldii*, Art +THAL treatment was fed with unenriched *Artemia* plus live *Thalassiosira*, ISO 6 was a control diet of *Artemia* enriched by feeding with frozen *Isochrysis* paste All diets were tested at 6°C, and a density of 10 zoea"l-1, with 6 replicates per treatment The ISO diet was also tested at 3°C (ISO 3) and 9°C (ISO 9), and at densities of 20 (ISO 20) and 40 (ISO 40) zoea"l-1 Larvae were cultivated in PVC tubes in glass beakers until reaching the first crab stage Survival on the A+THAL diet (91 7%) was significantly higher than all others, whereas UNFED larvae died within two weeks Survival in all other treatments was not significantly different Survival decreased slightly with increasing temperature, but not significantly Density had no significant effect on survival, but final mean density (16 zoea"l-1) was similar in the ISO 20 and ISO 40 treatments suggesting that a maximum carrying capacity for these conditions had been reached Length of development to the first juvenile crab stage (C1) was significantly longer (109 d) at 3°C than at 6°C (70 d), but did not decrease further at 9°C CONCLUSIONS Blue king crab larvae can be cultivated with high survival using the proper diet Larvae are not lecithotrophic and must be fed A temperature of 6°C is optimal for survival and length of development These results will be used to produce larger numbers of juvenile crab for laboratory research In addition, these techniques could be modified for use in enhancement of wild crab stocks

POSTER Benthic Habitat and Nearshore Ecology

Estuarine Residence Of Coho And Sockeye Smolts On The Copper River Delta

Mary Anne Bishop[1], Sean P Powers[2], and Gordon Reeves[3]

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Vast expanses of estuarine habitats serve as an essential connection for anadromous species of salmonids in the North Pacific Substantial variability in the early life history and migratory behavior of coho *(Oncorhyncus kisutch)* and sockeye salmon *(O nerka)*, each of which support important fisheries in the North Pacific, exist on both local and regional scales Of particular importance for stock assessments are the age and size of juveniles during outmigration For both species, juveniles have been found in estuaries as age 0 fry, 0+, 1, and 1+ year-old smolts Once in the estuary, residence time is highly variable (days to months) and is probably correlated to the age of outmigration With support from North Pacific Research Board we completed our first field season studying the estuarine phase in the life cycle of juvenile salmon on the Copper River Delta We documented outmigration at the outlet to Eyak Lake from 23 May -15 November 2004 For both sockeyes and coho, we observed intra-species differences in the timing of outmigration In general, both coho and sockeye smolts outmigrated from late May through early June, and again in early fall (October through mid-November) Fry and parr for both species outmigrated from the Lake throughout the season, peaking anywhere from late June to early August, depending on the species and life-stage We used fyke nets and seines to document salmon use in the upper portion of the estuary near the outflows of Alaganik Slough and Eyak River After 7 July, we captured few sockeyes at either site Similarly, by the end of June coho all but disappeared from the upper estuary near Alaganik, although coho parr and fry were captured through late October in the estuarine waters near the mouth of the Eyak River In the middle portion of the estuary, midwater trawls captured coho from early June through mid July Sockeye were captured in trawls from early June through mid-August, suggesting a longer residence time in the estuary In addition to our field work, we are experimenting with otolith microchemistry analyses as a means to determine juvenile residency time in the estuary

POSTER Benthic Habitat and Nearshore Ecology

Preferential Assimilation Of Resuspended Benthic Microalgae By Intertidal Bivalves In Kachemak Bay, Alaska

Carolyn Currin, John Brewer, Priscilla Delano

The relative dietary contribution of phytoplankton and benthic microalgae to the nutrition of intertidal bivalves was assessed using stable isotope analysis Cell counts and pigment analysis of sediment and water column samples provide information on the taxonomy, biomass and distribution of microalgae in Kachemak Bay, Alaska, a macrotidal estuary in southeast Alaska Phytoplankton delC13 and delN15 values averaged -21 4 and 5 1 , respectively, while benthic microalgal values were -16 9 and 5 9 The average dC13 value of Pacific blue mussels *(Mytilus trossulus)* was -17 6, and the Pacific littleneck clam, *(Protothaca staminea)*, had an average dC13 value of -17 0 Two-source mixing models suggest that benthic microalgae provide 40 to 80% of the carbon utilized by these abundant bivalves Water column samples were also collected from 1, 5 and 30 cm above tidal flats and clam beds over a tidal cycle Analysis of size-fractionated samples revealed that benthic diatoms represented the bulk of the fraction <50 microns, and this size-fraction was preferentially assimilated by intertidal clams and mussels The proportion of benthic microalgae in water column samples shows significant temporal and spatial variation These results can be used to improve resource management and guide aquaculture efforts

POSTER Benthic Habitat and Nearshore Ecology

Alternative Sampling Designs For Monitoring In The Nearshore

Thomas Dean and James Bodkin

USGS

Three alternative sampling designs are presented that focus on detecting changes in the nearshore Gulf of Alaska (GOA) that may occur over the next century as the result of both natural and human-induced causes All designs include the following elements 1) Synoptic sampling of specified physical and biological parameters (e g shoreline geomorphology and eelgrass cover) over the entire GOA, 2) Intensive sampling of a variety of specified biological and physical parameters (e g abundance and growth of intertidal organisms, abundance of selected birds and marine mammals) within a few specified areas spread throughout the GOA, 3) Sampling of a smaller suite of selected biological and physical parameters (e g the abundance, growth, and contaminant levels in mussels and clams) at a larger number of less intensively studied sites (referred to as extensive sites) stretching across the GOA, and 3) Conduct of shorter-term studies aimed at identifying important processes regulating or causing changes within a given system or subsystem Intensive sampling is designed to detect larger spatial-scale changes (e g those resulting from climate change) while extensive sampling is aimed at evaluating potential impacts from more localized sources, and especially those resulting from human activities (e g oil spills or shoreline development) Process studies focus on determining causes for observed changes Detailed sampling plans including a list of metrics, number and location of sampling sites, sampling frequency, and cost estimates are supplied for each alternative

POSTER Benthic Habitats and Nearshore Ecology

A Synthesis Of Natural Variability In The Nearshore Can We Detect Change?

Ginny Eckert

One of the primary goals of the GEM program is to detect anthropogenic changes within the four focal habitats in the Gulf of Alaska, however, natural variability in these systems can be so high that it prevents detection of human-induced effects This project synthesized existing data to identify, within the nearshore habitat, environments and species that have less natural variability so that these variables can be included in the GEM monitoring plan Longterm time series data from Gulf of Alaska nearshore populations were collected using datasets and literature identified by Bodkin and Dean in GEM Project # 030687, titled, 'Monitoring in the Nearshore A Process for Making Reasoned Decisions' Data from the Gulf of Alaska and across a broad range of geographic areas was synthesized to identify general characteristics that predict lower levels of natural variability in nearshore marine populations

POSTER Benthic Habitat and Nearshore Ecology

The Gulf of Alaska Shorezone Website

John Harper, Susan Saupe, Mary Morris, Joe Banta

The Gulf of Alaska ShoreZone website (www CoastAlaska net) provides public access to coastal mapping products developed with the ShoreZone Mapping protocol in the Gulf of Alaska At the present time, there are over 8,000 km of web-posted imagery, allowing web users to fly the coastline from Whittier to the Katmai National Park and including components from SE Alaska and from Kodiak Island Selected environmental mapping data is also web posted, allowing users to look at landscape scale distributions of thematic data (such as eelgrass) or zoom in to a specific site, approximately 5,000 km of coastal inventory data is now web-posted The mapping protocol, funded by EVOS, has been web-posted, allowing users to review the detailed procedures that are used in system mapping The ShoreZone data set has appealed to a wide variety of users, including spill response personnel, agency resource managers, scientific researchers and the general public, and the website offers wide-spread access to the dataset

POSTER Benthic Habitat and Nearshore Ecology

Rhodolith Beds, A New Nearshore Habitat In The North Pacific

Brenda Konar and Katrin Iken

In the summer of 2004, a rhodolith bed was discovered as a new habitat in Prince William Sound Rhodolith beds are known globally but until last summer, have never been described in the North Pacific Rhodoliths are unattached red coralline algae that can form extensive beds in nearshore areas Many species of rhodoliths exist In general, rhodoliths require water motion (waves, currents) or bioturbation to maintain in an unattached and unburied Rhodolith beds are economically important because they often are a nursery ground for commercially harvested species such as scallops and shrimp In many parts of the world, rhodoliths themselves are harvested and used as fertilizer because of their high calcium content Conservation of these beds has begun to receive international attention The rhodolith bed found in Herring Bay, Prince William Sound is an entirely new habitat for the North Pacific This bed lies in approximately 12 to 18 m water depth and extends over an area of at least 3000 m^2 Initial surveys showed that the cover of rhodoliths in the bed averaged 52 8% (±9 7se), with the remaining substrate consisting of 29 4% (±9 6se) sand and 17 8% (±8 0se) shell hash While the bottom was predominately soft, macroalgae were found attached to rhodoliths and shell hash The dominant species were *Laminaria saccharina* and *Agarum clathratum* Rhodolith density averaged 27 5±8 7 per 0 0625 m^2, with a biomass of 29 7±6 0 g/0 0625 m^2 A high diversity of marine invertebrates appeared to be associated with the rhodolith bed This new North American rhodolith bed opens the door for much comparative work

POSTER Benthic Habitat and Nearshore Ecology

Biogeography And Cryptic Diversity In *Mastocarpus*

Sandra Lindstrom

Mastocarpus papillatus ("Turkish Washcloth") is a common intertidal red alga on the west coast of North America from Baja California to Alaska It is the gametophyte phase of the tarspot *Petrocelis* Although it is considered diagnostic of mid-intertidal protected and semi-protected habitats in Washington State, it is of more sporadic occurrence on Alaskan shores Sequencing of the ribosomal ITS region of the nuclear genome revealed that *Mastocarpus papillatus* is actually a complex of five well-differentiated species These cryptic species show various patterns of horizontal (geographic) and vertical (tidal height) distributions from California to Alaska Although three of the five species have been recorded in Alaska, only two are common Both of these are widely distributed One occurs more commonly in the mid to upper intertidal, whereas the other species is found near 0 tide level These species exhibit different levels of genetic diversity, with the mid to upper intertidal species showing surprisingly higher levels of variation than the lower intertidal species The species are not clearly distinguished morphologically, and caution is advised when attempting to identify these species in the field In addition, two other *Mastocarpus*-like species have been recorded from the northwest Gulf of Alaska, one of which may be synonymous with a species occurring in northern Japan, while the other is probably new to science

POSTER Benthic Habitat and Nearshore Ecology

Mapping And Evaluating Juvenile Pacific Ocean Perch Habitat In The Aleutian Islands

Chris Rooper

The goal of this study is to assess the value of Aleutian Islands habitat to juvenile Pacific Ocean perch (POP) by mapping study areas using multibeam and sidescan sonar, modeling relationships between juvenile rockfish abundance and habitat characteristics, and linking the habitat to juvenile POP condition Each of five study areas surrounding the Islands of Four Mountains was mapped in summer 2004 using towed sidescan sonar (Klein 3000) and multibeam sonar (Simrad SM2000) systems to depict bottom depth and roughness Underwater video was collected using a towed camera sled to groundtruth the acoustic data Preliminary results indicate habitats sampled at each area varied widely, from bare sand fields, to rocky ledges, ridges and pinnacles Sponge and coral were the dominant epibenthic invertebrates observed in the video and trawl collections, although diversity in benthic organisms was quite high at some sites Atka mackerel and Pacific cod dominated the bottom trawl catches, although adult Pacific Ocean perch, Northern rockfish, Pacific halibut, and walleye Pollock were also common Sponge and coral were found at 85% of transects where trawls were made Juvenile POP were collected from three of the five study areas During the fall and winter of 2004-05 video, sediment samples, zooplankton, and fish collections will be analyzed in the laboratory

POSTER Benthic Habitat and Nearshore Ecology

Youth Area Watch Students Watch Weather

Sheryl Salasky

www chugachschools com/youth_area_watch/

Students from Chugach School District have been conducting scientific sampling projects based on community input and needs Whittier Community School participants are gathering weather data to include in a locally-produced brochure for mariners and visitors After gathering input from longtime community members, students from Tatitlek Community School have been monitoring their beaches, noting changes in the presence of targeted species

POSTER Benthic Habitat and Nearshore Ecology

Communities and Nearshore Monitoring

Marilyn Sigman

This session will provide an overview of the selection process for GEM nearshore monitoring sites and standardization of data collection protocols that is underway and opportunities for involvement by coastal community members and interested organizations It is the first of a series of community workshops to be held in February and March, 2006

Contaminants, HABs, and Invasive Species

Tuesday, January 25, 2005 3 30 pm – 5 30 pm

Chair Margaret Krahn

Keynote **Vibrio Occurrence in Shellfish**	Ray Ralonde
Application of the EPA Environmental Monitoring Assessment Program (EMAP) to Characterization of Alaska Coastal Marine Water Quality	Doug Dasher
Bitter Crab Syndrome	Joseph Morado
Contaminants in North Pacific Basin Marine Mammals	Shannon Atkinson
Organochlorine Contamination in Steller's Sea Lion Pups from Four Russian Rookeries	Matthew Myers
Initiating an Invasive Species Program in Alaska	Robert Piorkowski

Application Of The EPA Environmental Monitoring Assessment Program (EMAP) To Characterization Of Alaska Coastal Marine Water Quality

Doug Dasher and Ron Klein

Alaska, which is the nation's only arctic state, has water resources, which encompass more than 47,000 miles of coastline, and upland watersheds, which comprise approximately 40% of the nation's surface water These water resources support one of the world's largest marine fisheries, critical freshwater spawning grounds for salmon, and major breeding habitats for migrating waterfowl While Alaska is resource rich, it is data poor Without baseline environmental information, it is impossible to identify and assess potential impacts to Alaska's water resources from local, regional, or global stressors Alaska has the opportunity to learn more about its waters while it is in a relatively pristine state Baseline data provides for the development of applicable Alaska water quality criteria and the responsible management of the states resources The US EPA Environmental Monitoring Assessment Program (EMAP) utilizes a randomized sampling design that is an important component of Alaska's assessment methodology In 2002, Alaska utilized the EMAP approach in its first coastal assessment of the Alaskan province, one of 5 coastal provinces established in the EPA National Coastal Assessment sampling design Another EMAP coastal survey was carried out in Southeast Alaskan waters in the summer of 2004 Details of methodology, lessons learned, and some results of the 2002 South Central coastal assessment, along with a brief discussion of the 2004 fieldwork and future plans, will be presented

Bitter Crab Syndrome

Joseph Morado

Bitter Crab Syndrome (BCS) is a fatal disease of North Pacific snow and Tanner crabs Caused by a parasitic dinoflagellate, recent research suggests that BCS is affecting recruitment of both *Chionocetes* species, but affecting each species in a different manner For snow crabs, high disease prevalences in small crabs and subsequent associated mortality may be hastening a decline in population abundance For Tanner crabs, high disease prevalences in small crabs may be preventing recovery of the Eastern Bering Sea population Recent data on prevalence and distribution will be presented, and molecular based research on pathogen identification and monitoring will also be presented and discussed

Contaminants In North Pacific Basin Marine Mammals

Shannon, Atkinson, Matt Myers, and Gina Ylitalo

The impact of toxic organochlorines across regions and species in the North Pacific is a topic of on-going concern In this study, blubber or blood samples from three cetacean and three species of pinnipeds, all from North Pacific waters, were analyzed for levels of PCBs and DDTs Contaminant analyses of blubber biopsies from 13 free-ranging killer whales *(Orcinus orca)* in the Starichkov Island area near Eastern Kamchatka in the Russian waters of the North Pacific Ocean was completed during the summer season of 2002 Sum PCBs ranged from 12 to 3,400 ng/g wet weight with an average concentration of 680 ± 280 ng/g wet weight The DDT levels were higher than PCBs, with an average of 830 ± 330 ng/g wet weight (range 22 - 3,700 ng/g wet weight) In blood of beluga whales *(Delphinapterus leucas)*, from the Cook Inlet region (n=6), sum PCBs ranged from 0 84 to 1 9 ng/g wet weight with an average of 1 3 ± 0 16 ng/g wet weight The mean DDT level was 0 50 ± 0 23 ng/g wet weight and a range of 0 to 1 ng/g wet weight In one gray whale *(Eschrichtius robustus)* that stranded in the Turnagin Arm of the Cook Inlet, sum PCBs and DDTs in blubber were 200 ng/g wet weight and 98 ng/g wet weight, respectively In blubber of Steller sea lions *(Eumetopias jubatus)* from the Bering Sea (n= 9), the mean level of sum PCBs was 2,600 ± 590 ng/g wet weight (range 990 ± 5,700 ng/g wet weight) Concentrations of sum DDTs ranged from 590 to 4,100 ng/g wet weight, with an average of 2,300 ± 510 ng/g wet weight For harbor seals *(Phoca vitulina)* (n=4), sum PCBs in blubber ranged from 160 to 2,400 ng/g wet weight, with an average load of 930 ± 530 ng/g wet weight The average sum DDT level was 510 ± 280 ng/g wet weight, with concentrations ranging from 56 to 1,200 ng/g wet weight In blubber of a ringed seal *(Phoca hispida)* from the Bering Sea, concentrations of sum PCBs and DDTs were 590 ng/g wet weight and 270 ng/g wet weight, respectively Levels were highest in blubber of Steller sea lions, which feed at the same or lower trophic level as other marine mammals investigated here and may suggest that Steller sea lions are either feeding in areas with higher levels or are not able to metabolize organochlorines, as well as other marine mammals

Organochlorine Contamination In Steller Sea Lion Pups From Four Russian Rookeries

Matthew Myers

An inter-island comparison of contaminants was completed for Steller sea lion *(Eumetopias jubatus)* pups from four Russian rookeries An analysis of blood serum samples for both polychlorinated biphenyls (PCBs) and 1,1,1-trichloro-2,2-bis(p-chlorophenyl)ethane or dichlorodiphenyltrichloroethane (DDT) was conducted for 43 Steller's sea lion pups (24 males and 19 females) Overall, PCB levels in pups ranged from 0 56 to 19 00 ng/g wet weight with a mean of 4 14 ± 0 72 ng/g wet weight DDT levels in pups ranged from 0 29 to 12 99 ng/g wet weight with a mean of 2 86 ± 0 51 ng/g wet weight The four rookeries that were sampled were Medny Island (6 males and 4 females), Koslova Cape (7 males and 7 females), Iony Island (5 males and 4 females) and Yamskie Island (6 males and 4 females) Average contaminant levels were higher every time in females compared to males for each rookery, and for both PCBs and DDT, but the difference was never significant Medny, as part of the Commander Islands, was the eastern most area sampled, and had the lowest levels (one way ANOVA for PCBs p = 0 002 and for DDT p= 0 010) For Medny, PCBs ranged from 0 56 to 5 50 ng/g wet weight with a mean of 1 34 ± 0 42 ng/g wet weight, and DDT ranged from 0 29 to 6 80 ng/g wet weight with a mean of 1 24 ± 0 41 ng/g wet weight For Koslova Cape, PCBs ranged from 0 62 to 19 0 ng/g wet weight with a mean of 6 73 ± 1 80 ng/g wet weight, and DDT ranged from 0 70 to 12 99 ng/g wet weight with a mean of 4 16 ± 1 11 ng/g wet weight Koslova Cape had the highest levels of PCBs for all areas, but the difference was only significant versus Medny (p = 0 002) For Iony Island, PCBs ranged from 1 10 to 20 1 ng/g wet weight with a mean of 5 17 ± 1 72 ng/g wet weight, and DDT ranged from 0 68 to 26 49 ng/g wet weight with a mean of 5 65 ± 1 88 ng/g wet weight Iony Island had the highest levels of DDT for all areas, but the level was only significant versus Medny (p = 0 008) For Yamskie, PCBs ranged from 1 90 to 20 0 ng/g wet weight with a mean of 5 38 ± 1 70 ng/g wet weight, and DDT ranged from 0 70 to 24 85ng/g wet weight with a mean of 4 39 ± 1 39 ng/g wet weight This type of analysis suggests that contaminant exposure and potential effects may vary between areas for Steller sea lion pups from Russia Additional analysis will consider the relationship of contaminant level to endocrine disruption of cortisol and thyroid hormone in Steller sea lions

Initiating An Invasive Species Program In Alaska

Robert Piorkowski

Nonindigenous invasive species pose a major threat to Alaska's native flora and fauna and could potentially cause ecosystem disruptions that result in great economic harm to the people of Alaska The major species of present concern are northern pike, Atlantic salmon, New Zealand mud snail, and the green crab In 2002, the Alaska Department of Fish and Game wrote a state aquatic species nuisance management plan to deal with the NIS threat It was approved both by the Governor and by the Aquatic Nuisance Species Task Force Federal funding that followed allowed for the initial implementation of the invasive species program the plan laid out A program coordinator was hired in 2003 with an interdivisional ADFG NIS Team instituted in 2004 A statewide NIS Council is planned for 2005 Accomplishments of the program to date and future directions will be discussed

Oil Impacts

Tuesday, January 25, 2005 7 00 pm – 9 05 pm

Chair Craig Tillery

Keynote **Settlement Overview**	Charlie Cole
Update of the Status of Subsistence Uses	James Fall
2004/5 Assessment of Lingering Oil and Resource Injuries from the *Exxon Valdez* Oil Spill	Lucinda Jacobs
Persistence of Lingering Oil from the *Exxon Valdez*	Jeff Short
Restoration of *Exxon Valdez* Oil Contaminated Habitats by Sea Otters in Prince William Sound Mechanisms and Consequences	James Bodkin
Marine Bird Population Abundance of Prince William Sound, Alaska Trends Following the *T/V Exxon Valdez* Oil Spill, 1989-2004	David Irons
Oil, Salmon and How Urbanization Decreases Population Productivity	Ron Heintz

POSTERS

Sediment Quality Survey of Heavily-Oiled Beaches in Prince William Sound	Betsy Day
Geographic Response Strategies	Dale Gardner
Assessment of Bivalve Recovery on Treated Mixed-soft Beaches in Western Prince William Sound	Dennis Lees
Developing And Populating The GEM Database	Allen Macklin
Status of Killer Whales in the Northern Gulf of Alaska in 2004 Continuing EVOS Effects?	Craig Matkin
Exxon Valdez Oil Spill Trustee Hydrocarbon Database	Bonita Nelson
When is an Oil Spill Over?	Stanley Rice
Harlequin Duck Population Dynamics Measuring Recovery	Dan Rosenberg

Oil Impacts

Update Of The Status Of Subsistence Uses

James Fall

Subsistence uses are a vital natural resource service that was injured by the *Exxon Valdez* Oil Spill Based on interviews with 545 households in 15 communities, updated subsistence harvest and use data will be presented to illustrate trends Survey respondents also provided observations on the status of natural resource populations, food safety, and social and cultural activities supported by subsistence hunting and fishing, such as the role of elders and teaching young people

2004/5 Assessment Of Lingering Oil And Resource Injuries From The *Exxon Valdez* Oil Spill

Lucinda Jacobs, Les Williams, Damian Presiosi

Integral is conducting a series of evaluations using available scientific data to provide an independent analysis of recovery status of key resources and to define any linkage to residual oil This work is intended to provide the Trustee Council with an independent analysis of the ecological significance of lingering oil and the recovery status of injured resources, information to help focus and refine future work on oil-affected resources, and a process for achieving closure on some of the scientific and technical activities related directly to impacts from the *Exxon Valdez* Oil Spill Research to identify and obtain key reference documents and development of a project library to readily access those publications is largely completed A detailed approach to evaluating lingering oil, resource injury, and recovery was developed and provided in the Work Plan for the 2004 Assessment of Lingering Oil and Resource Injuries from the *Exxon Valdez* Oil Spill (Integral 2004a) A conceptual exposure model (CEM) was developed to provides a pictorial representation of the relationship between oil and injured resources, including fate processes that affect the persistence and distribution of oil and exposure pathways that address bioavailability and bioaccessibility (Integral 2004b) Work continues on the 2004 Assessment of Lingering Oil in Prince William Sound, which builds on the CEM and characterizes the location, spatial extent, volume, bioaccessibility, bioavailability, and toxicity of lingering oil remaining in and around Prince William Sound The CEM also provides the framework for assessing those resources currently classified as 'Recovering' or 'Not Recovered' Resource status reports are being prepared for all resource classified as 'Not Recovered' or 'Recovering' These status reports describe the natural history of the injured resource, summarize the technical basis for its current injury classification, present a resource-specific CEM, and re-evaluate recovery status, with an emphasis on spatial and temporal correlations of lingering oil and exposure, mechanisms of injury, and potential impacts to reproductive fitness and populations Key scientific uncertainties associated with the conclusions also will be fully characterized

Persistence Of Lingering Oil From The *Exxon Valdez*

J W Short, M R Lindeberg, J J Maselko, S D Rice

Auke Bay Laboratory, Alaska Fisheries Science Center, National Marine Fisheries Service, NOAA, 11305 Glacier Highway, Juneau, Alaska 99801-8626

Estimates of the rate that oil has dissipated from Prince William Sound beaches oiled by the 1989 *Exxon Valdez* oil spill will be examined and compared based on historical surveys of oil in the early 1990s and again in the early years of this century The area of beach that remains impacted will be compared with the area of beach impacted by hydrocarbon pollution from other sources such as asphalt leaked from storage tanks in Valdez and elsewhere following the 1964 earthquake, and fuels leaked from abandoned storage tanks at sites of historical industrial development The likely future dissipation rates will be estimated for surface and for subsurface oil deposits from all of these sources

Restoration Of *Exxon Valdez* Oil Contaminated Habitats By Sea Otters In Prince William Sound Mechanisms And Consequences

James Bodkin, Brenda E Ballachey, and Daniel H Monson

Following the 1989 *Exxon Valdez* oil spill and three years of cleanup and natural weathering processes, little visual evidence of oil remained on shorelines and it was generally anticipated that consequences of the spill would diminish and ecosystem recovery would proceed as life histories of the various affected species allowed However, by 1998, it became clear that (1) subsurface oil persisted in some intertidal sedimentary habitats, (2) some species of nearshore marine invertebrates had elevated PAH's in their tissues, (3) some vertebrates that occupy nearshore habitats, particularly those with trophic affinities to intertidal invertebrates, continued to be exposed to PAH's, and (4) effects of chronic exposure on nearshore vertebrates included increased metabolic costs, delayed growth, and reduced survival Sea otters in Prince William Sound rely extensively on clams that live below the sea-floor in fine sediment habitats, including those where lingering oil persisted To obtain those clams, the sea otters excavate sediments resulting in disturbance to the sediments and the creation of pits from which clams are removed, brought to the surface, and consumed When sea otters forage along shorelines with residual oil, their foraging behavior provides both a route of exposure to those contaminants, as well as a mechanism for the dispersal of those contaminants We use data on sea otter diet, home-range, and foraging behavior to estimate the potential for sea otters to gain exposure to, and cause dispersal of oil in intertidal habitats in Prince William Sound

Marine Bird Population Abundance Of Prince William Sound, Alaska Trends Following The *T/V Exxon Valdez* Oil Spill, 1989-2004

David B Irons[1], Kelsey M Sullivan[1], Aly E McKnight[1], Shawn W Stephensen[1], and Shay Howlin[2]

[1] U S Fish and Wildlife Service, Migratory Bird Management, 1011 East Tudor Road, Anchorage, Alaska 99503
[2] West Inc , 2003 Central Ave , Cheyenne, Wyoming 82001

We conducted small boat surveys to estimate marine bird and sea otter (*Enhydra lutris*) populations in Prince William Sound, Alaska during March and July 2004, using methods developed in 1989-91 (Klosiewski and Laing 1994) During 2004, we recorded 45 bird and 7 mammal species in March and 67 bird and 12 mammal species in July We estimated 254,463 $\pm$ 48,893 marine birds were in the Sound during March 2004 We estimated 64,696 $\pm$ 12,175 marine birds were in the oiled zone and 189,768 $\pm$ 47,644 birds were in the unoiled zone during March During July 2004, an estimated 171,936 $\pm$ 21,539 marine birds were in Prince William Sound We estimated 44,613 $\pm$ 11,097 marine birds were in the oiled zone and 127,323 $\pm$ 18,528 birds were in the unoiled zone Our data suggest that most taxa for which injury was previously demonstrated were not recovering Few species were recovering and some species showed continuing and increasing effects of the oil spill During winter, two taxa (Bufflehead and "goldeneyes") showed trends consistent with continuing and increasing oil spill effects, two taxa (Bald Eagles and "loons") showed trends consistent with a recovering population, while five taxa ("grebes," "cormorants," "scoters," "mergansers," Harlequin Ducks, did not exhibit any trend toward recovery During summer four taxa (Bald Eagles, Black Oystercatchers, "cormorants," and Northwestern Crows) showed trends consistent with a recovering population, and eight taxa ("loons," Mew Gulls, Glaucous-winged Gulls, Black-legged Kittiwakes, "terns," "murres," Pigeon Guillemots, and "murrelets") showed no trend toward recovery

Oil Impacts

Oil, Salmon And How Urbanization Decreases Population Productivity

Ron Heintz, Jeff Short, Mark Carls, and Stanley Rice

Auke Bay Fisheries Laboratory, NMFS, 11305 Glacier Highway, Juneau, AK 99801

The ultimate concern with respect to the release of contaminants into the environment is their effect on populations While the effects of catastrophic releases of contaminants have been described for some aquatic populations, much less is known about the effects of chronic exposure to low levels of contaminants One of the legacies of the Exxon Valdez oil spill is the observation that embryonic exposure to low concentrations of (PAHs) leads to immediate and delayed mortality among exposed pink salmon The sum of these effects results in reduced numbers of individuals returning to spawn Laboratory data describing these toxic effects of embryonic exposure to PAHs on pink salmon were combined with demographic data for a population monitored for over 70 years to understand how chronic contamination of incubating habitat would affect a simulated pink salmon population Results of the analysis demonstrate that density dependence offers pink salmon populations protection from extinction but reduces their productivity as measured by median return numbers Once the population falls below a third of its unexposed size, density independent effects lead to a significant increase in extinction risk Urban development near estuaries necessarily leads to increases in non-point pollution to natal fish habitats The data presented here demonstrate that the additive effects of these contaminants erode population production and place exposed populations at a significant risk of extinction

POSTER Oil Impacts

Sediment Quality Survey Of Heavily-Oiled Beaches In Prince William Sound

Betsy Day

Recent work by Short et al (2004) found lingering oil in subsurface intertidal sediments in 43 of the 91 beaches sampled In 2004, 5 pairs of beaches were sampled to assess the potential ecological effects to invertebrate populations resulting from lingering oil in subsurface intertidal sediments The types of data collected included sediment PAH and TPH concentrations, sediment toxicity using larval mussels and amphipod growth and survival tests, and benthic community structure Available information on this ongoing project will be presented

POSTER Oil Impacts

Geographic Response Strategies

Dale Gardner

Geographic response strategies (GRS) provide site-specific spill response plans to protect the priority sensitive areas in a geographic zone by presenting unified (the public, responders, and agencies) priorities and strategies for implementation During the last four years, over 250 GRS have been developed that identify the environmentally and culturally sensitive locations along the Alaskan coast that are vulnerable to oil spills and the spill response strategies that might best protect these sensitive areas

POSTER Oil Impacts

Assessment Of Bivalve Recovery On Treated Mixed-Soft Beaches In Western Prince William Sound

Dennis Lees

As late as 1997, NOAA data from a limited number of longterm intertidal sites in western Prince William Sound suggested that bivalve assemblages in mixed-soft sediments treated with high-pressure (HP) warm- or hot-water washing methods remained severely damaged in terms of species composition and function An EVOS Trustees Council study was initiated during summer 2002 to assess the generality of (or recovery from) this apparent injury Following completion of sample analyses, a finding that our earlier conclusions were accurate will indicate that 1) a considerable proportion of mixed-soft beaches in treated areas of the Sound remains extremely disturbed, and 2) these beaches are functionally impaired in terms of their ability to support foraging by damaged nearshore vertebrate predators such as sea otters The results may also provide insight into the potential need for restoring beach sediments to reestablish biodiversity and natural function in these assemblages

Thirteen (13) reference beaches, twenty-three (23) oiled beaches documented as having received HP washing, and four (4) treated sites studied by NOAA were sampled with 0 009 m^2 infaunal cores and 0 25 m^2 excavations to evaluate recent recruitment, population density, and size/age structure for the bivalve assemblage A preliminary review from these sample sets from these sites suggests that HP washing had long-term effects on species composition, population density, and population size structure on components of bivalve populations These treatment categories differ significantly but, in some cases, not in the predicted manner The most important differences appear in two important bivalve resources, littleneck and butter clams (*Protothaca staminea* and *Saxidomus gigantea*)

POSTER Oil Impacts

Developing And Populating The GEM Database

Allen Macklin

The *Exxon Valdez* Oil Spill Trustee Council is developing the GEM Data System, a regional database of marine ecosystem information and metadata The system will provide essential services to scientists and managers who are collecting and producing regional marine data The services include management of associated metadata and data archival/withdrawal In addition, the GEM Data System will provide information products that feature advanced visualization, analysis, and synthesis of internally stored data Archived data will be described using the metadata protocol dictated by the Ecosystem Metadata Language (EML) specification A funded GEM project is presently converting existing regional metadata records from the North Pacific Ecosystem Metadatabase (NPEM) into EML format for import into the GEM Data System This same project will soon begin a data discovery phase to identify other databases and data sets that pertain to the GEM region The project will develop an algorithm whereby GEM data managers can evaluate EML metadata to determine the most relevant data for import into the GEM Data System

POSTER Oil Impacts

Status of Killer Whales in the Northern Gulf of Alaska in 2004 Continuing EVOS Effects?

Craig Matkin, Eva Saulitis, Graeme Ellis, Lori Mazzuca

Monitoring of resident killer whales in Prince William Sound/Kenai Fjords, including the oil spill damaged AB pod, and the monitoring of the depleted AT1 transient population, has continued on an annual basis since 1984 In 2004, there were no new mortalities or new calves in the AB17 and AB10 sub-pods which continue to travel together However, the AB25 sub-pod was not observed or photographed The AB25 sub-pod was part of AB pod prior to the oil spill, but has been observed most frequently with AJ pod following the spill, although the AB25 whales have maintained their AB pod vocal dialect In 2003, members of the AB25 sub-pod were photographed with AJ pod only once, and, it appeared that at least two whales were missing from the AB25's Coverage of AJ pod was incomplete in 2004 It appears that the AB25 sub-pod has permanently separated from AB pod and should now be considered a separate pod The lack of sightings of the AB25 sub-pod over the past two seasons raises concern The loss of this subpod, or of many of the individuals within it, would be an unexpected long-term effect of the *Exxon Valdez* oil spill We believe that deaths of important matriarchs following the oil spill caused the initial splitting of AB pod and may have reduced the viability of the AB25 sub-pod Overall, numbers of individuals in Prince William Sound and southeastern Alaska resident pods continue to increase, while only AB pod has declined since the pre-spill counts in 1988 The hypothesis that the disappearance of 14 individuals at the time of the *Exxon Valdez* oil spill was due to factors other than the spill is increasingly unlikely No other resident killer whale mortality event of this magnitude has been observed in any area of the North Pacific

In 2004, we had 13 encounters with members of the AT1 population A total of 7 AT1 whales were repeatedly encountered in various groupings There are now a maximum of 8 whales remaining in the AT1 group, which numbered 22 whales prior to the spill In 2004, AT1 whales were observed preying on a Dall's porpoise, a harbor seal (genetics pending) and on an unidentified marine mammal (probable harbor seal) Additional harbor seal predation was reported by tourboats Harbor seals and Dall's porpoise were previously identified as primary prey items (Saulitis 2000) However, a new item was added to the list of known prey when AT1 whales were observed attacking and consuming a Northern fur seal on the outer coast between Kenai Fjords and Prince William Sound

POSTER Oil Impacts

Exxon Valdez Oil Spill Trustee Hydrocarbon Database

Bonita Nelson , Jeff Short and Jacek Maselko

The Auke Bay Laboratory provides data and sample archiving services for all samples collected for hydrocarbon analysis in support of 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 Additionally, we provide interpretive services for the hydrocarbon analyses Currently, the database contains results of the hydrocarbon analysis of more than 16,000 samples and collection information from more than 51,000 sediments, tissues and water samples The primary purpose of this project is to maintain the integrity of the database, incorporate new data and continue hydrocarbon data interpretive services and provide information for FOIA request A public release of the analyzed data is available

POSTER Oil Impacts

When Is An Oil Spill Over?

Stanley Rice

Auke Bay Fisheries Laboratory, NMFS, 11305 Glacier Highway, Juneau AK 99801

When is an oil spill over? This subject will be discussed in social, legal, chemical, and biological contexts The answers range from "it was over in 1989" to "it will never be over"

POSTER Oil Impacts

Harlequin Duck Population Dynamics Measuring Recovery

Dan Rosenberg

We compared age and sex composition, and population trends for harlequin ducks *(Histrionicus histrionicus)* between oiled and unoiled treatments of Prince William Sound from 1997-2004 Sex ratios were skewed towards males in all areas, consistent with other populations of Pacific harlequin ducks The oiled area had slightly lower proportions of females than the unoiled area Recruitment varied annually but not by treatment We found no significant difference in the mean rate of change in density (mean slopes) between oiled and unoiled treatments The lack of positive growth in oiled areas since 1995, and lower proportions of females, provided evidence for possible lingering oil spill effects Demographic data interpreted in concert with other biological parameters suggests harlequin duck populations are recovering from EVOS, but may not be fully recovered

Seabirds

Wednesday, January 26, 2005 8 00 am – 9 45 am

Chair Tuula Hollmen

Keynote **Surveying the Past North Pacific Pelagic Seabird Database**	Gary Drew
Wings, Fins and the Black Box Management Implications of Marine Bird and Fish	William Sydeman
Regime Forcing and Ecosystem Response in the Bering Sea (ReFER Phase II)	Alan Springer
First-passage Time Analysis and Identification of Marine Habitats Used by Short-tailed Albatrosses *(Phoebastria albatrus)* in the Northwest Pacific Ocean, Gulf of Alaska, and Bering Sea	Robert Suryan
Seabirds and Alaska Groundfish Fisheries Efforts to Understand Seabird Interactions with these Fisheries and to Mitigate Incidental Mortality	Shannon Fitzgerald

POSTERS

Tufted Puffins as Biological Indicators of Forage Fish Availability in the Western Gulf of Alaska	Loren Buck
Monitoring Marine Bird Distributions Across The Subarctic North Pacific Using Platform of Opportunity Vessels (2002-2004)	Karl David Hyrenbach

Surveying the Past The North Pacific Pelagic Seabird Database Version 1 0

Gary Drew and John Piatt

Data on the pelagic distribution and abundance of seabirds are critical for understanding the basic ecology of marine birds, monitoring population trends, assessing impacts of human activities, identifying critical marine habitats, and educating the public about seabird conservation To address these needs, the US Geological Survey and US Fish and Wildlife Service undertook the task of consolidating and providing comprehensive geographic data on the pelagic distribution of seabirds in Alaska and the North Pacific The North Pacific Pelagic Seabird Database (NPPSD) project has collected data from researchers in Canada, Russia, and the US (1974-2003) The current version of the NPPSD (v 1 0) includes surveys between 1974 and 2002 In addition to distributional data, algorithms were written to calculate densities for marine birds and mammals Collaborations with the US Fish and Wildlife Service, Minerals Management Service, University of California-Irvine, and the World Wildlife Fund have proven the great interest and worth of this data Future work should focus on (1) proofing and adding all additional data already collected, (2) continuing to collect known datasets from researchers, (3) developing a web-based interface for accessing data, and (4) publishing a hard-copy Atlas of Pelagic Seabird Distribution in Alaska and the North Pacific

Wings, Fins And The Black Box Management Implications Of Marine Bird And Fish

William J Sydeman, Kyra L Mills, Diana Watters, Steve Ralston and Tom Laidig

Factors affecting the oceanic life stage of many fish are not well known In this study, we test the hypothesis that marine birds, as near real-time indicators of biological productivity of lower trophic-level marine organisms, provide a means of quantifying variable oceanographic conditions and prey availability to juvenile and/or adult fish during their time at sea Marine bird data indicates significant variation in ecosystem and food web structure and dynamics at multiple time scales In particular, some seabirds (e g , auklets, murres, and some gulls) have very similar diets to herring and salmon Therefore, these birds may serve as useful indicators of ocean foraging conditions for planktivorous fish in the North Pacific Ocean As an example, we report how multidecadal (1971-2002) studies of seabird productivity and food habits from Southeast Farallon Island, California (42 km west of San Francisco) can promote understanding of spawning biomass and body condition for San Francisco Bay herring and recruitment rates for Central Valley chinook salmon We also report how diet data from 3 species of seabirds, in combination with NMFS pelagic juvenile rockfish trawls and salmon gut contents can be used to develop a multivariate index of interannual to interdecadal variability in juvenile rockfish (*Sebastes* spp) abundance Our results demonstrate that combining data from multiple sources (seabird and fisheries biologists) and organisms could be useful to the management of commercially valuable fish Use of this non-traditional information for assessing feeding conditions may provide novel perspectives on the ecological factors affecting survival of fish during the 'black box' of their life cycle

Seabirds

Regime Forcing And Ecosystem Response In The Bering Sea (ReFER Phase II)

Alan Springer, Alexander Kitaysky, and Sara Iverson

Our project aims to reveal how pelagic food webs are organized and to yield insights on patterns of food web productivity at several trophic levels, from zooplankton to forage fish and to birds, between habitats and over time We conduct our studies at three primary sites in the Bering Sea, which represent distinct oceanographic characteristics The primary sites are Buldir Island (deep ocean basin) and the Pribilof Islands St George (continental shelf edge) and St Paul (continental shelf)

Our project has four main components

1) We measure concentrations of the stress hormone corticosterone in free-living birds to assess seasonal and inter-annual dynamics of food availability
2) We conduct concurrent assessments of diet composition using quantitative fatty acid signature and stomach contents analyses
3) We compare the seasonal and interannual changes in quality of aggregate diets of seabirds, forage fishes and zooplankton in continental shelf and oceanic habitats
4) Finally, we assess (through this and collaborative projects) how reproductive performance of seabirds relates to the biological changes and physical variability of continental shelf and oceanic habitats

First-Passage Time Analysis And Identification Of Marine Habitats Used By Short-Tailed Albatrosses *(Phoebastria Albatrus)* In The Northwest Pacific Ocean, Gulf Of Alaska And Bering Sea

Robert Suryan[1], David Hyrenbach[2], Fumio Sato[3], Kiyoaki Ozaki[3], Gregory Balogh[4], Paul Sievert[5], Daniel Roby[6]

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We used satellite transmitters, oceanographic remote sensing data, and first-passage time analysis to determine the distribution, movement patterns, and characteristics of foraging areas of short-tailed albatrosses during May to November 2002 and 2003 Transmitters were deployed on birds immediately prior to their final departure from the breeding colony at Torishima (n = 11), or after capture at-sea in the Aleutian Islands (n = 3), and thus represent non-central-place foraging trips Tracking durations ranged from 51 to 138 days for a total of 7,400 location fixes after filtering (131 - 954 locations per bird) First-passage time analysis was used to both identify where area-restricted search (ARS) patterns occurred along albatross flight paths, and to determine the spatial scale at which ARS occurred Within an 8 hr daily window of satellite tracking, albatrosses concentrated their search effort within approximately 40 km, identifying an appropriate spatial scale to analyze species-habitat associations Areas of greatest first-passage time occurred primarily over continental shelf and slope regions, and included productive waters of the Kuroshio and Oyashio current regions off Japan, and the Kuril Islands, Russia In the Aleutian Islands, ARS patterns occurred most often within straits, particularly along the western part of the Chain (e g , Near Strait, Buldir and Seguam Passes), and in the Bering Sea, along the northern continental shelf break and the Kamchatka Current region These results indicate that non-breeding short-tailed albatrosses concentrate their foraging activities in oceanic areas characterized by specific bathymetric and hydrographic features

Seabirds And Alaska Groundfish Fisheries Efforts To Understand Seabird Interactions With These Fisheries And To Mitigate Incidental Mortality

Shannon Fitzgerald

The Alaska groundfish fisheries are extensive and complex Seabirds interact with these fisheries in a number of ways, most notably through mortalities resulting from various gear Due to the high quality information provided by the groundfish observer program we can characterize mortalities by region and fishery However, there are some sources of mortality that are not as well understood, such as interactions with trawl warps and third wires Collaborative efforts by the groundfish industry, Washington Sea Grant, the U S Fish and Wildlife Service, and the National Marine Fisheries Service have helped to mitigate seabird mortalities in the hook and line fleet, reducing mortalities from an estimated high of 26,100 birds in 1998 to a low of 4,094 birds in 2003 Similar efforts are currently underway in the trawl fleet The effect that mortalities have had on seabird populations is also not well understood While the focus of current efforts has been on seabird mortalities and means to reduce that mortality, efforts have been initiated to look at other types of seabird/fishery interactions such as overlaps and food habit studies

POSTER Seabirds

Tufted Puffins As Biological Indicators Of Forage Fish Availability In The Western Gulf Of Alaska

Loren Buck and Cory Williams

We are using Quantitative Fatty Acid Signature Analysis (QFASA) and stable isotope analysis to estimate the diets of tufted puffins *(Fratercula cirrhata)* breeding in Chiniak Bay, Kodiak, AK The primary objectives of this study are to assess seasonal and inter-annual variation in the diets of adult and nestling puffins and to investigate how this variation relates to reproductive success, chick growth rates and forage fish availability We captured and sampled a total of 88 adult and 35 nestling tufted puffins Whole blood and adipose tissue samples were collected from adults during 3 time-periods, pre-incubation (n=31, 22 May-1 Jun), late-incubation (n=31, 1 Jul-11 Jul), and late-chick rearing (n=26, 21 Aug-4 Sep) Collection of blood and adipose tissue from nestlings occurred during the late chick rearing period (n=35, 21 Aug-4 Sep) Extraction and trans-esterfication of lipids from fat biopsies as well as stable isotope analysis is currently in progress We established nine plots to monitor reproductive success at four colonies located within Chiniak Bay, Kodiak, AK In total, 170 burrows were monitored from late July to early September to determine burrow occupancy, fledging success and nestling growth rates Data furnished from these monitoring plots will be used to determine if reproductive parameters are affected by diet quality as determined by fatty acid analysis This study, in collaboration with the University of Alaska's Gulf Apex Predator-prey (GAP) program, will enable us to determine the effects of changing oceanographic and foraging conditions on the diets of tufted puffins and to evaluate their use as biological indicators of forage fish availability in the Gulf of Alaska In addition, it will also provide insight into the potential effects of changing foraging conditions on puffin populations that may result from climatic fluctuations, commercial exploitation of fisheries resources, and/or longterm global warming

POSTER Seabirds

Monitoring Marine Bird Distributions Across The Subarctic North Pacific Using Platform Of Opportunity Vessels (2002-2004)

Karl David Hyrenbach, Mike Henry, Ken Morgan, David Welch, William Sydeman

In 2002, we initiated a multi-year monitoring program to survey marine bird and mammal communities from British Columbia (Canada) to Hokkaido (Japan) using the bulk-cargo carrier 'Skaubryn' as a platform of opportunity This ambitious project, supported by the North Pacific Research Board, seeks to document persistent spatial gradients in upper-trophic predator assemblages, as well as temporal fluctuations in community structure across the subarctic North Pacific Ocean and the southern Bering Sea In this paper, we report the results of a methodological field study designed to determine the most appropriate method for conducting marine bird surveys at-sea from this novel platform of opportunity We used distance sampling observations collected during the first two pilot cruises (June and October 2002) to quantify potential biases associated with the use of 100-m, 200-m, 400-m, and 800m strip widths Namely, we contrasted the proportion of the sighted birds that were identified to species level, and the observed and expected apparent densities (number / km^2) of the observed species across strip transects of different width We also examined the effects of weather (Beaufort sea state and cloud cover) and bird behavior (e g , sitting versus flying individuals of the same species) on identification rates and density estimation While different taxa showed distinct distributions of perpendicular sighting distances, we conducted community-level analyses to determine the most appropriate strip width to survey the entire avifauna Based on these results, we selected a 400-m transect for subsequent surveys from this platform Using these standardized survey protocols, we have conducted six more surveys to date Herein, we provide an atlas of the seasonal (spring, summer, fall) and interannual (2002 - 2004) distribution of the numerically dominant seabird species Our replicate surveys have documented large-scale spatial gradients in faunal distributions, with a particularly striking east to west segregation of the three shearwater species Sooty Shearwaters, *Puffinus griseus,* dominate off BC and in the Gulf of Alaska, Short-tailed Shearwaters, *P tenuirostris,* are numerically dominant in the Southern Bering Sea, and Streaked Shearwaters, *Calonectris leucomelas,* are most numerous in the Kuroshio - Oyashio current We have also been able to document seasonal changes associated with the latitudinal shifts of subtropical and subarctic species, and year-to-year fluctuations in seabird abundance concurrent with changing water mass properties These results suggest that repeated surveys from large bulk-cargo carriers can provide valuable insights into the spatial and temporal structure of marine communities The development of standardized methodological criteria is essential to facilitate comparisons of overall seabird densities and community structure using at-sea data from disparate survey platforms

Marine Mammals

Wednesday, January 26, 2005 10 00 am – 2 15 pm

Chair Andrew Trites

Keynote **Differences in Recent Trends in the Populations of Western Steller Sea Lions and Northern Fur Seals**	Lowell Fritz
Causes of Mortality for Northern Sea Otters	Verena Gill
A Summary of Recent Killer Whale Studies in the Aleutian Islands, Bering Sea, and Western Gulf of Alaska	Paul Wade
Harbor Seal Population Change in Alaska – The Big Picture	Grey Pendleton
Photographic Population Analysis of Killer Whales in the Coastal Waters of Southwest Alaska	John Durban
Ecosystem Analysis of Steller Sea Lion Dynamics, Their Prey and Predators	Sylvie Guenette
Physiological Answers to Ecosystem Questions What We Have Learned from Laboratory Studies About the Decline of Steller Sea Lions in Alaska	David Rosen
Steller Sea Lion Abundance in Russia in 2004	Vladimir Burkanov
Sperm Whale Depredation	Jan Straley
Tracking Critically Endangered North Pacific Right Whales *(Eubalaena japonica)* in Alaskan Waters Using Passive Acoustics	Lisa Munger

POSTERS

Seasonal Dynamics Of Harbor Seals In Cook Inlet	Peter Boveng
Modern Status of the Sea Otter Population on the Commander Islands, Russia	Alexander Burdin
Winter Movements of Female Bearded Seals *(Erignathus barbatus)* in Kotzebue Sound and the Chuchki Sea	Michael Cameron
Evaluating Ecological Niche Overlap Between Steller Sea Lions and Commercial Trawl Fisheries in Alaska	Edward Gregr
Harbor Seals Tractable Sensors Of Ecological Change?	Anne Hoover-Miller
Reproductive Performance in Steller Sea Lions at Chiswell Island, Gulf of Alaska	John Maniscalco
Variation of Fecal Corticosterone Concentrations in Captive Steller Sea Lions *(Eumetopias jubatus)* in Relation to Season, Social Status, and	

Behavior	Lisa Petrauskas
Potential Interactions Between State-managed Fisheries and Steller Sea Lions, *Eumetopias jubatus*	Nathan Soboleff
Acoustic Behavior and Tracking of Sperm Whales Around Longline Fishing Vessels	Aaron Thode
A Range-wide Review of Steller Sea Lion Diets and the Evidence for Dietary Change in the North Pacific	Andrew Trites
Risk of Extirpation of the Steller Sea Lion in the Gulf of Alaska and Aleutian Islands	Arliss Winship

Differences In Recent Trends In The Populations Of Western Steller Sea Lions And Northern Fur Seals In Alaska

Lowell Fritz[1], Tom Gelatt[1], Wayne Perryman[2], Rolf Ream[1], Charles Stinchcomb[2], and Rod Towell[1]

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The population sizes of the western Steller sea lion *(Eumetopias jubatus)* and the northern fur seal *(Callorhinus ursinus)* in Alaska are much smaller today than 30 years ago However, recent population assessments of both species in Alaska conducted by NMFS Alaska and Southwest Fisheries Science Centers suggest that while the decline in the Steller sea lion population may have abated, the decline of northern fur seals may have accelerated Counts of adult and juvenile Steller sea lions on western trend sites in Alaska from aerial photographs increased at 23% yr^{1} between 2000 and 2004 This 4-year period of increase followed a near 30-year period of decline, with annual rates as great as -15% yr^{1} in the late 1980s However, there are differences between regions in Alaska in the recent sea lion count trends Between 1991-2004, sea lion counts in the center of the western stock's range (eastern Aleutian Islands and western Gulf of Alaska) were generally stable Counts stabilized more recently in the central Aleutian Islands and eastern Gulf of Alaska, while the decline may be continuing, though slower, in the western Aleutian Islands and central Gulf of Alaska

By contrast, the estimated number of Northern fur seal pups born on the Pribilof Islands (where approximately 70% of the population in the North Pacific Ocean resides in summer) has declined by 6% yr-1 since 1998 The 2004 production estimate of less than 140,000 pups is the smallest observed since 1916-18, when the population was increasing following the cessation of pelagic sealing, and is 15% lower than the 2002 estimate In addition, the number of adult male fur seals counted on the Pribilof Islands in 2004 was the lowest since 1930 NMFS is actively pursuing research on foraging ecology, diet and demography to determine the causes of recent changes in the status of western Steller sea lions and Northern fur seals in Alaska

Causes Of Mortality For Northern Sea Otters

Verena Gill

There is little information regarding the causes of mortality for the northern sea otter *Enhydra lutris kenyoni* population in Alaska Similarly, not much is known regarding the infectious diseases that may be affecting this population Beginning in 2002, we initiated a study that successfully demonstrated the ability to recover sea otter carcasses suitable for comparative pathology study, with work being conducted in California with southern sea otters We conducted comprehensive necropsies, including histopathology and screening for protozoal, viral, and bacterial pathogens, which has provided new information on causes of mortality in Alaska The collaborative work between biologists and pathologists studying southern and northern sea otters has already revealed some important differences between Alaska and California otters that require further examination So far in Alaska, necropsies have been performed on 13 fresh dead, and over 50 frozen carcasses Results of necropsy examinations performed to date show that about 70% of the fresh carcasses had mild to severe endocarditis and the bacteria most commonly isolated belong to the *Streptococcus bovis* group In comparison, out of hundreds of California otters that have been necropsied, this infection has only recently been found in two Other causes of death in Alaska include emaciation, boat strike and unknown trauma, myocarditis, colonic impaction, porencephaly and sarcoma Interestingly, so far in contrast to southern sea otters, no cases of protozoal infections (e g , *Toxoplasma gondii* and *Sarcocystis neurona*) have been detected High rates of protozoal pathogens have been identified as a major factor limiting recovery of the threatened southern sea otter The neurotoxin, domoic acid, a significant cause of mortality in southern sea otters, has not been detected in the northern sea otter population Comparison of the causes of mortality in both populations will allow southern and northern sea otter researchers to better monitor patterns and changes in disease risks affecting these populations

A Summary Of Recent Killer Whale Studies In The Aleutian Islands, Bering Sea, And Western Gulf Of Alaska

Wade, P , Zerbini, A , Waite, J , Durban, J , Dahlheim, M , Herman, D , Burrows, D , LeDuc, R , Matkin, C , Krahn, M

The documented declines of Steller sea lions, harbor seals, northern fur seals and sea otters in the western Gulf of Alaska and Bering Sea have generated a range of hypotheses regarding possible causes of these declines One recent theory suggests that transient killer whale predation may be responsible for reducing sea otter and pinniped populations (Springer et al 2003) Evaluation and testing of this hypothesis requires empirical data on the abundance, distribution and feeding ecology of killer whales in this area Prior to 2001, relatively little data existed for killer whales in Alaskan waters west of Kodiak Island NOAA Fisheries' National Marine Mammal Laboratory has conducted killer whale studies since 2001 Through this work, and the work of other killer whale researchers in Alaska, some basic information has been determined about killer whales in the Aleutian Islands, Bering Sea, and western Gulf of Alaska All three ecotypes known from the eastern North Pacific are found in this region Line transect estimates of abundance from 2001-2003 surveys were 251 (95% CI 97-644) for mammal-eating ('transient') killer whales and 991 (95% CI 379-2585) for fish-eating ('resident') killer whales Mammal-eaters were found in higher densities in the eastern Aleutians and western Alaska Peninsula (from approximately Samalga Pass to the Shumagin Islands) The density of mammal eating killer whales was not higher in areas where Steller sea lions have declined most rapidly, in fact, killer whale density was highest in the one area where Stellers increased from 1991 to 2004 Fish-eating whales were found in highest densities in the eastern Aleutians and around Kodiak Island Very limited movements of individuals have been seen between the eastern Aleutians/western Alaska Peninsula and the Kodiak region, suggesting there may be subpopulation structure For both mammal-eating and fish-eating ecotypes, mtDNA genetic data strongly suggests a population boundary exists between the eastern and central Aleutian Islands, perhaps in the vicinity of Samalga Pass On recent NOAA surveys in the Aleutians and Alaska Peninsula, killer whale predation or feeding was seen on a minke whale, a gray whale, and on a Dall's porpoise Mammal-eating killer whales were seen in close proximity to Dall's porpoise and sea otters, and to both Steller sea lion and harbor seal haul-outs Prey preferences were investigated with blubber biopsy samples that were analyzed for fatty acids, carbon and nitrogen stable isotopes and organochlorine contaminants Four specific groups (West Coast residents & transients, Gulf of Alaska residents, and AT1 transients) were found to have stable isotope values that were consistent with dietary preferences reported in the literature or derived from available stomach content, kill, and harassment data Fatty acid, stable isotope and PCB profiles for the fish-eating residents and the mammal-eating transients were consistent with values expected for these predators based on these known dietary preferences These chemical profiles exhibited broad similarity across geographical regions, suggesting that the dietary specialization found in these ecotypes in the eastern North Pacific also extends to the less-studied populations in the western Gulf of Alaska and Aleutian Islands Though sample sizes are limited, stable isotope results suggest that Aleutian Islands and Gulf of Alaska transients could not have a diet that was exclusively composed of Steller sea lions or harbor seals

Harbor Seal Population Change In Alaska - The Big Picture

Grey Pendleton

Harbor seal populations in Alaska have been monitored at specific sites since the 1970s, with more widespread and consistent monitoring since about 1990 As measured by the sample of sites with data, there have been regional differences in the population trajectories (i e , population change over time) Sampled populations at Kodiak and in Bristol Bay declined dramatically beginning in the 1970s and have been increasing in the 1990s, but remain at reduced levels Seal populations in Prince William Sound declined throughout the 1990s, but might be stabilizing The seal population in Glacier Bay has declined dramatically throughout the 1990s with the decline apparently continuing At sample sites in northern and southern Southeast Alaska, seal populations increased from the 1980s and are currently stable Some caution is needed in interpreting these estimates, as they are from a non-random sample of seal haulouts, glacial ice sites in particular are poorly represented and might have different patterns In addition, the observed patterns largely are based on molting counts, the limited pupping period counts (i e , June) show somewhat different patterns

Photographic Population Analysis Of Killer Whales In The Coastal Waters Of Southwest Alaska

Durban, J , Dahlheim, M , Ellifirt, D , Waite, J , Ellis, G , Matkin, C , Barrett-Lennard, L , Pitman, R and Wade, P

Recent attention has focused on the possible role of predation by killer whales in the population declines of several marine mammal species in the western Gulf of Alaska, Aleutian Islands and the Bering Sea Evaluating this hypothesis requires information on the abundance of mammal-eating killer whales in this area We report on a collaborative project to apply mark-recapture models to individual photo-identification data to provide baseline information on the number of whales using the coastal waters between the Kenai Peninsula and the central Aleutian Islands However, for photo-identification analyses of whale populations, the traditional capture-recapture methods developed in ecology need to be applied with caveats In the traditional ecological framework, the researcher controls the capture mechanism, but for studies of whales in remote marine environments, which are costly and difficult to survey, the design is generally more observational We used both standardized data and opportunistically collected killer whale photographs, so could not control the probability of inclusion in a photo-identification sample Instead, each sample covered a different subset of the population, and interacted with each other depending on their spatial and temporal coverage We explored novel Bayesian mark-recapture models to take into account both heterogeneous catchability and correlation among the sources We analyzed ~7000 individual identification images collected between 2001 and 2003 for photographic quality and individual distinctiveness, to minimize violations of the integral mark-recapture assumptions of no mark-change and correct documentation of markings Based on the individual identity of whales in these high quality photographs, we produced estimates of abundance that will be useful for assessing the extent of killer whale predation on prey populations

Marine Mammals

Ecosystem Analysis Of Steller Sea Lions Dynamics, Their Prey And Predators

Sylvie Guenette, Sheila J J Heymans, Villy Christensen, Andrew W Trites

Steller sea lions have declined in the western Gulf of Alaska since the late 1970s, while the population in Southeast Alaska has increased during the same period We constructed ecosystem models of Southeast Alaska, Central Gulf of Alaska and Western Aleutians to evaluate the role of fishing, environment and predation on the different sea lion populations Fishing mortality explains the population dynamics of most heavily fished species, such as Pacific Ocean perch, sablefish, halibut, and herring In Southeast Alaska, fishing and environmental variation were sufficient to explain the increase in Steller sea lion abundance while in the Aleutians and the Central Gulf, the results were more ambiguous The steep decline of sea lions in the late 1980s could be explained by an increase in transient orca predation assuming that 1) their numbers have increased, 2) their diet consists mainly of sea lions, and, 3) the proportion of the sea lion population vulnerable to orca predation is high

Physiological Answers To Ecosystem Questions What We Have Learned From Laboratory Studies About The Decline Of Steller Sea Lions In Alaska

David Rosen

Measuring the physiological status of individual wild animals is a critical step in evaluating the impact of potential ecosystem changes on marine mammal populations However, controlled experiments are needed to understand how environmental changes might affect individuals in the wild and, ultimately, impact population numbers For example, changes in the prey base may have contributed to the decline of Steller sea lions in Alaska, but little is known about the physiological changes that should have occurred from short-term changes in the quality and availability of prey to sea lions We have conducted a series of studies with captive Steller sea lions to test several potential links between prey quality and sea lion health Our findings indicate that body composition (fat to total mass ratio) changes with season (when animals are fed constant, maintenance-level, isocaloric diets of high or low-lipid prey), but that body composition is not affected by whether the prey are high or low-lipid In contrast, sea lions lose body mass when they experience short-term shortages of prey, but lose a greater portion of their mass from their lipid reserves when eating low lipid prey compared to eating high lipid prey Further experiments have shown that Steller sea lions can alter their food intake to compensate for changes in prey quality and/or foraging opportunities However, there is a physiological ceiling beyond which required food intake levels exceed the digestive capacity of young sea lions Our experiments thus suggest that juvenile Steller sea lions are physiologically living 'on the edge', and provide insights into how changes in the types of prey available in the North Pacific may have caused the decline of sea lions

Steller Sea Lion Abundance In Russia In 2004

Vladimir Burkanov, Donald G Calkins and Thomas R Loughlin

Steller sea lion (SSL) abundance in Russia Steller sea lion survey conducted from Russian charter boat 'Vsevolod Timonov' in June 13 through July 22, 2004 A total 41 of 45 known SSL sites were surveyed (12 of 12 in the western Bering Sea, 12 of 14 in Commander Islands, 15 of 16 along East Kamchatka, and, 5 of 6 in the northern part the Sea of Okhotsk) Non-pup animals were counted from high locations or a boat, while pups were counted by two observers walking through rookery Steller sea lions were found at 15 sites in number of 3,791 non-pup and 2,076 pups In the western Bering Sea, we counted 135 non-pup animals and no pups The number increased 7 5 times compare with similar survey in 2002 when only 18 Steller sea lion were found here In the Commander Islands number of non-pup at the same sites as in 2002 increased from 528 to 602 (+14 0%) Pup production changed from 210 to 220 (+4 8%) individuals Number of sea lions along East Kamchatka also increased from 491 to 548 non-pup (+11 6%) and from 90 to 107 (+18 9%) for pups accordingly The highest increase of Steller sea lion occurred in the northern part of the Sea of Okhotsk Number of non-pup changed from 2,072 to 2,357 (+13 8%) and pups from 980 to 1,756 (+79 2%) individuals In spite of this fact, a positive trend in Steller sea lion abundance occurred between two the most recent surveys Total number of this species in the western Bering Sea, East Kamchatka and Commander Islands stayed at a low level, between 3% and 34% of total abundance in early 1980s The number of Steller sea lion in the northern part of the Sea of Okhotsk increased by 70% since 1989

Sperm Whale Depredation

Jan Straley and Aaron Thode

Sperm whales have learned to take sablefish, a natural prey, off longline gear in the Gulf of Alaska Reports of depredation were first noted in 1978 and have steadily increased in frequency and severity, with a notable increase since the late 1990s likely due to the lengthening of the fishing season In Alaska, injury to whales has not yet occurred, however, mortalities and serious injury of sperm whales have occurred in other areas of the world due to similar fisheries interactions Fishermen have felt economic impacts due to reduced catch Through cooperative research with fishermen, government and scientists, our ultimate goal is to provide recommendations for strategies to reduce or eliminate depredation on longline gear by sperm whales As a first step, we are collecting information, with collaboration from the southeastern Alaskan fishing fleet, on the timing of interactions seasonally and diurnally This research will define the scope of the problem, help identify stock structure and the ecology of this endangered species, provide baseline information needed for studying depredation mechanisms and cues, and finally, assist in the development of non-lethal deterrence to sperm whale depredation The core team of 10 fishing boats for the Southeast Alaska Sperm Whale Avoidance Project (SEASWAP) participated during the 2003 and 2004 fishery Each SEASWAP member was issued a logbook and digital camera to capture photographs of whales near their vessels In 2003, 56 percent of the SEWSWAP longline sets had whales present, 64 percent of the sets with whales present had depredation Seventeen individual whales were identified in 2003, 14 in 2004, with one whale re-sighted between years A population estimate of sperm whales for the study area yielded 134 (53, 269 95% CI) A crossbow and dart were used to take small pieces of skin and blubber for genetic sampling Ten samples were taken from 6 whales in 2003, all of these whales were male Six samples were taken in 2004 and have yet to be processed Additionally, in 2004 we added an acoustic component to the study Sperm whales are very vocal and we have determined acoustically that whales feeding in the absence of longline gear work at around 250 m, while whales feeding around longline gear are working at 50 m The 2004 data is being analyzed and we hope to continue in the future with more emphasis on deterrents

Tracking Critically Endangered North Pacific Right Whales *(Eubalaena japonica)* In Alaskan Waters Using Passive Acoustics

Lisa Munger

We used two types of passive, underwater acoustic instrumentation to provide information on critically endangered North Pacific right whales (*Eubalaena japonica)* in the Bering Sea and western Gulf of Alaska In the Bering Sea, we deployed Directional Fixing And Ranging (DIFAR) sonobuoys during vessel-based cetacean surveys in summers of 2002 and 2004 to detect and localize calling right whales Real-time acoustic localization guided the vessel to whales from distances of 20-100 km, enabling researchers to obtain photographs, biopsy samples, and to attach satellite tags We also deployed autonomous, seafloor-mounted hydrophones in three study areas the southeast Bering Sea middle-shelf domain (in years 2000-2002 and 2004-2005), the Bering Sea shelf break (2004-2005), and the Gulf of Alaska southeast of Kodiak Island (2003) The seafloor packages recorded continuously over year-long periods at an effective bandwidth (5-250 Hz in 2000-2002, and 5-500 Hz thereafter) encompassing that of most North Pacific right whale calls These autonomous recorders provided long-term data on right whale seasonal occurrence and acoustic behavior over spatial scales ranging from 10 to 100s of km We report preliminary findings on the seasonal occurrence of right whale calls, and right whale acoustic behavior on shorter temporal scales (hours to days) Our research is conducted with collaboration and/or support from NOAA Alaska Fisheries Science Center, National Marine Mammal Laboratory, Southwest Fisheries Science Center, and Pacific Marine Environmental Laboratory, North Pacific Marine Research Institute and North Pacific Research Board, National Fish and Wildlife Federation, and others

POSTER Marine Mammals

Seasonal Dynamics Of Harbor Seals In Cook Inlet

P L Boveng, M A Simpkins, and J L Bengtson

Harbor seal populations have declined in several regions of Alaska during recent decades Because harbor seals are key upper-trophic predators in the marine ecosystem, as well as an important subsistence resource for Alaska Natives, it is critical to assess accurately their abundance, distribution, and risk from human activities We are conducting a study, supported by the Minerals Management Service, to quantify seasonal changes in the abundance, distribution, movements, habitat use, and behavior of harbor seals in Cook Inlet, an area potentially at risk from oil spills and other industrial accidents Aerial surveys of all seal haul-out sites form the basis for estimates of abundance and distribution ashore during June and August, important periods for breeding and molting, and during October and April, when the seals are not constrained by those major life history events Time-lapse cameras at selected haul-out sites provide series of images (i e , counts of seals) that are used to develop and refine statistical models of the factors that influence numbers of seals ashore, such as date, time of day, and tide height Finally, satellite telemetry provides data on movements, marine habitat use, and corrections to abundance estimates for seals missed because they were at sea during aerial surveys Preliminary results demonstrate dramatic seasonal fluctuations in numbers of seals ashore, and that the foraging ranges of seals in Cook Inlet extend into Shelikof Strait and the Gulf of Alaska

POSTER Marine Mammals

Modern Status of the Sea Otter Population on the Commander Islands, Russia

Alexander Burdin and Donald Calkins

Based on sea otter surveys conducted in the last decade, the population in the Commander Island appears to be stable and may have shown some growth Both Bering and Medny Islands should be considered as a single unit as there is migration and exchange of sea otters within the Commander Archipelago (25 miles strait)

In 1990 the Commander population of sea otters reached between 5,200 and 5,400 individuals The first mass death of sea otters was observed on Bering Island during the winter of 1990-1991 More than 700 (20 6%) dead sea otters were recovered, primarily males of reproductive age (two to six years) Studies of the dead animals showed that various diseases occurring during a lean period caused the deaths The conclusion was that the mass deaths were the result of prolonged stress and were a natural process for the normalization of the age structure and sex ratio in natural populations of sea otters (Bodkin et all, 1999) In a later period (1992 to 2002), sea otter mortality rate fluctuated on the level of 6 8% -13 2% Mortality level on Medny Island is still uncertain because of difficulty of observation

In 2003 ASLC initiated collaborative research directed at continuation of long term monitoring of the sea otter population of the Commander Islands including 1) Annual sea otter skiff survey on the Commander Islands (June-July), 2) Year-round sea otter counts on Bering Island, and 3) Tagging program (November – March) The last surveys conducted in summer 2004 showed that total numbers of sea otter in the Commander Islands (Bering and Medny) was 4,903 individuals (including 817 pups)

Bering Island Skiff surveys were conducted twice 15 -16 July and 29-30 July 2004 Total number of sea otters were 2,989 and 2,669 respectively Population decreased 20 5% since 2002 survey (3,763 to 2,989) Birthrate declined from 23 4% in 2002 to 19 7% in 2004, but remains high Mortality level increased to 412 individuals Average of previous years = 289 25

Medny Island Sea otter skiff survey was conducted on June, 23 2004 Total number of sea otters counted – 1,914 Total population increased by 20 9% since the 2002 survey (1,770 to 2,239) Birthrate in 2004 was 14 5%, less than previous years, but pup numbers (325) remain high Mortality level – unknown, only 11 sea otter remains (mostly skulls) were recovered in summer

The decrease of sea otter numbers on Bering Island may be a result of several factors 1) Redistribution of independent animals from Bering Island to Medny (possibly only in summer period), 2) Changes in physical parameters of the environment destruction of kelp beds due to severe weather conditions (storms) in winter and spring, 3) Scattered distribution of sea otters around the island was seen, as a result there was an apparent absence of large aggregations which may have resulted in increased survey error and underestimation of sea otter numbers

POSTER Marine Mammals

Winter Movements Of Female Bearded Seals *(Erignathus barbatus)* In Kotzebue Sound And The Chuchki Sea

Michael Cameron, Alex Whiting, Kathy Frost, Lloyd Lowry, John Goodwin, Chuck Schaeffer, Rob Delong, Gaye Sheffield

Bearded seals are an important resource for the native peoples of northern and western Alaska, they are a key ecological component of arctic marine ecosystems and, because they are sensitive to suitable sea ice conditions, they may be particularly vulnerable to climatic change However, studies of their seasonal movements and habitat use have never been conducted in U S waters In October, 2004, we tagged two sub-adult, female, bearded seals *(Erignathus barbatus)*, with satellite-linked dive recorders in Kotzebue Sound, Alaska One seal remained near the coast of inner Kotzebue Sound and the other moved into the deeper waters of the Chuchki Sea Despite their different habitats, they exhibited similar patterns in the use of their surroundings Both seals exhibited a tendency to remain in a given area, presumably foraging, for a number of days (i e , 3-18), before moving to a new location, usually in excess of 150 km away The seals are currently still being tracked and further analyses investigating their diving behavior and the effects of bathymetry and sea ice on their movements will be presented

POSTER Marine Mammals

Evaluating Ecological Niche Overlap Between Steller Sea Lions And Commercial Trawl Fisheries In Alaska

Edward J Gregr and Andrew W Trites

We constructed a simple, spatially explicit model to predict the marine habitat use of mature female Steller sea lions *(Eumetopias jubatus)* during summer and winter in the Gulf of Alaska and Bering Sea The modeled habitat use showed broader distributions in winter compared to summer, when it was tightly distributed around rookeries Seasonal comparisons with observed sea lion distributions derived from opportunistic sightings (primarily from fishing vessels) showed greater agreement with the predicted winter habitat use We then calculated the niche overlap between predicted female Steller sea lion distributions and commercial trawl effort (i e , the probability of fisheries and sea lions occurring together) Overlap between trawl fisheries and sea lions was higher in winter than in summer, but was relatively low overall This work represents the first attempt to quantify niche overlap between Steller sea lions and commercial fisheries While previous studies have attempted to measure competition on a basin-wide scale, the niche overlap method, combined with estimates of prey abundance, will lead to measures of competition at a resolution meaningful to Steller sea lions Refinements to the habitat model using data on diet and prey abundance are in progress The inclusion of data from state managed fisheries will improve the accuracy of the overlap assessment The ultimate goal is to provide managers with the ability to quantitatively evaluate management actions, and to develop effective means of mitigating possible effects of fisheries on Steller sea lions

POSTER Marine Mammals

Harbor Seals Tractable Sensors Of Ecological Change?

Anne Hoover-Miller

Harbor seals in three regions of the Gulf of Alaska - Tugidak Island, Alalik Bay, and Central Prince William Sound - have received targeted research and monitoring during the past 40 years Monitoring has been of different intensity in each region but has included periods of rapid population decline, stabilization, and, in some areas, initial phases of recovery Three indices commonly collected during population monitoring studies reflect different attributes of the population

(1) Pup counts identify the number of females that have successfully given birth and provide a measure of reproductive effort that can be tracked over time
(2) Pup non-pup ratios are often cited as measures of reproductive success, effort, or productivity Pups, however, are dependent on haulouts for nursing and resting and have been shown to be least affected by local environmental conditions, conversely, seals without pups show much greater variability with respect to haulout attendance during the pupping season Some variability observed for nonpups may be associated with the condition of the seal Seals in good condition or with local food resources can afford to spend more time at haulouts than seals needing to forage The ratio of pups non-pups, rather than providing a measure of productivity, may provide a stronger indication of the relative condition of seals and/or local foraging opportunities
(3) Molt counts often are used for monitoring population trends of harbor seals since molting seals spend time ashore to facilitate hair growth Although the number of seals hauled out during the molt varies with local haulout conditions, that variability is considerably less than for non-pups counted during the pupping period

This study contrasts these three indices relative to the population dynamics of seals in Alalik Bay and adjacent areas during the past 23 years The combined use of these indices provides insight as to how different reproductive classes of seals responded as population and ecological conditions changed over time

POSTER Marine Mammals

Reproductive Performance In Steller Sea Lions At Chiswell Island, Gulf Of Alaska

John Maniscalco

We conducted a longitudinal study of the reproductive rates of female Steller sea lions at a small rookery in the northern Gulf of Alaska from 2001 through 2004 Reproductive rates were calculated from individually recognizable females with at least a two-year history at Chiswell Island when their pupping status was known or estimated Reproductive rates were high but decreased annually from 89 7% in 2001 to 75 0% in 2004 The number of live-born pups increased from 52 to 78 over the same period Estimates of reproductive success from observed copulations and subsequent year pup production were similar to estimates based on pups born to known individual females for 2002 and 2004, but not 2003 Seventy-four percent of females gave birth in at least two consecutive years Counter to expectations, females who had no pup or whose pup died during the first two months of life were less likely to pup the subsequent year than females whose pup lived until at least two months of age Females who did not pup or whose pup died gave birth significantly earlier (07 June) the following year, compared to year(s) following a birth with no pup loss (11 June) We speculate that the reproductive performance of sea lions at Chiswell Island indicates that this rookery has changed from an older female population to one that is generally younger and is becoming reproductively mature during the course of this study

POSTER Marine Mammals

Variation Of Fecal Corticosterone Concentrations In Captive Steller Sea Lions *(Eumetopias jubatus)* In Relation To Season, Social Status, And Behavior

Lisa Petrauskas

The worldwide population of Steller sea lions has decreased dramatically since trend counts began in the late 1960s Populations undergoing stress can be monitored through the physiological response to the stressor Little information is available regarding adrenal activity of Steller sea lions in relation to season, social status, and behavior For this study, fecal samples were obtained from three adult (1 male SSL-01, 2 females SSL-02 & SSL-03), reproductively intact, captive Steller sea lions housed at the Alaska SeaLife Center (ASLC) in Seward, Alaska Samples were collected opportunistically by the marine mammal husbandry staff from September 2001-September 2004 The objective of this study was to monitor the fecal corticosterone concentration in captive Steller sea lions over a three year time period and compare those results to season, social status, and behavior There was a significant difference between summer and winter fecal corticosterone concentration in two of the three sea lions The two females did have significantly different fecal corticosterone concentrations, the dominate female exhibiting higher corticosterone concentrations Higher fecal corticosterone concentrations correlated significantly with less attentive behavior during training for the male only These results quantify the changes in fecal corticosterone concentration in relation to season, social status, and behavior in a captive setting

POSTER Marine Mammals

Potential Interactions Between State-Managed Fisheries And Steller Sea Lions, *Eumetopias jubatus*

Nathan J Soboleff and Gordon H Kruse

Our goal is to gain new insights into Steller sea lion declines by conducting an exploratory data analysis of anthropogenic factors that have not yet been examined, namely interactions with fisheries managed by the State of Alaska Recent studies indicate top-down factors as the most probable causative agents in the most recent (1990-present) portion of the Steller sea lion decline Potential top-down factors include, among others, disturbance by fishing vessels and continued intentional shooting Our primary motivating question is Are the spatial and temporal patterns of sea lion declines consistent with development of certain (e g , species-gear-area) state-managed commercial fisheries and vessel activity? Specific objectives are to determine whether observed historical patterns of sea lion declines are similar to patterns of particular nearshore fisheries that could have had adverse effect by mechanisms such as disturbance of animals on rookeries and haulouts by vessels, shooting from vessels, or reductions in sea lion prey We analyzed data from the NMFS count database and ADFG's Fish Ticket database on commercial fisheries from 1976 to 2002 June and July population counts for Steller sea lions were analyzed from Alaska's eight Steller sea lion geographic regions (identified by NMFS), which were examined for spatial patterns of covariation, and regrouped into clusters exhibiting significant ($p < 0\ 05$) positive covariation Once combined into new rookery groupings, commercial fisheries statistical areas were selected within a fifty nautical mile radius of rookery groupings and analyzed for fisheries interactions Preliminary results of our analysis will be presented

POSTER Marine Mammals

Acoustic Behavior And Tracking Of Sperm Whales Around Longline Fishing Vessels

Aaron Thode, Jan Straley, Tory O'Connell, and Kendall Folkert

Scripps Institution of Oceanography, University of California, San Diego

Sperm whales have learned to take sablefish off longline gear in the Gulf of Alaska Over the past two years the Southeast Alaska Sperm Whale Avoidance Project (SEASWAP) has collected biopsy and photo-ID data concerning longline depredation, via collaboration with local fishermen in Sitka, AK In 2004, in collaboration with SEASWAP, sets of autonomous acoustic recorders were attached to the anchor lines of several longline deployments, effectively converting the fishing gear into a vertical acoustic array deployed 200 m beneath the surface The fishing vessels then left the area, leaving the acoustic instruments behind to monitor the area Several hours later, typically the next morning, each vessel would return and begin hauling in the gear, a procedure that was also recorded by the instruments In May and August 2004, interactions of sperm whales with longline recovery efforts were recorded Additional acoustic data were also recorded around sperm whales foraging away from longlines Acoustic multipath was exploited to estimate the range and depth of sperm whales in both the presence and absence of longlines The May encounter found that the animals started producing sounds within 20 minutes of the longline recovery and continued being extremely vocally active throughout the recovery The August encounter will also be discussed [Work sponsored by the North Pacific Research Board]

POSTER Marine Mammals

A Range-Wide Review Of Steller Sea Lion Diets And The Evidence For Dietary Change In The North Pacific

Andrew W Trites, Emma L Bredesen, Ruth Joy, and Arliss J Winship

A dietary switch from primarily high energy fish, such as sand lance, to low fat fish, such as walleye Pollock, has been hypothesized to underlie the population decline of Steller sea lions in western Alaska We evaluated the assertion that diets changed by compiling all available dietary information from Steller sea lions collected throughout their North Pacific range Data were compiled from 31 reports published since 1901 for 10 geographic regions between California and Japan Dietary information prior to 1990 is relatively sparse Overall, analyses of all available stomachs and scats indicate that Steller sea lions consume a wide number of species However, their diets are typically dominated by eight species or groups of species walleye pollock, sand lance, herring, cod, Atka mackerel, salmon, flatfish, and, cephalopods Diets vary by region and showed shifts in the only two regions where sufficient sample sizes were available to undertake quantitative analyses Samples collected at Atkins and Chernabura Islands (western Gulf of Alaska) contained large amounts of capelin and greenlings in the 1950s, but no pollock In contrast, pollock dominated the diet of the low sea lion population at these two sites in the 1990s Further south in British Columbia, the diet of the large and growing sea lion population in and around Queen Charlotte Sound was dominated by sand lance and herring in the 1990s Pollock were only reported in the samples taken during the late 1950s and early 1960s when it dominated the diet of the small BC sea lion population at haulouts Thus,the available data are consistent with the hypothesis that dietary shifts occurred over time in the diets of Steller sea lions in the North Pacific, and that there is a link between high-energy species and high sea lion population numbers The data further suggest some correspondence between oceanographic regime shifts and the dominance of certain species of prey in the diets of sea lions

POSTER Marine Mammals

Risk Of Extirpation Of The Steller Sea Lion In The Gulf Of Alaska And Aleutian Islands

Arliss Winship and Andrew Trites

We estimated the risk and uncertainty that the Steller sea lion will be extirpated in western Alaska by combining a population viability analysis (PVA) with a Bayesian analysis of historical population dynamics Our analysis considered alternative hypotheses about the roles of density dependent and density-independent factors in past and future population dynamics It also established functional relationships between population size, growth rate, and the risk of extinction under alternative hypotheses about population regulation and environmental variability that can be used to develop recovery criteria and guide research and management decisions Key model parameters (e g , birth and survival rates) were derived by fitting a simple age-structured model to time-series of pup and non-pup counts from 33 rookeries (1978-2002) We found that differences in model structure affected parameter estimation, and could produce counterintuitive predictions of the risk of extinction when comparing alternative hypotheses Results suggest that many subpopulations of Steller sea lions have a high probability of going extinct within the next 100 years if recent 1990s trends continue However, there are two clusters of subpopulations that have lower risks of extinction during the next 100 years due to their current sizes and average rates of growth during the 1990s (Unimak Pass area in the western Gulf of Alaska/eastern Aleutian Islands and the Seguam-Adak region in the central Aleutian Islands) Increases in a number of subpopulations in the Gulf of Alaska since the late 1990s reduce their risks of extinction Predictions of the risk of extirpation of the species in western Alaska were drastically different depending on the particular scenario considered The risk of extirpation was low assuming that population trajectories were deterministic and/or that there was density dependent compensation in birth and survival rates However, the predicted risk of extirpation was relatively high when stochastic variability was incorporated in future dynamics due to the currently reduced sizes of subpopulations

Fisheries Science and Management

Wednesday, January 26, 2005 2 30 pm – 5 15 pm

Chair Bill Wilson

Keynote **NOAA's Ecosystem Approach to Management**	Jack Dunnigan
Corroboration and Application of a Bioenergetics Model to Estimate the Growth of Juvenile Walleye Pollock *(Theragra chalcogramma)* in the Western Gulf of Alaska	Michael Mazur
Genetic Divergence, Phylogeography, and Recognition of Asian and North American Chinook Salmon Populations	Tony Gharrett
Assessing Long-Term Viability of a Marine Reserve	Sue Hazlett
A Conceptual Model Approach to Utilizing Traditional Knowledge in Resource Management	Kimani Kimbrough
Size at Maturity of Bering Sea Walleye Pollock	Gordon Kruse
Further Developments from Acoustical Data Loggers on Pollock Vessels	Terrance Quinn
Life History, Ecology and Population Dynamics of Spiny Dogfish, *Squalus acanthias*, in Alaska	Cindy Tribuzio
Implications of Environment Variability on Spawning and Management of Pacific Herring in Northern Bristol Bay, Alaska	Naoki Tojo

POSTERS

Establishing a Statewide Data Warehouse of Salmon Size, Age and Growth Records	Bev Agler
Pacific Cod Studies in the Bering Sea	M Elizabeth Conners
Patterns in Atka Mackerel Small-Scale Distribution and Variation in Maturity Schedule	Dan Cooper
Small-Mesh Trawl Surveys in Kachemak Bay, Alaska	Richard Gustafson
Reproductive Ecology of the Atka Mackerel. Embryonic Developmental Series	Jared Guthridge
The Influence of Adult Salmon Carcasses on Energy Allocation in Juvenile Salmonids	Ron Heintz
Discriminating Among Northern Gulf Of Alaska Herring Populations Using Chemometry Of Heart Tissue Fatty Acids	Ted Otis

Methods to Determine Consistency of Spiny Dogfish Age Readings	Joel Rice
Marine Derived Nutrients (MDN) In Riverine Ecosystems Developing Monitoring Tools For Tracking MDN In Alaska Watersheds	Daniel Rinella
Kodiak Archipelago's Youth Area Watch	Teri Schneider
Monitoring Dynamics of the Alaska Coastal Current and Development of Applications for Management of Cook Inlet Salmon	Mark Willette

Corroboration And Application Of A Bioenergetics Model To Estimate The Growth Of Juvenile Walleye Pollock *(Theragra chalcogramma)* In The Western Gulf Of Alaska

Michael Mazur, Matt Wilson, and Annette Dougherty

A bioenergetics model for juvenile walleye pollock *(Theragra chalcogramma)* was applied to a spatially distinct grid of samples in the western Gulf of Alaska to investigate the influence of temperature, prey quality, and prey quantity on size-specific growth Similarities in independent estimates of prey consumption generated from the bioenergetics model and a gastric evacuation model for September of 2000 corroborate the performance of the bioenergetics model Similarly, daily growth estimates generated from the bioenergetics model were within the range of growth estimates obtained from otolith analysis However, temperature and prey quality alone did not account for the observed variation between bioenergetics and otolith growth estimates Estimates of stomach fullness for walleye pollock did not correlate with model estimates of ration size Therefore, knowledge of the vulnerable fraction of prey in the environment and how prey vulnerability and walleye pollock foraging changes across space and time is needed to further explain differences among growth habitats These results suggest that the bioenergetics model for juvenile walleye pollock is a useful tool for evaluating the influence of spatially variable habitat conditions on the growth potential of juvenile walleye pollock

Genetic Divergence, Phylogeography, And Recognition Of Asian And North American Chinook

A J Gharrett, V A Brykov, S Hall, and Z Li

We surveyed mtDNA and microsatellite variation in chinook salmon populations sampled broadly around the Pacific Rim from California to Kamchatka, looking for relationships among populations We used genealogical relationships of mtDNA haplotypes to learn about the evolutionary dynamics and demographic history of the species and populations Both mtDNA and microsatellites revealed strong divergence among geographic regions and among most populations within regions Many of the populations are strongly isolated from the others included in our analysis Divergences among Asian populations were not as strong as among populations in other regions The northernmost Asian population has probably experienced gene flow from Alaskan populations However, markers were found that allow resolution of Asian and North American stocks The mtDNA haplotypes record several episodes of severe population decline followed by population expansions Populations in Southeast Alaska indicate that they probably resulted from colonization from both southern and northern refugia following the last glaciation Asian and western Alaskan populations have lower levels of variation than other populations, suggesting that they have been isolated since the last episode of population reduction During the last glacial episode, Kamchatka Peninsula remained relatively ice-free, which suggests that Asian chinook populations are chronically small This work was supported by PCCRC

Fisheries Science and Management

Assessing Long-Term Viability Of A Marine Reserve

Sue Hazlett

Neither ecosystems nor social systems are inherently stable Change in either system, either long-term, predicted change, or change through stochastic events, can affect the viability of marine reserves and marine protected areas This study examines both the ecological and social factors that influence the establishment and maintenance of marine reserves over time This study also looks at interactions between factors and potential sources of conflict that can affect enforcement of reserve regulations and management effectiveness

Fisheries Science and Management

A Conceptual Model Approach To Utilizing Traditional Knowledge In Resource Management

Kimani Kimbrough

The conceptual model approach is used to present a concise depiction of traditional environmental knowledge for use by coastal managers, scientist, and policy makers Matrices, a simple straight forward way to characterize ecosystems, were used to organize and prioritize information obtained from village Elders A conceptual model was developed to capture the interactions between relevant societal behaviors (Activities) that result in ecosystem perturbations (Stressors), which negatively affect organisms and habitats valued by the village Activities were grouped into global, regional, local and village categories to address the scope of the relevant issues Natural, commercial, industrial, and village derived stressors were found to affect both economically valuable and traditionally utilized species The conceptual model approach is a means through which traditional knowledge can be utilized to drive future research efforts, and assist in resource management decisions

Fisheries Science and Management

Size At Maturity Of Bering Sea Walleye Pollock

Gordon Kruse

University of Alaska Fairbanks, School of Fisheries and Ocean Sciences

Walleye pollock, *Theragra chalcogramma*, are both ecologically and commercially important in the eastern Bering Sea (EBS) Maturity is a critical parameter in the stock assessment to set annual total allowable catch Pollock maturity has not been examined in the EBS since 1976, and possible interannual and geographic variation has never been considered Our goal is to estimate correct maturity schedules for EBS pollock Maturity data, fish lengths and macroscopic maturity stages were collected aboard pollock trawlers during winter 2002 and 2003 across the EBS from 10,197 pollock Similar data were collected by NMFS scientists during hydroacoustic surveys from 1989-2002 Length at 50% maturity (L50) was estimated by year and area by logistic regression using maximum likelihood methods Maturity data were separated by area using ArcGIS software Geographic variability exists, fish mature at the smallest lengths north of the Pribilof Islands Size at maturity varies interannually, as well Temporal and spatial variation in maturity may be due to biological or environmental factors Variation in length-at-age between year classes and areas may cause shifts in L50 Differences in growth among year classes or
areas may be regulated by environmental variables, such as temperature, through its direct effects on physiological processes, or prey availability and/or abundance through its effects on pollock food consumption An inverse relationship between pollock density and L50, suggests that density-dependent growth may occur as well

Fisheries Science and Management

Deployment Of An Acoustic Data Logger On Commercial Fishing Vessels To Evaluate The Potential Of Fishing-Induced Declines In Local Pollock Abundance

Terrance J Quinn II[1] and Mr Stephen Barbeaux[2]

[1] SFOS, University of Alaska Fairbanks, Juneau AK
[2] Alaska Fisheries Science Center, Seattle WA

Investigators undertook a "proof of concept" project to evaluate the feasibility of installing acoustic data loggers on catcher/processors in the EBS pollock fishery to study localized depletion of pollock The project is developing a prototype data logger that interfaces with the ship's 38 kHz echo sounder and captures the acoustic backscatter returns In 2002, we developed the system and installed it on three catcher/processors The backscatter data is post-processed and integrated with observer and logbook data A preliminary analysis has been conducted that shows that the devices record information that is correlated with pollock catches In 2003, an additional 4 vessels were equipped with acoustic data logging systems, bringing the total number of PCC vessels equipped to 7, or nearly half the fleet Further work has included classifying the searching behavior of the vessel, identifying pollock aggregations detected while searching, and evaluating what inferences, if any, can be made concerning the rate at which those aggregations are reduced in abundance The project is moving forward in developing more sophisticated analytical tools for inferring the temporal dynamics of pollock spatial pattern using multiple data sources A major focus of recent research has been vessel calibration to assure that the hydroacoustic signal truly measures biomass and school characteristics

As of September, PI's have processed approximately 2,880 hours of RAW data from the winter 2003 fishery Processing the data involves manually loading the data into the Echoview template and scrutinizing each second for noise due to surface interference, other bad data regions, and areas where the bottom detection algorithm has failed to successfully detect bottom Besides processing the ES-60 RAW data, a technician has been recording a detailed log on all problems encountered during processing This log is being used as a reference to develop algorithms, which will eventually enable us to automate processing In June of 2004, we conducted a calibration exercise on a large vessel, and we were able to overcome the difficulties of calibrating such a large vessel and successfully calibrated the ES-60 system aboard the vessel We were also able to find a suitable calibration location within Elliott Bay We now have a tested and tried method and location for calibrating ES-60s on large factory processing vessels of the class that operate in the Bering Sea

Further work will include classifying the searching behavior of the vessels, identifying pollock aggregations detected while searching, and evaluating what inferences, if any, can be made concerning the rate at which those aggregations are reduced in abundance or altered in size and shape PI's have investigated the ability to detect local depletion from commercial catch-per-unit-effort (Battaile and Quinn, in review) That work has shown that statistically significant depletion can be detected in the pollock fishery but that it provides only a relative index of depletion Furthermore, it appears that spatial distribution from the summer trawl survey does not match well with the spatial distribution of catch during either the winter or fall fisheries Therefore, this current investigation is important for resolving spatial distribution of the pollock population, and this resolution is probably not possible in any other way

Fisheries Science and Management

Life History, Ecology And Population Dynamics Of Spiny Dogfish, *Squalus Acanthias*, In Alaska

Cindy Tribuzio

University of Alaska Fairbanks, School of Fisheries and Ocean Sciences

In the Northeast Pacific Ocean, spiny dogfish *(Squalus acanthias)* have supported commercial fisheries for over 100 years, despite sparse biological knowledge about the species Tagging studies suggest diverse stock structure, including migratory offshore stocks and distinct nonmigratory inshore stocks that require region-specific management and research Biological differences exist between these groups of dogfish For example, a related study by one of us (CAT) found differences in timing of parturition among dogfish in British Columbia (BC, Canada) inshore waters, and those residing in neighboring Puget Sound, Washington (WA) This suggests that biological differences will exist between these previously studied groups and Alaskan dogfish, and possibly even differences among Alaskan dogfish In Alaska, there is currently no directed fishery, but interest in opening one is increasing Thus, it is crucial to advance our region-specific knowledge of this species, so that management strategies can be adapted from past lessons learned in other jurisdictions with biological parameters appropriate for Alaska New Alaskan research projects include assessment of stock status, population demography (e g , age and size composition, maturity, mortality), life history, ecology, and fisheries bycatch Biological samples are being collected throughout the Gulf of Alaska to document spatial and temporal variability in biology and ecology to assist in the development of appropriate management units Ecological impacts of this species are also being investigated by examining predator/prey interactions, consumption, abundance, and seasonal and interannual shifts in geographic distributions This research is intended to assist ADFG and the Alaska Board of Fisheries to assess the merits of proposed new directed commercial fisheries, as well as to support NMFS and the North Pacific Fishery Management Council to manage spiny dogfish bycatch in federal fisheries This project began in July 2004 This presentation will cover the project design and sampling plans for the next 3 years, as well as preliminary results from the first sampling season

Fisheries Science and Management

Implications Of Environment Variability On Spawning And Management Of Pacific Herring In Northern Bristol Bay, Alaska

Naoki Tojo and Gordon H Kruse

University of Alaska Fairbanks, School of Fisheries and Ocean Sciences, Juneau Center, 11120 Glacier Highway, Juneau, AK 99801 (email ftnt@uaf edu, phone 907-465-8453)

Spawning timing and location of Pacific herring *(Clupea pallasi)* vary annually Accurate predictions of spawning variability are important to the fishing industry and fishery managers, who strive to maximize product quality and prices Roe quality peaks just prior to spawning and the largest, most valuable herring spawn first Declining worldwide demand for roe and increasing costs of fishing operations exacerbate the need for accurate timing of fishery openings In cooperation with ADFG, we are studying dynamics of pre-spawning school distributions, spawning timing, and spawning location of herring in northern Bristol Bay, Alaska Historical data on pre-spawning and spawning herring distributions and sea surface temperature (SST), surface air temperature (SAT), and sea ice concentration were analyzed within a geographic information system (GIS) at multiple spatial and temporal scales A statistically significant (P<0 001, r2=0 82) non-linear relationship exists between spawning timing and offshore (57 87 N, 171 03 W) sea ice concentration in April during 1977 to 1994, but less variability (P<0 001, r2=0 65) in spawning timing is explained when more recent data are included A weaker, but still significant (p=0 005, r2=0 35), linear relationship exists between April SST and herring spawning timing Within shallow nearshore areas adjacent to spawning sites, pre-spawning herring schools show a general in-season pattern of movement from east to west, and spawning events are later in the west than in the east This local movement corresponds to temperature gradients around spawning areas as revealed by AVHRR satellite imagery It appears that climate-driven thermal dynamics affect the physiology of maturing herring in offshore waters during winter, rates of shoreward migration in late winter/early spring, as well as local school behavior in nearshore areas just prior to spawning in spring

POSTER Fisheries Science and Management

Establishing A Statewide Data Warehouse Of Salmon Size, Age And Growth Records

Bev Agler and Pete Hagen

Collecting biological data is fundamental to managing and monitoring Alaska's salmon resources Throughout Alaska, hundreds of thousands of salmon are examined annually to record gender and size, and scales are collected for age determination This represents an enormous sampling effort that has resulted in approximately 12 million data records and their corresponding scale samples from over 40 years of data collection These data were collected by the Alaska Department of Fish and Game to serve local management needs, which usually resulted in the raw data being summarized into tables Because of this, no common process or protocol for managing and preserving the historical data was ever developed Many of these records were placed in file boxes in remote storage areas, and thus subject to loss or damage This project was an effort to gather information about the temporal and geographic extent of these records, begin a process of preserving and indexing the records using a common protocol, and develop a strategy for establishing an electronic data warehouse to allow access of these records through the internet The rationale for this project is simple salmon, returning to their natal areas, contain within their size, age and growth histories a unique biological record that reflects marine and in some cases freshwater conditions Given the extensive geographic and temporal range this collection represents, collating this data in an accessible location has the ability to augment future research studies and monitoring programs However, given the size and complexity of this endeavor, it is also one that is best implemented in phases Phase one of this project has been completed and the inventory and data standards adopted by the project working group are accessible at http //www taglab org/ASL/reports/default asp Under phase two, work will involve populating the database with available electronic records, developing reports and procedures for annually updating the database from the various collection sites, and addressing the recovery and data entry of records available only as hard copies The final phase of the project would be to complete data entry of key regional systems and join derivative products, such as the growth histories of salmon extracted from the scales through image analysis, to this database Scale growth data in particular (which in its simplest form may contain up to 120 measurements per specimen) provides an enormously detailed means of tracking changes in marine conditions that support salmon production Capturing and preserving these records under a data warehouse scheme will be valuable contribution to longterm monitoring programs

POSTER Fisheries Science and Management

Pacific Cod Studies In The Bering Sea

M Elizabeth Conners, Peter Munro, Yunbing Shi, Elizabeth Logerwell

The Fisheries Interaction Team at the Alaska Fisheries Science Center is conducting field experiments on Pacific cod in the southeast Bering Sea, using modified commercial pot gear The main experiment is an effort to determine if commercial trawling during the winter cod season creates a measurable depletion in local cod abundance Cod are an important item in the diet of endangered Steller sea lions in this area, and there are concerns that commercial fishing could affect food availability for sea lions by creating a localized depletion of sea lion prey This experiment is conducted around the no-trawl zone at Cape Sarichef on Unimak Island This no-trawl zone intersects a shelf area that has historically been popular cod trawling ground The goal of the experiment is a statistical test of whether the local abundance in the heavily trawled area outside the boundary declines relative to the 'control' area inside the no-trawl zone The winter 2004 field efforts were highly successful, sampling a full array of 80 stations with good replication Results for this year very strongly indicate no difference in the rate of change in cod abundance between the trawled and untrawled areas Both areas showed an increase of roughly 50% in local cod abundance from early January to late March Bootstrap simulations from the 2004 data indicate that sample size was adequate and the power of the test to detect differences in local abundance was good Data suggest that results of the local abundance experiment are closely tied to short-term and seasonal movements of Pacific cod in the region Preliminary tagging studies indicate a directional seasonal movement pattern, with some cod covering large distances and others remaining in or returning to the 'cod alley' study area The local abundance experiment and analysis of tagging data will continue through winter 2005

POSTER Fisheries Science and Management

Patterns In Atka Mackerel Small-Scale Distribution And Variation In Maturity Schedule

Daniel W Cooper and Susanne F McDermott

Atka mackerel are one of the most abundant groundfish species in the Aleutian Island ecosystem Many aspects of their life history and reproductive ecology are still unknown Variability in reproductive output may influence the productivity of a species and may contribute to variability in recruitment Small-scale distribution patterns of this species are complex and closely tied to their reproductive cycle This study examines variability in Atka mackerel female maturity schedule and small-scale distribution patterns by maturity, stage, fish length, and sex ratio Gonad samples were collected from 1999-2004 in the Aleutian Islands, specifically at Seguam Pass, Tanaga Pass and the Amchitka Island area Sexual maturity and maturity stages are determined with histological methods To date, female length at maturity from Seguam pass in 2002 has been estimated, and is not different from 1992-1994 Atka mackerel small scale distribution are being presented in three major local aggregations to identify small scale distribution patterns by maturity stage and also by sex ratio, length frequency, and depth Spawning habitat was characterized by the presence of females in spawning stage, males in spawning colors, and egg batches that were found in the samples Understanding these patterns might give insight into availability of the fish to survey and fishing gear and the use of spawning versus feeding habitat by the population

POSTER Fisheries Science and Management

Small-Mesh Trawl Surveys In Kachemak Bay, Alaska

Richard Gustafson and William R Bechtol

Ecosystem structure in the northern Gulf of Alaska, as indicated by the dominant fish and predator populations, exhibited dramatic shifts in the late 1970s and early 1980s Abundances of many apex populations, particularly piscivores at or near the top of the marine food chain, declined in the Gulf of Alaska from the 1970s through the 1990s At the same time, the Gulf exhibited a drastic change in the type and abundance of forage species, such as herring, capelin, sand lance, shrimp, pollock and cod These population changes are now believed to be related to a decadal shift in climate as warming waters likely resulted in a transition from a crustacean-dominated forage population to a population dominated by fish, particularly gadid species, such as pollock and cod Standardized small-mesh trawl surveys, conducted by the Alaska Department of Fish and Game (ADFG) in Kachemak Bay in lower Cook Inlet, Alaska since 1971, have produced a strong database to document these changes Coupling trawl survey data with information on apex populations will allow scientists identify ecosystem links with the ultimate goals to improve (1) monitoring of ecosystem changes, (2) identification of species or resources that are at risk, and, (3) management of human use to reduce impacts on species at risk As a component of the Gulf Ecosystem Monitoring (GEM) project, ADFG conducted a small-mesh net bottom trawl survey during May 12 to 14 and 26 to 28, 2004 to document relative abundance and biomass of fish and invertebrate populations in Kachemak Bay, Alaska This project will refine longterm monitoring of forage species populations in Cook Inlet, an area representative of ecosystem conditions and changes in the northern Gulf of Alaska

POSTER Fisheries Science and Management

Reproductive Ecology Of Atka Mackerel Embryonic Developmental Series

Guthridge, J [1], Nicola Hillgruber[2], Robert Lauth[3], Susanne McDermott[3], Shannon Atkinson[1]

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Atka mackerel *(Pleurogrammus monopterygius)* range from Asia to North America in the southern Bering Sea and northern Pacific Ocean In Alaska, a better ecological understanding of this integral species that supports a multimillion dollar commercial trawl fishery is critical for reliable management programs We aim to determine the embryonic developmental series for Atka mackerel, as one component of a comprehensive multi-objective study to elucidate the reproductive ecology of this species Currently available data on the embryonic developmental series of Atka mackerel are not suitable for accurate age determination of eggs due to lack of information, detail, and standardized methods Our primary objective of this component is to generate a complete embryonic developmental series for Atka mackerel at 4, 7, and 10°C Fertilized eggs collected from captive Atka mackerel were transferred into closed-system incubation tanks, sampled at regular intervals, and preserved in Stockard's solution Spawning events were video recorded to determine time zero Subsequent data analysis and descriptions will be performed according to recent embryonic developmental research conducted on other species Incubation and sampling has been completed at 10°C with eggs hatching at 40-45 days, 7°C with eggs hatching at 75-80 days, and 4°C with eggs hatching at 100-105 days after fertilization Data from a complete embryonic developmental series will allow the assessment of age of eggs found in situ when the prevailing water temperature is known As a consequence, it will be possible to estimate spawning and hatching dates, thus providing critical information for better stock assessment and management of Atka mackerel in Alaskan waters ***This study is one component of a multi-objective study funded by the NPRB***

POSTER Fisheries Science and Management

The Influence Of Adult Salmon Carcasses On Energy Allocation In Juvenile Salmonids

Ron Heintz and Lawrence Schaufler

The aim of this project is to understand how the presence of adult salmon carcasses influences energy allocation strategies in juvenile salmonids by sampling Dolly Varden charr periodically from streams on the Kenai Peninsula Juvenile fish in lotic systems must balance the conflicting demands of growth and energy storage to maximize their probability of surviving over winter Little is known about how juvenile salmonids resolve these demands and how the energy presented by salmon carcasses influences the resolution In this project we contrast the energy allocation strategies of juvenile Dolly Varden sampled from the north Fork of the Anchor River, stream with adult salmon runs, and Happy Valley Creek, a stream with no adult salmon runs Fish were sampled in May, June, July, August and October of 2004 and will continue next spring The fatty acid compositions of the fish will be used to verify the presence of marine influence in their tissues Growth differences between populations will be examined through RNA/DNA analysis and the proportion of energy allocated to growth or storage will be determined from their proximate compositions Initial results for age 2 fish sampled in June and July indicate that lipid content is highest in fish sampled from Happy Valley Creek, the stream without carcasses (P = 0 040) This suggests fish from Happy Valley Creek allocated greater amounts of energy to storage than those from the Anchor River between June and July Pending analyses will be used to verify this conclusion This project will ultimately provide an integrated measure of the impacts of adult escapement in one year on smolt production in subsequent years

POSTER: Fisheries Science and Management

Discriminating Among Northern Gulf Of Alaska Herring Populations Using Chemometry Of Heart Tissue Fatty Acids

Ted Otis, Ron Heintz, and Jacek Maselko

Understanding the stock structure of northern Gulf of Alaska herring is relevant to how these exploited populations should be assessed and managed. Typically, genetic techniques such as microsatellite DNA variation are employed to resolve stock structure. However, when there is gene flow between spawning aggregations, as is the case with herring, this method is not useful. The fatty acid composition of heart tissue has been proposed as a useful criterion for discriminating stocks, as was demonstrated in our 2001 pilot study. In that study, we showed that discriminant functions could correctly identify an individual's stock more than 90% of the time, even when the stocks were discriminated over relatively fine spatial scales (< 100 km). These discriminations were based on differences among pre-spawning females collected from spawning aggregates in Kamishak Bay, Paramanof Bay, Montague Island and Fairmont Bay. The temporal stability of these differences is currently unknown. In Spring 2005, we will begin evaluating the temporal stability of these stock discrimination criteria. Hearts will be collected during the spring and fall/winter of 2005 and 2006 from putative herring stocks from Sitka, PWS, Kamishak, Kodiak, Dutch Harbor, Togiak, and Kuskokwim Bay. The fatty acid compositions of the hearts will be measured by gas chromatography and the resulting compositions discriminated using rules derived from the 2001 collection. In this presentation we provide an example of how the analysis will proceed using samples collected from Prince William Sound approximately six months after those used in the pilot study.

POSTER: Fisheries Science and Management

Methods To Determine Consistency Of Spiny Dogfish Age Readings

Joel Rice, Vincent Gallucci[1], Cindy Tribuzio[2] and Gordon Kruse[2]

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The spiny dogfish *(Squalus acanthias)* is a major component of the biomass of many coldwater ecosystems in the North Pacific and North Atlantic coasts of North America. Despite its ubiquitous presence over its range and its apparent abundance, relatively little is known about the species and its role in the ecosystem. Interest in the species has recently risen due to its increasing export value and interest in ecosystem based management. Effective management of dogfish requires greater knowledge their life history, population dynamics, and role as a keystone predator. The exploitation history of this shark species often characterized by large harvests, followed by crashes. However, the ability to determine the age of specimens facilitates the study of its population dynamics, in comparison to other shark species. Two spines anterior to both dorsal fins are used for ageing, following standard methodology (Beamish and McFarlane, 1985). Problems associated with ageing by different laboratories include systematic differences in laboratory procedure and thus possibly different stock assessments. Methodology to statistically compare readings between different laboratories facilitates identification of whether the differences are genetic or environmental, rather than procedural. The statistical experiment to compare ageing results will include laboratories in Alaska, Washington State, Nanaimo, and Woods Hole. A standard set of spines will circulate among the laboratories. The experimental design involves a random sample, stratified over the lengths of the sharks, from which age estimation will occur. Analyses are carried out using available and simulated data. The implications of statistically different age estimates on the calculation of life history parameters and stock assessments are explored.

POSTER Fisheries Science and Management

Marine Derived Nutrients (MDN) In Riverine Ecosystems Developing Monitoring Tools For Tracking MDN In Alaska Watersheds

Daniel Rinella, Mark Wipfli, Coowe Walker, Craig Stricker

The objectives of this study are to develop a water chemistry proxy for monitoring salmon returns and to track and measure marine derived nutrients and carbon (MDN) effects in stream, riparian and nearshore environments on the southern Kenai Peninsula Our approach in year 1 of this 3-year effort was to link stream chemistry, marine isotope signatures, and lipid and fatty acid measures along a gradient from headwaters to river mouth in watersheds with and without spawning salmon (i e , North Fork Anchor River and Happy Valley Creek, respectively) Year 1 analyses are ongoing but some preliminary results are available Year 1 spawning runs delivered 13,000 kg of chinook *(Oncorhynchus tshawytscha)* biomass and 2000 kg of coho *(O kisutch)* biomass to the North Fork Anchor River Nutrient concentrations were low in both streams and nitrate concentration increased (~10x) coincident with chinook spawning, potentially indicative of a dissolved MDN pulse Dolly Varden char *(Salvelinus malma)*, Horsetail (*Equisetum* sp), and several macroinvertebrate taxa collected in spawning reaches of the North Fork Anchor River prior to seasonal salmon runs showed enriched 15N values relative to Happy Valley Creek, suggesting that MDN was incorporated into biota and sequestered for extended periods of time Aquatic macroinvertebrates also showed a general trend toward 15N enrichment along a gradient from headwaters to mouth for both streams, suggesting that trophic complexity increased with stream size regardless of spawning salmon presence The ongoing analysis of lipids and fatty acids, and N, C, and S stable isotopes from peak salmon spawning periods will give additional information into temporal and spatial patterns of MDN uptake and the utility of stable isotope and fatty acid analysis as tools for MDN tracking In years 2 and 3, we will expand this study to replicate across several salmon and non-salmon watersheds and integrate with related studies in other areas of southcentral Alaska to develop a broader regional understanding and a widely-applicable long-term monitoring program for the GEM region

POSTER Fisheries Science and Management

Kodiak Archipelago's Youth Area Watch

Teri Schneider

http //www kodiak k12 ak us/index html

The Kodiak Archipelago's Youth Area Watch has operated in the Kodiak Island Borough School District since 1999 and has provided opportunities for students throughout the islands to connect with scientists and their work in the field From water and weather monitoring, and "green up/green down" projects utilizing GLOBE protocols, to high school summer internships in the fields of marine biology and archaeology, as well as an in depth study of our salmon, students utilize scientific and cultural methods to explore their surroundings Documentation of traditional ecological knowledge is published in "Iluani," a student produced oral history magazine Students, Elders, educators and other community members take part in the annual Academy of Elders/Science Camp and Rural Science Fair, where the focus for learning is the culturally and environmentally relevant knowledge of our Elders

POSTER Fisheries Science and Management

Monitoring Dynamics Of The Alaska Coastal Current And Development Of Applications For Management Of Cook Inlet Salmon

Mark Willette

This project uses a vessel of opportunity to collect physical oceanographic and fisheries data along a transect across lower Cook Inlet from Anchor Point to the Red River delta Logistical support for the field sampling is provided in part by the Alaska Department of Fish and Game which has chartered a vessel annually to fish along this transect each day during July, providing in-season projections of the size of salmon runs returning to the inlet The project provides an opportunity for long-term monitoring of oceanographic conditions in Cook Inlet as part of these ongoing fisheries surveys Investigators are analyzing physical oceanographic data collected by the project to improve management of Cook Inlet salmon through improved in-season salmon run projections Several hypotheses regarding effects of changing oceanographic conditions on salmon migratory behavior will be tested (1) salmon migration is delayed when fish encounter strong salinity gradients, (2) interannual changes in freshwater outflow from upper Cook Inlet or the northward extent of the Alaska Coastal Current affect salmon migratory timing, (3) the variance of relative salmon density is a function of salmon abundance and the structure of tide rips, and (4) salmon use tidal currents in upper Cook Inlet to facilitate their northward migration The oceanographic data collected by the project will also provide for valuable validation of remote sensing products, improved understanding of ocean dynamics in lower Cook Inlet, and a highly powerful statistical evaluation of oil spill risk analysis models

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Web sites vanish so fast scientific papers just can't keep up
Disappearing links cause consternation -- it's not academic

Rick Weiss, Washington Post
Sunday, November 30, 2003

URL: sfgate.com/article.cgi?file=/c/a/2003/11/30/MNGBD3BLD61.DTL

It was in the mundane course of getting a scientific paper published that physician Robert Dellavalle came to the unsettling realization that the world was dissolving before his eyes.

The world, that is, of footnotes, references and Web pages.

Dellavalle, a dermatologist with the Veterans Affairs Medical Center in Denver, had co-written a research report featuring dozens of footnotes -- many of which referred not to books or journal articles but, as is increasingly the case these days, to Web sites that he and his colleagues had used to substantiate their findings.

Problem was, it took about two years for the article to wind its way to publication. And by that time, many of the sites they had cited had moved to other locations on the Internet or disappeared altogether, rendering useless all those Web addresses -- also known as uniform resource locators (URLs) --

they had provided in their footnotes.

"Every time we checked, some were gone and others had moved," said Dellavalle, who is on the faculty at the University of Colorado Health Sciences Center. "We thought, 'This is an interesting phenomenon itself. We should look at this.' "

He and his co-workers have done just that, and what they have found is not reassuring to those who value having a permanent record of scientific progress. In research described in the journal Science last month, the team looked at footnotes from scientific articles in three major journals -- the New England Journal of Medicine, Science and Nature -- at three months, 15 months and 27 months after publication. The prevalence of inactive Internet references grew during those intervals from 3.8 percent to 10 percent to 13 percent.

"I think of it like the library burning in Alexandria," Dellavalle said, referring to the 48 B.C. sacking of the ancient world's greatest repository of knowledge. "We've had all these hundreds of years of stuff available by interlibrary loan, but now things just a few years old are disappearing right under our noses really quickly."

Cause for concern

Dellavalle's concerns reflect those of a growing number of scientists and scholars who are nervous about their increasing reliance on a medium that is proving far more ephemeral than archival. In one recent study, one-fifth of the Internet addresses used in a Web-based high school science curriculum disappeared over 12 months.

Another study, published in January, found that 40 percent to 50 percent of the URLs

referenced in articles in two computing journals were inaccessible within four years.

"It's a huge problem," said Brewster Kahle, digital librarian at the Internet Archive in San Francisco. "The average lifespan of a Web page today is 100 days. This is no way to run a culture."

Of course, even conventional footnotes often lead to dead ends. Some experts have estimated that as many as 20 to 25 percent of all published footnotes have typographical errors, which can lead people to the wrong volume or issue of a sought-after reference, said Sheldon Kotzin, chief of bibliographic services at the National Library of Medicine in Bethesda, Md.

Popular resource

But the Web's relentless morphing affects a lot more than footnotes. People are increasingly dependent on the Web to get information from companies,

organizations and governments. Yet, of the 2,483 British government Web sites,

for example, 25 percent change their URL each year, said David Worlock of Electronic Publishing Services Ltd. in London.

That matters in part because some documents exist only as Web pages -- for example, the British government's dossier on Iraqi weapons. "It only appeared on the Web," Worlock said. "There is no definitive reference where future historians might find it."

Web sites become inaccessible for many reasons. In some cases individuals or groups that launched them have moved on and have removed the material from the global network of computer systems that makes up the Web. In other cases the sites' handlers have moved the material to a different virtual address (the URL that users type in at the top of the browser page) without providing a direct link from the old address to the new one.

When computer users try to access a URL that has died or moved to a new location, they typically get what is called a "404 Not Found" message, which reads in part: "The page cannot be displayed. The page you are looking for is currently unavailable."

Consider the stakes: The Web contains unfathomably more information than did the Alexandria library. If our culture ends up unable to retrieve and use that information, then all that knowledge will, in effect, have gone up in smoke.

MEMBERS

Alaska Longline Fishermen's Association
www.alaskaoceans.net/alfa

Alaska Marine Conservation Council
www.akmarine.org

Bering Sea Council of Elders
www.alaskaoceans.net/bsce

Cook Inlet Keeper
www.inletkeeper.org

Earthjustice
www.earthjustice.org

National Environmental Trust
www.environet.org

Oceana
www.oceana.org

The Ocean Conservancy
www.oceanconservancy.org

Trustees for Alaska
www.trustees.org

World Wildlife Fund
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Alaska Oceans Network

ALASKA

The Alaska Oceans Network is a voluntary association of conservation, fishing, and Alaska Native organizations with a mission to restore and maintain healthy marine ecosystems in Alaska. Although we have different approaches, we share a common concern about the scale of human activities, including pollution, industrial fishing practices, coastal zone and fossil fuel development, and shipping and transport. We are committed to using the best available science and educating the broader public about ocean issues in Alaska and their relevance to people's daily lives.

The oceans off Alaska's 33,000 mile coastline are some of the most productive in the world, supporting an extraordinary array of marine mammals, seabirds and the nation's largest fisheries. Over four billion pounds of seafood are produced from Alaska's waters each year; over half of all U.S. fisheries combined.

The Alaska pollock fisheries supply mild white fish filets, fake crab, and a high value fish egg product to retailers around the globe ranging from fast food restaurants and grocers to luxury markets. Catches of this one species alone account for a quarter to a third of the nation's total. These figures raise concerns about the limits of Alaska's remarkable ocean environments, especially because of pollock's value as food for other fish, birds, and marine mammals.

OCEANS

Healthy oceans are vital to biological diversity, species survival, cultural identity, recreation and economic prosperity here in Alaska and throughout the world.

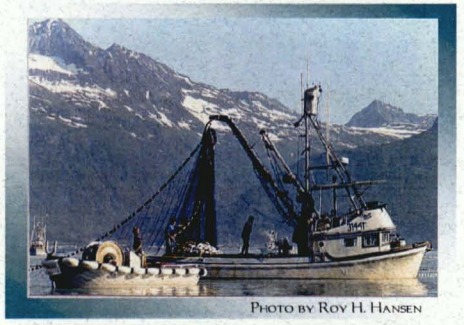

Photo by Roy H. Hansen

Alaska's biologically rich marine ecosystems show signs of stress and decay. Moreover, government management of marine resources is fragmented and inadequately addresses the many uncertainties about sustainable levels of human use.

- 25 species of mammals and seabirds spend some or all of their lives in the North Pacific are listed as threatened or endangered under the Endangered Species Act. Other marine mammals and seabirds are severely declining.
- Listed as endangered, Steller sea lions have declined by 80-90% over the previous thirty years in the Bering Sea and parts of western and central Gulf of Alaska.
- Scientific knowledge is dangerously lacking about commercially-caught species. The National Marine Fisheries Service only knows the health of one of every seven of the 220 North Pacific fish species. The other six may be overfished or healthy.
- In the United States, less than 1% of the ocean environment is completely protected from all extractive uses.
- Persistent organic pollutants and heavy metals accumulate in Arctic regions and magnify in living organisms. They are known to cause reproductive, immunological, neurological, and developmental effects as well as cancer in humans and wildlife.

NETWORK

AON member groups are engaged in:

- Educating the public about Alaska's marine environment
- Protecting marine habitats and their ability to support natural ecosystems, viable fisheries, and future generations of Alaskans
- Minimizing bycatch – the unintentional taking of non-targeted species of fish and other marine life – in all fisheries
- Redefining overfishing to give more consideration to complex marine food webs, and adoption of policies better able to avoid overfishing even of species for which there is little scientific information.

The Network is significantly supported by the David and Lucile Packard Foundation, the Oak Foundation, the Orca Fund, the 444 S Foundation, the Surdna Foundation, and the Alaska Conservation Foundation which also serves as our fiscal agent.

Be a Partner for Marine Stewardship.
Join one of our member organizations.

Theme Page North Pacific Ecosystem Metadatabase

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Goal

To advance understanding of the North Pacific Ocean ecosystem through the continuing development of an on-line inventory of data and other information

Status

The North Pacific Ecosystem Metadatabase began in 1996 as the Bering Sea Ecosystem Biophysical Metadatabase with three-year support from NOAA/ESDIM. It has since earned support and endorsement from FOCI, PICES, the North Pacific Marine Research Program, and the North Pacific Research Board. To establish the metadatabase, we solicit scientists, advertise in science newsletters, make national and international presentations, and through PICES, develop contacts with Canadian, Chinese, Japanese, Korean, and Russian institutes.

The metadatabase now contains 2251 records. The regional distribution of these records is shown in Fig. 1.

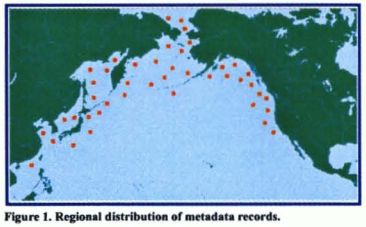

Figure 1. Regional distribution of metadata records.

To date, most contributions pertain to the eastern North Pacific Ocean. We suspect that there has been a similar quantity of research performed in the western North Pacific Ocean, however results from this research are not as readily available to us. For example, although more than ten Asian institutes have contributed to the metadatabase, these records make up less than 11% of the holdings. Holdings span all biological and physical scientific disciplines, including historical and present information, ranging from atmosphere to open ocean to intertidal areas. Figure 2 shows the distribution of metadata records by source country and keyword.

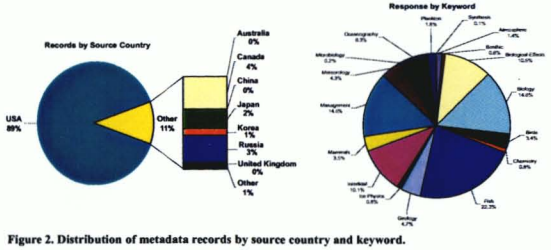

Figure 2. Distribution of metadata records by source country and keyword.

Access

The North Pacific Ocean Theme Page (http://www.pmel.noaa.gov/np/) is the internet gateway to the metadatabase. The theme page and the metadatabase offer a rich suite of environmental information to scientists, students, teachers, managers, and casual users. Since their inception, both the theme page and the metadatabase have increased in popularity as shown in Fig. 3. Peaks in user activity correspond to important announcements of availability of research funds or other resources.

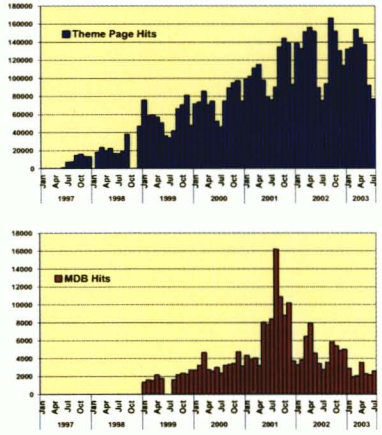

Figure 3. Theme page and metadatabase user activity.

The metadatabase is found through the Theme Page's Data link or can be accessed directly at http://www.pmel.noaa.gov/np/mdb/. Once on-line, a user can learn about the metadatabase, contribute metadata, or search for metadata by time, location, keyword, ID number, country of origin, etc.

A sample search result is shown in Fig. 4. This is a record from JODC (→). The contributor has allowed us to link the metadata record directly to its referenced data through a dynamic URL (→). Updates (→) are planned for the data set as needed. To inquire about this data, one could write, phone, or e-mail the source (→). The contributor has placed no constraints (→) on access or use of the information. This record can also be recovered by searching on one of the keywords listed in the table. Keywords (→) are supplied by the contributor.

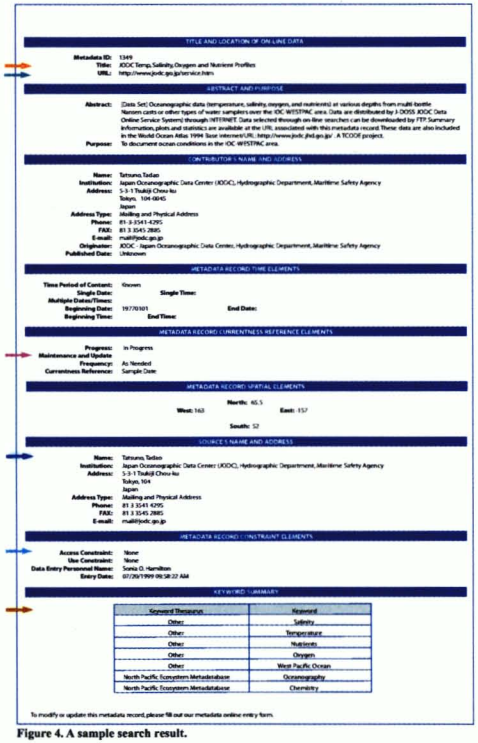

Figure 4. A sample search result.

Future Directions

We will continue to archive all metadata associated with the North Pacific Ocean. In particular, we want to increase holdings of Asian metadata to enrich our references to the western North Pacific Ocean and bordering regions.

We also intend to cooperate with other North Pacific marine data centers (e.g., KODC, JODC, etc.) in order to implement "federated searches" or queries that search metadata sets that span physically separate data locations in a manner that is completely transparent to the user.

REVIEW

Long-Term Ecosystem Response to the Exxon Valdez Oil Spill

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The ecosystem response to the 1989 spill of oil from the Exxon Valdez into Prince William Sound, Alaska, shows that current practices for assessing ecological risks of oil in the oceans and, by extension, other toxic sources should be changed. Previously, it was assumed that impacts to populations derive almost exclusively from acute mortality. However, in the Alaskan coastal ecosystem, unexpected persistence of toxic subsurface oil and chronic exposures, even at sublethal levels, have continued to affect wildlife. Delayed population reductions and cascades of indirect effects postponed recovery. Development of ecosystem-based toxicology is required to understand and ultimately predict chronic, delayed, and indirect long-term risks and impacts.

Before the Exxon Valdez oil spill, information available for constructing risk assessment models to predict ecological impacts of petroleum hydrocarbons was limited to selective, largely short-term monitoring after previous oil spills and to tests of acute toxicity in laboratory-tolerant taxa (*1*). After the tanker Exxon Valdez grounded on Bligh Reef in northern Prince William Sound on 24 March 1989, the magnitude of the spill, extent of shoreline contamination, and evident high mortality of wildlife prompted an evaluation of ecological impacts of unprecedented scope and duration extending now for more than 14 years (*2*–*5*). The release of 42 million liters of Alaskan North Slope crude oil contaminated to some degree at least 1990 km of pristine shoreline. Prince William Sound was most severely affected, but the oil spread more than 750 km to the southwest along the Kenai Peninsula, Kodiak archipelago, and the Alaska Peninsula (Fig. 1). Years of study provide a new understanding of long-term biological impacts and recovery processes in a coastal ecosystem populated by abundant marine mammals, seabirds, and large fishes (*2*–*5*).

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Delays in recovery and emergence of long-term impacts are understood by bringing an ecosystem perspective to ecotoxicology (*6*). The ecosystem framework extends ecotoxicology to include interactions among multiple abiotic and biological components rather than treating each species separately and restricting assessment to acute short-term impacts (*7*). Disagreements exist between Exxon- and government-funded scientists (*8*), and unknowns persist, especially in understanding how multiple processes combine to drive observed dynamics. Nevertheless, these uncertainties do little to diminish the general conclusions: oil persisted beyond a decade in surprising amounts and in toxic forms, was sufficiently bioavailable to induce chronic biological exposures, and had long-term impacts at the population level. Three major pathways of induction of long-term impacts emerge: (i) chronic persistence of oil, biological exposures, and population impacts to species closely associated with shallow sediments; (ii) delayed population impacts of sublethal doses compromising health, growth, and reproduction; and (iii) indirect effects of trophic and interaction cascades, all of which transmit impacts well beyond the acute-phase mortality.

Acute-Phase Mortality

After the release of crude oil from the Exxon Valdez into Prince William Sound (PWS), acute mortality followed a pattern largely predictable from other oil spills. Because marine mammals and seabirds require routine contact with the sea surface, these taxa experience high risk from floating oil (*2*, *6*). Oiling of fur or feathers causes loss of insulating capacity and can lead to death from hypothermia, smothering, drowning, and ingestion of toxic hydrocarbons. Accordingly, mass mortalities of 1000 to 2800 sea otters (*9*) and unprecedented numbers of seabird deaths estimated at 250,000 (*10*) were documented during the days after the spill. An estimated 302 harbor seals, a short-haired marine mammal, were killed not by oiled pelage but likely from inhalation of toxic fumes leading to brain lesions, stress, and disorientation (*2*). Mass mortality also occurred among macroalgae and benthic invertebrates on oiled shores from a combination of chemical toxicity, smothering, and physical displacement from the habitat by pressurized wash-water applied after the spill (*5*, *7*).

Persistence of Oil: Ecosystem Sequestration

Only early phases of transport and transformation of the petroleum hydrocarbons followed expectations (*11*). About 40 to 45% of the oil mass grounded in 1989 on 787 km of PWS beaches; another 7 to 11% was transported to contaminate 1203 km of Gulf of Alaska shoreline (*11*, *12*). About 2% remained on intertidal PWS beaches after 3.5 years (*11*); this reflected an exponential decay rate of -0.87 year^{-1}, which in turn produced a loss of 58% over a year. Unexpectedly (*3*), rates of dispersion and degradation diminished through time, as most oil remaining after October 1992 was sequestered in environments where degradation was suppressed by physical barriers to disturbance, oxygenation, and photolysis (*12*). A 2001 survey of intertidal PWS shorelines revealed 55,600 kg of often little weathered, Exxon Valdez oil in intertidal subsurface sediments and a perhaps equal mass of high-intertidal degraded surface oil and lower-intertidal, minimally weathered subsurface oil (*13*). This represents a decay rate from 1992–2001 of only -0.22 to -0.30 year^{-1} (20 to 26% loss over a year) from the 806,000 kg estimated to be present on PWS beaches in 1992.

Sedimentary refuges inhibited degradation and sequestered persistently toxic oil in the intertidal zone of coarse-grained gravel shores where geomorphologic armoring by boulders and cobbles inhibited disturbance by waves (*12*). Some of this oil was similarly trapped under mussel beds providing an

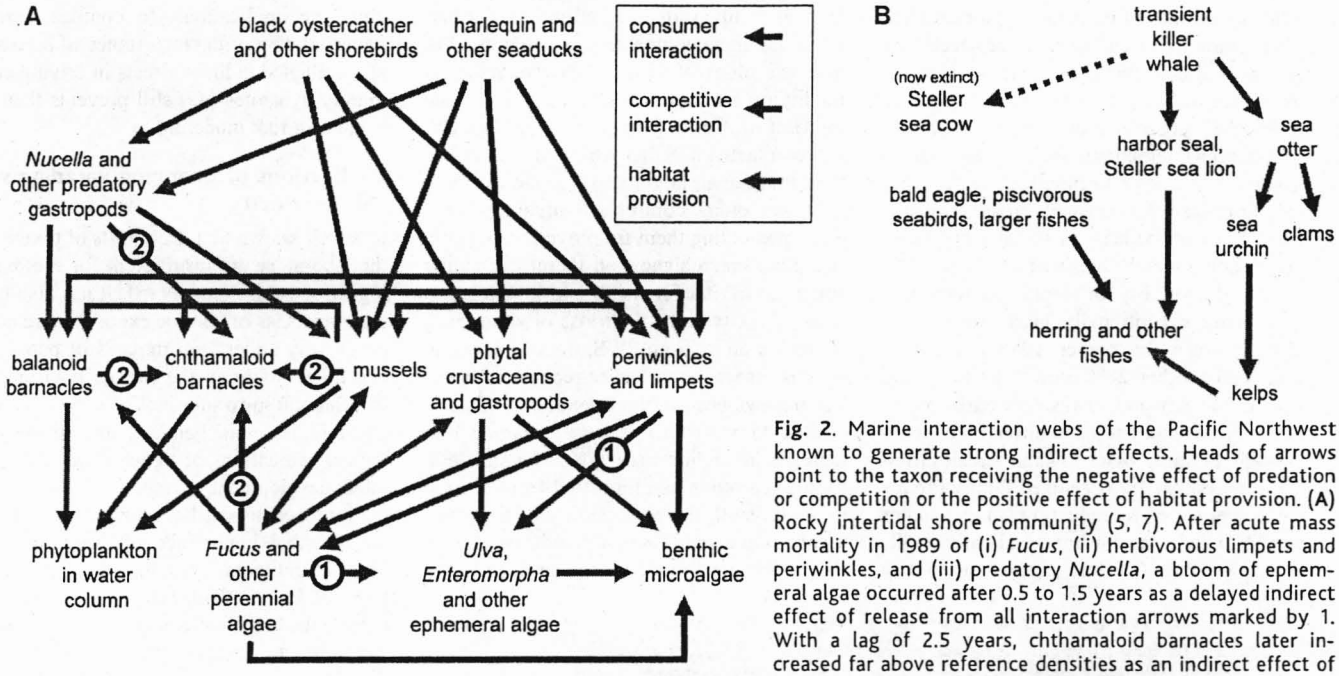

Fig. 2. Marine interaction webs of the Pacific Northwest known to generate strong indirect effects. Heads of arrows point to the taxon receiving the negative effect of predation or competition or the positive effect of habitat provision. (**A**) Rocky intertidal shore community (*5*, *7*). After acute mass mortality in 1989 of (i) *Fucus*, (ii) herbivorous limpets and periwinkles, and (iii) predatory *Nucella*, a bloom of ephemeral algae occurred after 0.5 to 1.5 years as a delayed indirect effect of release from all interaction arrows marked by 1. With a lag of 2.5 years, chthamaloid barnacles later increased far above reference densities as an indirect effect of release from all interaction arrows marked by 2 (*4*, *7*). (**B**) Subtidal kelp forest community (*36*, *41*). Despite acute loss of over 50% of the sea otters at heavily oiled northern Knight Island, there exists only limited evidence of initiation of this potentially strong trophic cascade. Some patches of larger sea urchins have appeared but no explosion of their abundance and no evident overgrazing of kelp have been seen even in the absence of sea otter recovery to date (*22*, *23*).

events indirectly affecting individual survival or reproduction after sublethal exposures. Oil exposure resulted in lower growth rates of salmon fry in 1989 (*8*), which in pink salmon reduce survivorship indirectly through size-dependent predation during the marine phase of their life history (*30*). After chronic exposures as embryos in the laboratory to <20 ppb total PAHs, which stunted their growth, the subsequently marked and released pink salmon fry survived the next 1.5 years at sea at only half the rate of control fish (*21*). In addition, controlled laboratory studies showed reproductive impairment from sublethal exposure through reducing embryo survivorship in eggs of returning adult pink salmon that had previously been exposed in 1993 to weathered oil as embryos and fry (*31*). These definitive experimental demonstrations of compromised survival and reproduction from sublethal dosing conform with a growing understanding of how exposure to xenobiotics at sensitive early stages in vertebrate development can lead to enhanced mortality and reproductive impairment later in life through endocrine disruption and developmental abnormalities (*32*). Abnormal development occurred in herring and salmon after exposure to the Exxon Valdez oil (*14*, *20*).

Support for the inference that sublethal effects of chronic exposure to toxics through ingestion of oil led to population-level impacts on shorebirds comes from studies of the black oystercatcher. In summer 1989, pairs of black oystercatchers with foraging territories on heavily oiled shores showed reduced incidence of breeding and smaller eggs than those that bred elsewhere (*33*). Chick mortality was enhanced in proportion to degree of shoreline oiling in both 1989 and 1990. Subsequent study (*34*) revealed that black oystercatchers indeed consumed oiled mussels and that parents gathering prey on oiled shores in 1991 and 1992 fed chicks more to achieve less growth than on unoiled shores, which implies energetic or developmental costs and reproductive impairment from ingestion of toxics 3 years after the spill. Fledging late or at small size has negative implications for chick survivorship.

Cascades of indirect effects. Indirect effects can be as important as direct trophic interactions in structuring communities (*35*). Cascading indirect effects are delayed in operation because they are mediated through changes in an intermediary. Perhaps the two generally most influential types of indirect interactions are (i) trophic cascades in which predators reduce abundance of their prey, which in turn releases the prey's food species from control (*36*); and (ii) provision of biogenic habitat by organisms that serve as or create important physical structure in the environment (*37*). Current risk assessment models used for projecting biological injury to marine communities ignore indirect effects, treating species populations as independent of one another (*7*, *8*), even in rocky-shore systems, where basic community ecology would indicate otherwise (*38*).

Indirect interactions (Fig. 2A) lengthened the recovery process on rocky shorelines for a decade or more (*7*). Dramatic initial loss of cover by the most important biogenic habitat provider, the rockweed *Fucus gardneri*, triggered a cascade of indirect impacts. Freeing of space on the rocks and the losses of important grazing (limpets and periwinkles) and predatory (whelks) gastropods combined to promote initial blooms of ephemeral green algae in 1989 and 1990 and an opportunistic barnacle, *Chthamalus dalli*, in 1991. Absence of structural algal canopy led to declines in associated invertebrates and inhibited recovery of *Fucus* itself, whose recruits avoid desiccation under the protective cover of the adult plants. Those *Fucus* plants that subsequently settled on tests of *Chthamalus dalli* became dislodged during storms because of the structural instability of the attachment of this opportunistic barnacle. After apparent recovery of *Fucus*, previously oiled shores exhibited another mass rockweed mortality in 1994, a cyclic instability probably caused by simultaneous senility of a single-aged stand (*5*, *39*). The importance of indirect interactions in rocky shore communities is well established (*38*), and the general sequence of succession on rocky intertidal shores extending over a decade after the Exxon Valdez oil spill closely resembles the dynamics after the Torrey Canyon oil spill in the UK (*40*). Expectations of rapid recovery based on short

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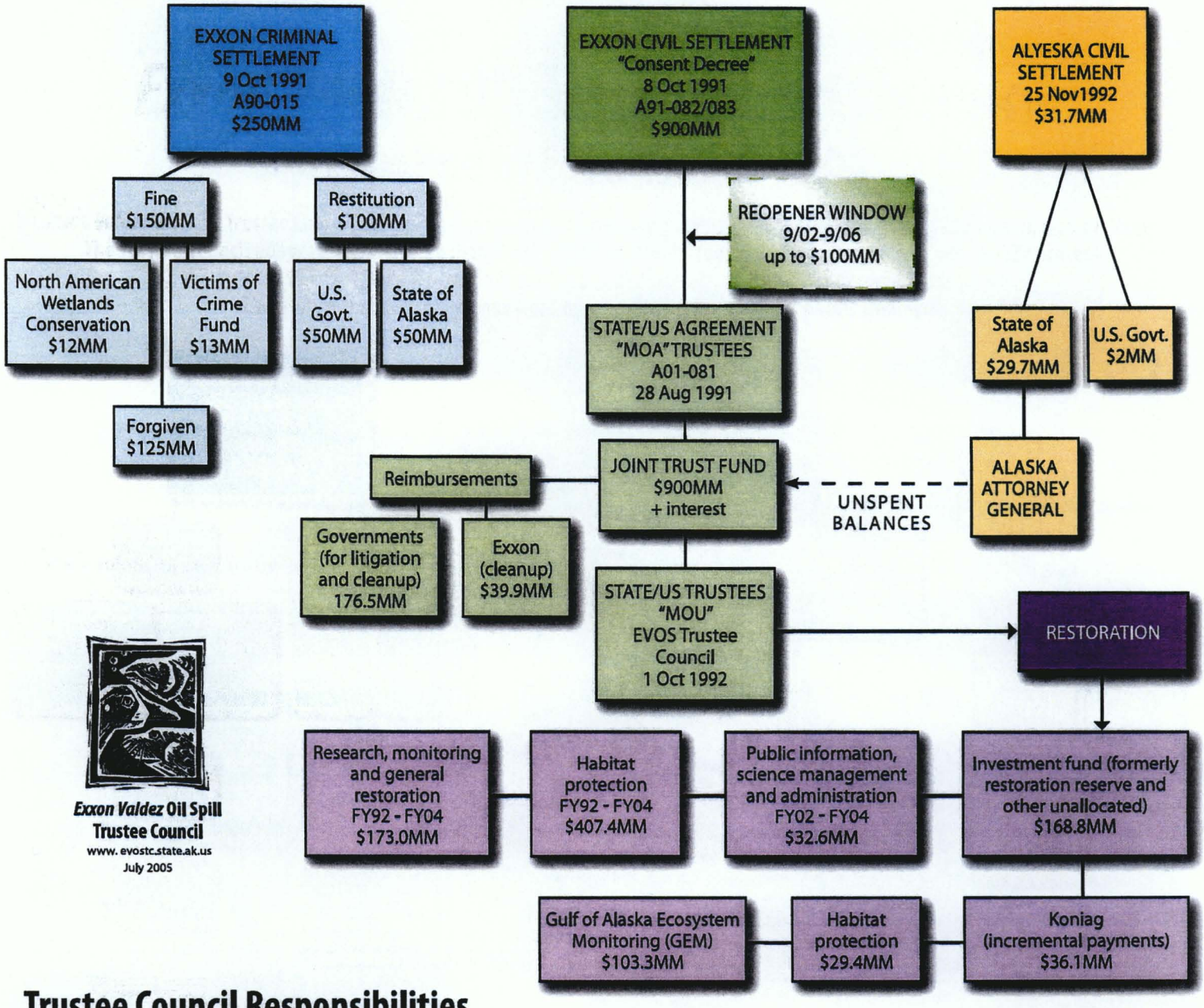
Supporting Online Material

www.sciencemag.org/cgi/content/full/302/5653/2082/DC1
SOM Text
References and Notes

Exxon Valdez Oil Spill and Settlement

Timeline of Events 1991-2004

The *Exxon Valdez* Oil Spill Trustee Council oversees restoration of injured ecosystems through the use of the $900 million civil settlement. The Trustee Council adopted a Restoration Plan for the civil settlement funds in 1994 after an extensive public process. More than 2,000 people participated in public meetings or sent written comments. The uses of the civil settlement were adopted in response to that public comment.



***Exxon Valdez* Oil Spill Trustee Council**
www. evostc.state.ak.us
July 2005

Trustee Council Responsibilities

- ***Manage the use of settlement funds,*** including earnings, as long as they exist.
- ***Provide for meaningful public participation*** and Public Advisory Committee (PAC) involvement.
- ***Track recovery of injured resources and services,*** providing periodic updates to the public.
- ***Manage restoration programs*** for research, monitoring, general restoration and habitat protection.
- ***Synthesize injury, restoration and recovery information*** for injured resources and services.
- ***Use an ecosystem approach to long-term monitoring*** through the Gulf of Alaska Ecosystem Monitoring (GEM) Program.
- ***Provide requested information*** to governments.
- ***Make recommendations*** to U.S. and Alaska governments as to whether Trustee Council should continue to provide oversight for the GEM Program and any remaining trust funds.

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Ed Zeine, Cordova	local government	Ed Zeine, Cordova

Joint Meeting
EVOS Scientific and Technical Advisory Committee (STAC)
NPRB Science Panel
Alaska Ocean Observing System (AOOS)

Thursday, January 15, 2004
Hotel Captain Cook, Foredeck
9 am – noon

Purpose: To brief both NPRB and EVOS science panels on status of Integrated Ocean Observing System (IOOS) and Alaska Ocean Observing System (AOOS) efforts. To seek input from these two bodies as AOOS begins to develop an implementation plan for an integrated ocean observing system for Alaska. To discuss how these three organizations can work collaboratively toward developing a long-term monitoring program for Alaska marine ecosystems.

9:00 am	Introductions Opening remarks Purpose of meeting	Molly McCammon, AOOS
9:15 am	NPRB Overview and Status	Clarence Pautzke, NPRB
9:30 am	GEM Overview and Status	Phil Mundy, EVOS/GEM
9:45 am	IOOS Overview and Status	Molly McCammon, AOOS
10:00 am	Surface Current Monitoring	Dave Musgrave, UAF
10:15 am	Priorities for AOOS National backbone observations Regional observations – Arctic, Bering Sea, Gulf of Alaska Discussion	Two Crow and Molly McCammon
11:00 am	Data standards and integration	Allen Macklin and Bern Megrey
11:15 am	Pilot efforts	Carl Schoch and Two Crow
11:30 am	Follow-up discussion	Molly McCammon

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The purpose of the Prince William Sound Oil Spill Recovery Institute (OSRI) is to:

- Support Research
- Support Educational Projects
- Support Demonstration Projects

All of which are designed to deal with oil spills in Arctic and sub-Arctic marine environments.
Reference: Oil Pollution Act of 1990, Public Law 101-380, Title V, Sec. 5001

Our Goals

Understand

Attain four-dimensional[1] interdisciplinary understanding of PWS to enable detection and prediction of spill-related impacts and subsequent recovery.

[1] Time and 3 dimensional space (x,y,z,t coordinates)

- Design Nowcast/Forecast observation and modeling system, demonstrate its utility, and seek long-term operational funding
- Conduct environmental research
- Profile potential impacts on economy, life-style and well-being of communities and resource users in the PWS

Respond

Enhance the ability of oil spill responders to mitigate impacts of spills in Arctic and sub-Arctic marine environments

- Fill knowledge gaps on behavior of spilled oil
- Fill knowledge gaps on use and effectiveness of specific mitigation techniques
- Identify and evaluate new prevention and response technologies

Inform

Disseminate information and educate the public on the issues of oil spill prevention, response and impacts

- Publish scientific and technical results in open literature
- Brief oil spill responders on OSRI products and assist to include them in operational activities
- Facilitate the exchange of information and ideas
- Provide graduate and undergraduate fellowships and internships

Partner

Partner with other organizations to take advantage of pooled funding, facilities, knowledge and experience

- Collaborate with other partners in achieving a long-term coastal and ocean observing system for Alaska
- Coordinate with the efforts of other related programs, such as GEM and NPRB

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Planning Documents and Annual or Other Requests for Proposal Cycles

- OSRI Science Plan – January 2005 draft posted at web site (Board approval anticipated in February 2005).
- Graduate Research Fellowship Program - Three graduate research fellowships for award 2005. Fellowships may be funded for up to two years for masters or three years for doctoral level research. The award amount for 2005 is $25,000 per year that may be used for tuition and research related expenses. Details and application process is posted at the web site.
- Cold Climate Spill Research Request for Proposals – In partnership with the Coastal Response Research Center (CRRC) and the Cooperative Institute for Coastal and Estuarine Environmental Technology (CICEET), OSRI issued a RFP in August 2004 inviting proposals focused on cold climate spill research. Review of those proposals is currently underway and award of one or multiple projects is expected in March 2005; the awards may total up to $600,000. Plans are to continue the cooperative RFP process in future years; watch for release of the 2005 RFP in late summer.
- FY 2005 Work Plan is posted at the web site with descriptions of funded programs.

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Walter B. Parker, Prince William Sound Science Center Board of Directors, Anchorage, Alaska

Our History

The Prince William Sound (PWS) Oil Spill Recovery Institute (OSRI) was authorized in 1990 by the United States Congress to "*identify and develop the best available techniques for preventing and responding to oil spills in the Arctic and sub-Arctic*" (Title V, Section 5001, Oil Pollution Act of 1990); and, also to "*assess and understand the long range effects of Arctic or sub-Arctic oil spill impacts on the natural resources of Prince William Sound. . . and the environment, the economy and the lifestyle and well-being of the people who are dependent on them.*" OPA90 identifies the PWS Science and Technology Institute (commonly known as the PWS Science Center) in Cordova, Alaska, as administrator and home for OSRI. Since 1997, when amendments instituted a funding mechanism for OSRI, the program has received annual interest earnings from a $22.5 million trust held by the U.S. Treasury.

OSRI solicited its first proposals for grant projects in late 1997. Since 1998, OSRI has awarded an annual average of one million dollars supporting a wide range of projects in the Arctic and sub-Arctic with a primary focus in Prince William Sound. Between 1998 and 2003, OSRI supported development of a Nowcast Forecast system for PWS. Building on the science foundation from both that program and the previous Sound Ecosystem Assessment (funded by the Exxon Valdez Oil Spill Trustee Council in the mid 1990's), today OSRI is partnering with the PWSSC and many others (UAF, NRCS, NOAA, AOOS) to develop an expanded PWS Observing System, part of the national initiative for an integrated ocean observing system. The evolution of the OSRI Nowcast Forecast system into PWSOS will allow better utilization of infrastructure contributed by a host of partner organizations. The role of OSRI in the PWSOS, to fulfill the mandate of understanding the effects of oil spills on Arctic and sub-Arctic environments, will be to maintain the core components of the PWSOS (e.g. met stations, ecological observations, circulation models) until other funding sources are found or until 2010, whichever comes first.

Prince William Sound Science Center

PO Box 705 - Cordova, AK 99574 - (907)424-5800 Fax 424-5820
pwssc@pwssc.gen.ak.us **On the web:** www.pwssc.org

Principal Investigators and Project List *as of Oct. 2004*

Richard Thorne, Ph.D., Senior Scientist & Director, Acoustics Research Program

- **Herring and Pollock Monitoring,** supported by Oil Spill Recovery Institute
- **Zooplankton Monitoring,** supported by Oil Spill Recovery Institute
- **Effects of prey availability and predation risk on the foraging ecology and demography of harbor seals in Prince William Sound: development and test of a dynamic state variable model,** supported by the North Pacific Research Board (in cooperation with ADF&G, Douglas)
- **Steller sea lion winter food limitation research project: The role of Pacific herring as critical winter forage for Steller sea lions,** supported by NOAA (Congressional appropriation)
- **Impacts of Seafood Waste Discharge in Orca Inlet,** supported by the Exxon Valdez Oil Spill Trustee Council

Contact: thorne@pwssc.gen.ak.us phone ext. 226

Mary Anne Bishop, Ph.D., Ecologist

- **Shorebird Conservation at the Copper River Delta,** supported by the National Fish & Wildlife Foundation, Chase Wildlife Foundation and U.S. Fish & Wildlife Service
- **Ecology of Copper River Delta Flats,** supported by Oil Spill Recovery Institute, the Exxon Valdez Oil Spill Trustee Council and NOAA (Congressional appropriation)
- **Estuaries as Essential Fish Habitat for Coho and Sockeye Salmon** supported by the North Pacific Research Board
- **Impacts of Seafood Waste Discharge in Orca Inlet,** supported by the Exxon Valdez Oil Spill Trustee Council
- **Contaminant Pathways on the Copper River Delta,** supported by the Prince William Sound Regional Citizens' Advisory Council **Contact:** mbishop@pwssc.gen.ak.us phone ext. 228

Thomas C. Kline, Jr., Ph.D., Aquatic Ecologist and Dive Officer

- **GLOBEC - A long-term observation program using stable isotope abundance for detecting coastal Gulf of Alaska zooplankton source fluctuations in fishes,** supported by the National Science Foundation
- **Salmon derived nutrients,** supported by the EVOS Trustee Council
- **Stable isotope analysis of halibut,** supported by the International Pacific Halibut Commission

Contact: tkline@pwssc.gen.ak.us phone ext. 233

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- **Observational Oceanography in Prince William Sound,** supported by the Oil Spill Recovery Institute

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Nancy Bird, President **G. Carl Schoch, Ph.D.,** Oceanographer/Marine Ecologist

- **Enhancements to the Prince William Sound Ocean Observing System: Improving real-time data streams and model output,** supported by NOAA (Congressional appropriation)

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Walter Cox, M.S., Program Manager

- **2004 Prince William Sound Lagrangian Field Experiment,** supported by the Oil Spill Recovery Institute and NOAA (Congressional appropriation) **Contact:** cox@pwssc.gen.ak.us phone ext. 236

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From the Forest to the Sea summer camp, Discovery Room, high school, and Outreach Discovery programs
Allen Marquette allen@pwssc.gen.ak.us phone ext. 237
Discovery Room, Community Education, high school and Outreach Discovery programs
These programs are supported by Oil Spill Recovery Institute, ConocoPhillips, Coastal Impact Assistance Program & small grants.

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Nancy Bird, President, PWS Science Center & Director, Oil Spill Recovery Institute bird@pwssc.gen.ak.us ext. 225
Penelope Oswalt, Director of Finance penya5@pwssc.gen.ak.us ext. 224
G. Carl Schoch, Ph.D., Science Director, Oil Spill Recovery Institute cschoch@pwssc.gen.ak.us ext. 234

Science of the Sound Education Programs

Science of the Sound is an award-winning education partnership program organized by the PWS Science Center and the Cordova Ranger District of the U.S. Forest Service.

- **The Discovery Room** has been the mainstay of the Science of the Sound for more than 14 years. During the school year, every Cordova student in Kindergarten through sixth grade visits the "Disco" Room once a month to explore a new theme such as the northern lights, garbage, glaciers, plants or shorebirds. Hands-on learning experiences reinforce the lessons.

- **Outreach Discovery** involves travel by educators to take several of the Discovery Room's monthly theme topics to children in more remote parts of Prince William Sound.

Students enjoy their monthly visits to the Discovery Room.

- **Community Programs** include field trips, lectures and citizen science projects for adults and families. These are offered on a weekly basis throughout the school year and on a periodic basis during the summer months.

- **From the Forest to the Sea** is an environmental science residential summer camp offered during 5-7 sessions for children aged 7-15 years. Campers explore the "living laboratory" of Prince William Sound and the Copper River Delta, a combination of marine, river delta and forest ecosystems.

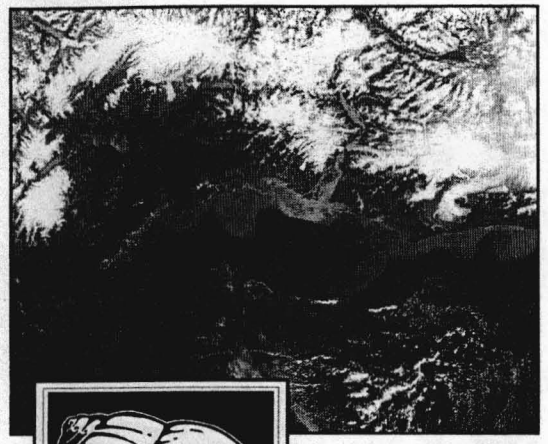
PRINCE WILLIAM SOUND SCIENCE CENTER CORDOVA, ALASKA

Prince William Sound Science Center

Mail: P.O. Box 705
Physical address: 300 Breakwater Ave.
Cordova, AK 99574

Phone: 907-424-5800
Fax: 907-424-5820
Email: pwssc@pwssc.gen.ak.us

Visit our web site for more details about our research and education programs.
www.pwssc.org

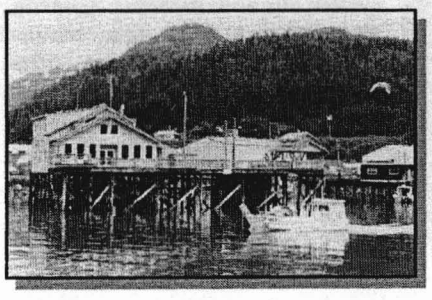


Satellite image of Prince William Sound, the Copper River and the Gulf of Alaska, courtesy NASA

PRINCE WILLIAM SOUND SCIENCE CENTER CORDOVA, ALASKA

Mission

- Contribute to the comprehensive description, sustained monitoring and ecological understanding of Prince William Sound, the Copper River and Gulf of Alaska;
- Promote long-term, self-regulating biodiversity, productivity and sustainable use of renewable resources;
- Educate and inform the youth and general public about the critical interdependence of the biology and regional economies of Alaska.



Improving our abilities to predict changes in the ecosystem

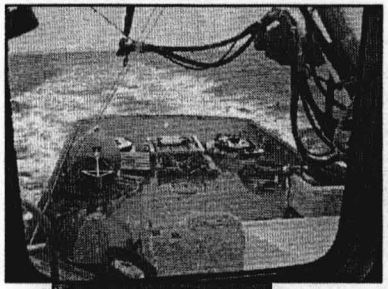
The Prince William Sound Science Center was founded in 1989 to facilitate and conduct research that will increase our understanding of the ecosystems in both Prince William Sound and the Copper River Delta. The Center is committed to implementing ecosystem-based research programs emphasizing the long-term health and sustainability of resources upon which local residents depend.

Current programs include oceanographic observations, fish and plankton population assessments, food web analysis using stable isotopes, Steller sea lion observations and, on the Copper River Delta, investigations of the intertidal, shorebird and fish ecology.

Dr. Thomas Kline and Cordova high school students examine plankton collected in a sample taken from the Science Center's deck.

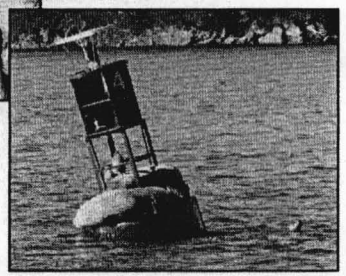
The Science Center is also working with stakeholders in the region to build a regional ocean observing system. Part of an evolving national program, this system currently includes real-time meteorological data, ocean observations and ocean and atmospheric models. Future plans include incorporation of biological data into this system with broad data distribution to the public through the Internet.

Sampling of research project photos



Deployment preparations for a series of acoustic Doppler current profiler moorings in Hinchinbrook Entrance and Montague Strait, PWS.

For more than a decade, PWSSC staff have conducted annual hydroacoustic surveys of Pacific herring and Pollock, as well as their zooplankton food sources.



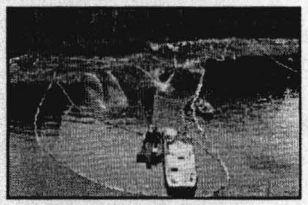
Investigations of the critical winter food resources for Steller sea lions are currently underway.

Critical habitat and food resources needed by migrating shorebirds like the Western sandpiper are the focus of a three-year study by PWSSC researchers in collaboration with the U.S. Fish and Wildlife Service.

Learning from Mistakes

Since the 1989 *Exxon Valdez* oil spill, many improvements to the oil spill prevention and response system have occurred. The PWS Science Center is the administrator for a federally-funded research and education grant program focused on oil spills in the Arctic and sub-Arctic marine environments. The Oil Spill Recovery Institute (OSRI) is housed at the Science Center and awards approximately $1 million each year for research and education projects. OSRI's programs are directed by a 16-member Advisory Board composed of federal and state representatives, industry and public representatives.

For further details on OSRI programs, visit www.pws-osri.org or pwssc.org



1989 beach clean-up from the Exxon Valdez oil spill

Examples of some OSRI-funded projects:

Prince William Sound Ocean Observing System

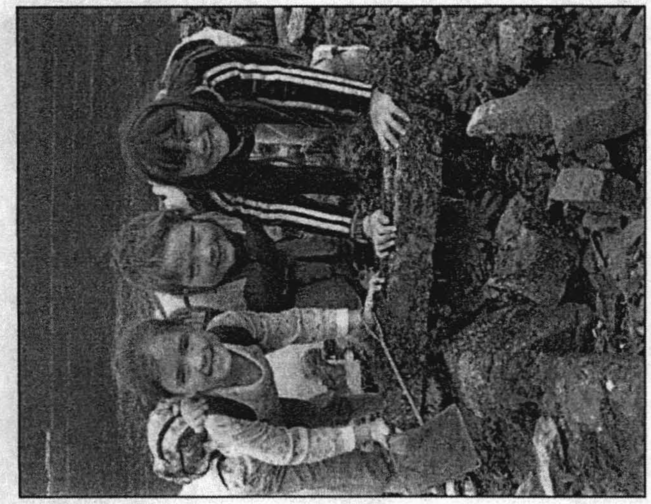
Oil spill contingency and response model (OSCAR)

Post doctoral fellowships in wildlife research, oceanographic modeling and anthropology of climate change

International Oil and Ice Workshop and follow-up Oil and Ice Workshop and publications

Local science curriculum and scholarship support

"When one tugs at a single thing in nature, he finds it attached to the rest of the world."
- John Muir



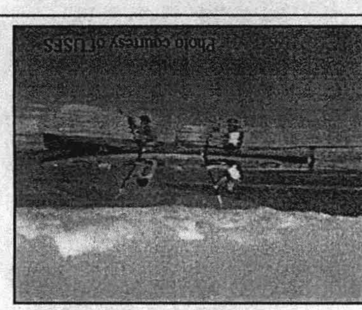
From the Forest to the Sea

It's all connected

2005 Summer Environmental
Science Camp
Cordova, AK

Run in partnership by the Prince William Sound Science Center and the USDA Forest Service/ Cordova Ranger District.

Prince William Sound Science Center
PO Box 705
Cordova, AK 99574
Phone: (907)424-5800
Fax:(907)424-5820



2005 Camp Sponsors:

ConocoPhillips

Alaska Natural History Association

Prince William Sound Oil Spill Recovery Institute

Look us up on the web at
http://www.pwssc.gen.ak.us/pwssc/educ/camp/camp.htm

Summer 2005 Camp Dates

SESSION	DATE	AGES	COST
Science Day Camp	June 20-24	7-14	$150
Science Camp I	June 27-July 1	11-13	$325
Mini Camp	July 6-7	8-9	$50
Family Kayaking	July 9	All ages!	TBA
Youth Leadership*	July 18-22	15-18	$325
Science Camp II	July 25-29	10-12	$325
Science Camp III	August 1-4	9-11	$225
Science Camp IV	August 8-12	12-14	$325
Family Canoe Day	August 20	All ages!	TBA

*Denotes NEW programs! Check out the website or contact Kate at the Science Center for more information.

Registration Form

Preferred Camp Session__________ Second Choice?________

Camper's name:______________________Age:_____Sex: ____

Parent/guardian's name:________________________________

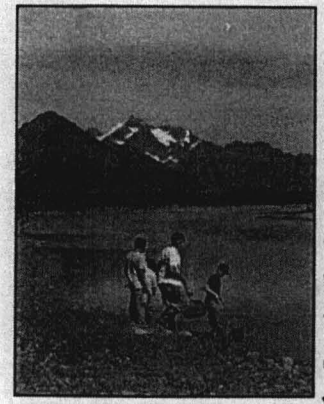
Address:____

Home Phone:______________ Work Phone:_______________

E-mail address:_______________________________________

Amount enclosed:________ To pay with a credit card, contact Shelley at (907)424-5800 ext. 223

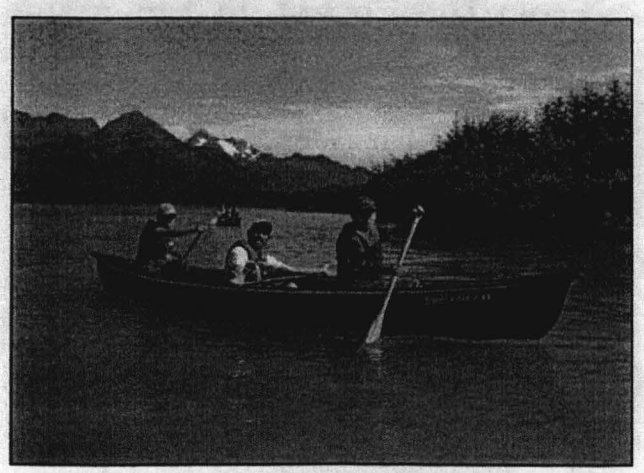
▫ My child is unable to attend science camp this summer, but please accept my tax-deductible donation of ______ to the Carol Treadwell Scholarship Fund.



From the Forest to the Sea

Environmental Science Camp is an opportunity for campers to experience the natural wonders that surround them in an exciting and educational way. During your stay at camp, we'll hike through the rainforest, observe glaciers up close, canoe through the wetlands, and kayak through the tide pools and ocean. From the forest to the sea...it's all connected.

At camp you'll meet kids from all over Alaska and the lower 48. In addition to our daily adventures, evenings are filled with campfires, s'mores, survival skills, orienteering, games and stories.



We are dedicated to teaching youth about the intricate world around them through ecological principles, while sharing respect for the land and using resources wisely.

Camp Staff

Camp instructors include educators and scientists from the US Forest Service and the PWS Science Center. With a ratio of 4:1, each camper is sure to get highly personalized, caring instruction.

All staff members are college graduates with training in (at a minimum) CPR, First-aid, gun safety training, and education and interpretation techniques.)

Photo courtesy of USFS

Accommodations

Campers stay at our semi-permanent base camp located near mile 25 on the Copper River Highway. There are two weather ports with wooden floors and cots for sleeping, a cook tent, and a yurt for eating and "indoor" activities. Space is limited to 12* campers so sign up soon!

*Day camp program is open to 24 participants

Camp Fee details:

A $100 deposit ($50 for mini camp) is required to reserve your spot at camp. The balance is due before your session of camp begins. Scholarships are available through the Carol Treadwell Scholarship Fund. In 2005, one full scholarship and 7 partial scholarships of up to $100 will be awarded. See our website or contact Kate for more details. Applications for scholarships are due May 14,2005.

What does camp include?

- Overnights at our base camp near mile 25 on the Copper River Delta, and all daily adventures.
- All meals and snacks while camp is in session.
- Transportation during camp.
- Airport/ferry pick-up and drop-off.

How do I sign up?

Contact Kate at the PWS Science Center to check for openings and reserve your space.
Then complete the registration form on reverse side and detach and mail with your deposit to:
Kate Alexander, PWSSC
PO Box 705
Cordova, AK 99574

Registration forms can also be printed from our website at:
http://www.pwssc.gen.ak.us/pwssc/educ/camp/camp.htm

Questions? Contact Kate at the PWSSC:
Phone:(907)424-5800 ext. 231
Email:kate@pwssc.gen.ak.us

Investing in Science For the Future of Prince William Sound

Prince William Sound
Science Center

An overview
of programs:
1989 - 2003

PRINCE WILLIAM SOUND
SCIENCE CENTER
CORDOVA, ALASKA

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The Growing Network of Regional Science Centers in Alaska

by Mead Treadwell

If you travel the coast of the Lower '48 you'll find marine research institutions based from Maine to the Gulf of Mexico and from southern California to the northern coast of Washington. The names Woods Hole, Scripps, Duke Marine Lab, and Monterey Bay Aquarium Research Institute come to mind, to name just a few of these renowned institutions. Alaska has more coastline than the rest of the nation combined, yet not long ago much of the knowledge of Alaska's coastal resources was based on the reports of "expedition scientists" -visitors who seldom lived where they studied.

Only in the last two decades has this lack of consistent research on Alaska's coastline changed. The state can now boast a growing network of regional science centers. This "string of pearls" was stimulated in part by the Exxon Valdez disaster, in part by the development and modernization of Alaska's offshore fisheries, and in part by the guiding hand of community activists and a supportive Congressional delegation.

These new science centers have fostered results: stronger understanding of regional ecosystems; better management of specific fish stocks; permanent monitoring of resources; and greater predictive capacity. Perhaps even more important than these advances is the greater interaction between those who use our common resources and those who study them. Traditional ecological knowledge provided by resource users can be valuable to the scientific process, and is incorporated more often as interaction improves.

Now, travelers in Alaska can find permanent research centers along the many miles of coastline, including Juneau's Auke Bay Lab, Cordova's Prince William Sound Science Center, Seward's Institute of Marine Science and the Alaska Sea Life Center, Homer's Center for Alaskan Coastal Studies, the Kachemak Bay Research Reserve, Kodiak's Fisheries Technology Center, and Barrow's rejuvenation of the ancient Naval Research Lab, now known as the Barrow Arctic Science Consortium (BASC). Plans are in the works for permanent coastal science facilities in several other communities, including Little Diomede Island in the Bering Sea.

Because of these facilities, scientific talent has moved to rural Alaska communities. Most centers have strong educational programs that open the doors for young Alaskans to better understand Alaska's natural resources, and to the possibilities of careers in science. Many young Alaskans will take part in a new monitoring network called the Alaska Ocean Observing System (AOOS), formerly the Coastal Alaska Observing System. The AOOS will provide valuable meteorological, oceanographic, and biological information, often in real time.

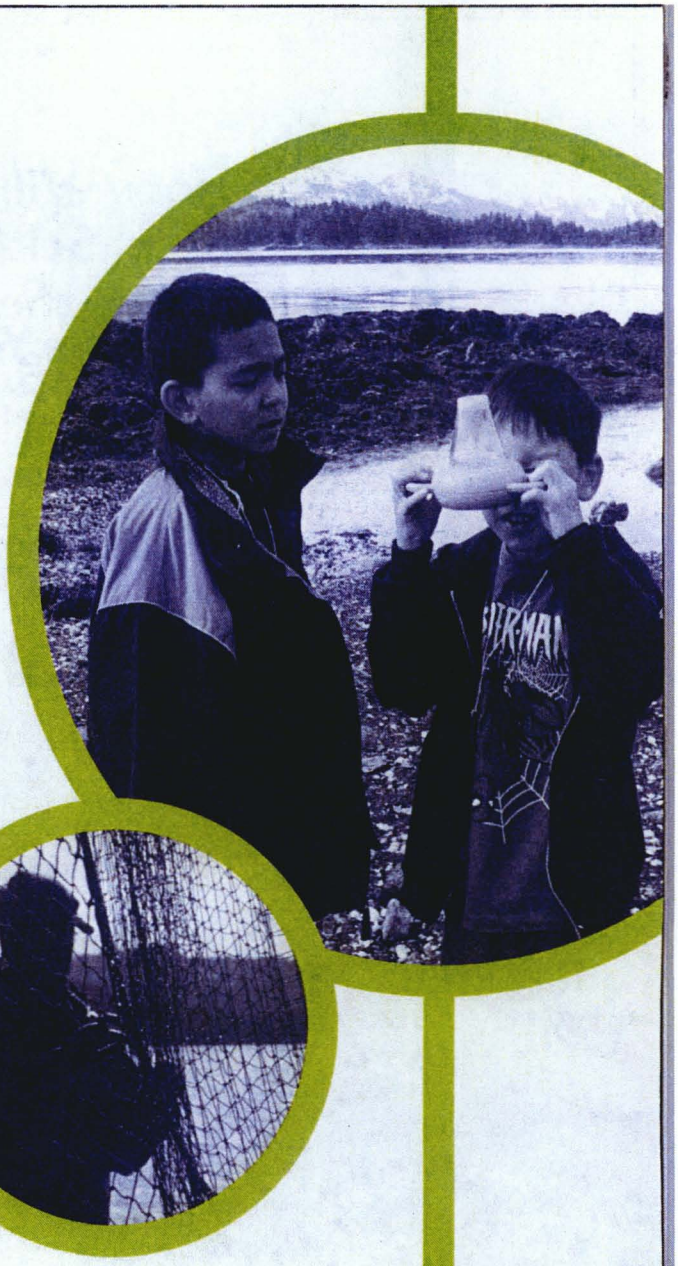
Both government and private bodies recognize the importance of investing in Alaska. The National Science Foundation (NSF) estimates more than $250 million is spent on scientific research and development annually. New funding mechanisms help drive this investment, including the $160 million North Pacific Research Board endowment, the $120 million Exxon Valdez-endowed Gulf Ecosystem Monitoring (GEM) monies, and the $22.5 million Prince William Sound Oil Spill Recovery Institute (OSRI), part of Cordova's Science Center. Major investments, notably in Seward, Juneau, Kodiak, and Barrow, will provide a sound financial platform for some time. Congress provided for a new icebreaking research vessel, the Coast Guard's Healy, to support research at both Poles. The University of Alaska plans to invest in a replacement for its offshore research vessel, the Alpha Helix.

Science may be a key industry in Alaska, but it also helps maintain the state's other major industries. For example, in recent years Steller sea lion populations have dropped dramatically. The cause of this drop is currently unknown, but the situation could threaten the state's $1 billion plus groundfish harvest. Several research approaches taken by different scientists could provide the answers – both for the sea lions and for the fishery. Oil spill

prevention and response research helps keep another major economic driver, petroleum, operating safely. Climate research helps communities predict changes that will affect all, from new coastline erosion to changes in the ocean's currents which could affect fisheries. The Alaska State Legislature, recognizing the value of this research, called in 2001 for a more robust Alaska ocean monitoring system.

Our improved and expanded scientific research, continuing analysis to develop predictive capacity, and better ties to resource management agencies, all backed by committed, long-term funding can help guarantee that Alaskans will have biodiversity and abundance on their coastlines for generations to come.

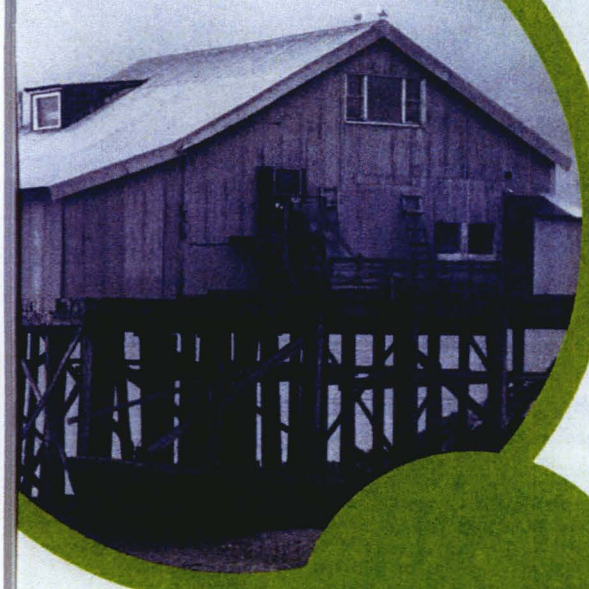
Mead Treadwell is CEO of Venture Ad Astra (Anchorage) and currently serves as a Commissioner on the U.S. Arctic Research Commission. Former Director of the Cordova Oil Spill Response Office and a Deputy Commissioner, Alaska Dept. of Environmental Conservation, Treadwell served on the PWSSC Board of Directors in 1989 and 1990, and again from 1994 until 2003. He was also a member of the OSRI Advisory Board in both the early 1990's and from 1997 to 2000.



Prince William Sound Science Center, the Formative Years

by RJ Kopchak

Prior to 1989, conversations in Prince William Sound between fishermen, resource managers, researchers, community members and the University of Alaska Marine Advisory Program often referred to frustration over the lack of local capacity to house and retain research. Teams of scientists often descended on the area to poke, peek, and ponder, but typically left without sharing what they had learned.



PWSSC Building 1989

Starting in late 1987, Rick Steiner, marine advisory agent at the Cordova Alaska Sea Grant office, sponsored an "almost every Wednesday" bag lunch as a forum to brainstorm strategies for starting a research center. James Brady of the Department of Fish and Game, Riki Ott, fisherman and marine toxicologist, Ken Hill, fisherman and veterinarian, Chuck Monnett and Lisa Rotterman, sea otter research biologists, Kate Wynne, marine mammal biologist, Bruce Suzumoto of Prince William Sound Aquaculture Corporation, City Manager Don Moore, fisherman and city council member RJ Kopchak, and others met over the next year. During the same time, the U.S. Forest Service contemplated starting a "Copper River Delta Institute" to focus research on the river delta system. Steiner and Kopchak drafted a business plan for a research support station based on these early talks.

The geographical area of interest was "the drainages of Prince William Sound and the Copper River, and the associated waters between Cape Suckling and Cape Cleare." This included well over 2,700 miles of coastline, a million acres of wetlands, and a thousand miles of river, adding up to almost 30 million acres of land and water. This area was interdependent, surrounded by the tallest coastal mountain range in the world, including two giant bowls of biodiversity that converged at the fishing village of Cordova.

The Prince William Sound Science Center (PWSSC) was originally envisioned as a membership institute, modeled after the Organization for Tropical Studies, with various universities paying for the use of facilities and support services. This would allow the local center to capture data generated by ongoing and proposed research, and to provide access to and interpretation of that information to regional resource users.

Establishment of the center was accelerated in late March of 1989 when the oil tanker Exxon Valdez went aground. Paperwork for the institute was in "rough draft" form. Within days, the articles of incorporation were filed and an abandoned icehouse secured to accommodate the institute. Over the next few months the City of Cordova loaned the fledgling research facility $100,000 for start up costs. Chuck Monnett, Ph.D. joined Kopchak, Suzumoto, Ott, and Moore on the board of founding directors. At the same time Kopchak, working with the City of Cordova, established the Oil Spill Response Office to coordinate community efforts. The city then hired Mead Treadwell to head up the local oil spill response action. Treadwell would play a major role both in developing the city's spill response strategies and in creating the Oil Spill Recovery Institute (OSRI).

By May of 1989, Penny Oswalt and biologist Mimi Oliver were on staff at the new science center, soon followed by Nancy Bird. Fundraising, building renovation, and support for science planning filled their days and nights. Kopchak became the paid president for several months after a grant was received from Conservation International. Governor Steve Cowper offered state support through a $250,000 building renovation grant; years later he also served briefly on the OSRI Advisory Board. Spencer Beebe of Ecotrust, an early PWSSC mentor, joined the Science Center board and provided introductions to private foundations and encouragement that resulted in several early grant awards. Treadwell, Rotterman, and Steiner, along with Pete Mickelson, Ph.D. ornithologist, joined the board of PWSSC later in the summer of 1989.

By July of 1989, John P. Harville, Ph.D. had joined the effort as mentor and Founding

Director. Dr. Harville had recently retired as Executive Director of the Pacific States Marine Fisheries Commission, and had been founding director of both the Moss Landing Marine Laboratories on Monterey Bay, and the National Coastal Resources Research and Development Institute at Newport, Oregon. While Harville worked on institutional relationships and science plans, other board members worked on ways to raise funds to keep the fledgling center growing and effective. Treadwell believed that long term institutional funding was possible through federal legislation. He drafted language for the Oil Spill Recovery Institute, which Senator Ted Stevens included in the Oil Pollution Act of 1990.

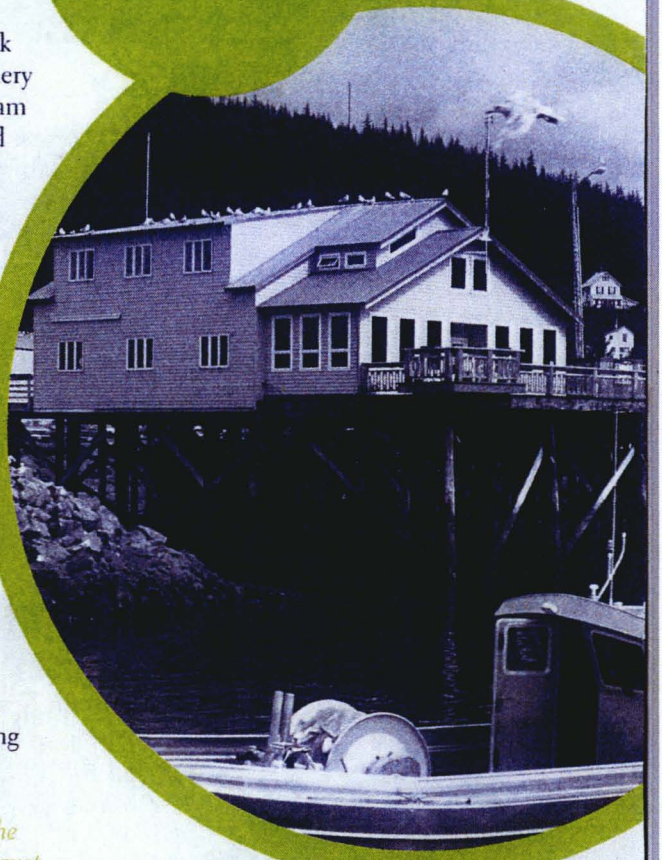
It was challenging to obtain research grants in the early years, and equally difficult to establish scientific credibility without the research grants. In 1990, Monnett and Rotterman moved their U.S. Fish and Wildlife Service research grant for surveys of sea otters to the Science Center. That work, combined with several private foundation awards supporting research planning workshops comprised the Center's initial programs.

In March of 1990, Harville served as moderator for a regional research planning conference. Over 115 invited participants representing researchers, resource managers, commercial fishing interests, and agencies identified and prioritized research topics. The highest priority was given to monitoring, modeling and mitigating the long-term impacts of the Exxon Valdez oil spill. A regional science planning team evolved. Known as "Prince William Sound Fisheries Ecosystem Research Planning Group" (PWSFERPG), the team developed an approach that would evolve into the "SEA" program, the Sound Ecosystem Assessment. Commercial fishing interests were finally well-represented within this planning team of researchers, educators and officials. PWSSC was in the center of these regional efforts, and has remained an active leader since.

In October of 1990, Gary Thomas, Ph.D. was named Science Center President. July of 1991 saw the publication of Prince William Sound, Copper River, and North Gulf of Alaska Ecosystem. Conceived by Spencer Beebe of Ecotrust, and sponsored by PWSSC, Conservation International, and the U.S. Forest Service Copper River Delta Institute, this study and series of photos and maps initiated the effort to look at the entire region as an interconnected system. The document was the first step in laying out a data-rich, spatially explicit landscape approach to understanding the complexities of the region.

The Board and staff of the Science Center continued to work towards an "ecosystem approach" to research, but funding and support merely trickled in. Finally, after two years of pink salmon and herring fishery failures in Prince William Sound, fishermen and women lined up their boats to block the entrance to the Port Valdez oil terminal, expressing their frustration at the lack of effort and funds expended to research the oil spill's continued affect on the region. Soon after, the Exxon Valdez Oil Spill (EVOS) Trustee Council backed research that would consider the impact of the spill using an ecosystem approach.

PWSSC
Building 2004



RJ Kopchak maintains the Cordova office for Ecotrust (www.ecotrust.org/fisheries/copper.html). A commercial fisherman, Kopchak was the founding President of the Prince William Sound Science Center. He currently serves on the OSRI Advisory Board.

Nancy Bird,
President, Prince William Sound Science Center, 2003 - present

by Meera Kohler

Nancy Bird was appointed President of the Prince William Sound Science Center in June of 2003, after serving as Chief Executive Officer and Acting President from the time of Dr. Gary Thomas' departure in October 2002. One of the first staff members at the Center, Nancy initially served as Public Affairs and Administrative Coordinator from 1989 to 1994 and then as Vice President from 1994 to 2002. She concurrently serves as the Oil Spill Recovery Institute's Director.

Nancy Bird's history in Cordova is long and varied, but with a common thread of extensive community involvement and participation in Cordova's high priority issues. Nancy arrived in Cordova in 1976 after receiving her Bachelor of Arts degree in History from Carleton College in Minnesota. She worked first for Eyak Youth Services Center and later for the Cordova School District, Cordova District Fishermen United and the Cordova Museum. For eight years she taught courses in the histories of Alaska, Prince William Sound, Modern India, the Middle East, and the Alaska Legislature at Prince William Sound Community College. She was Editor of the Cordova Times twice during the 1980's and was published in the Alaska Fisherman's Journal, Alaska Magazine, Fairbanks Daily News-Miner, and the Valdez Vanguard.

Always active in various community organizations, she served for many years on the Cordova Historical Society's Board of Directors. She is currently serving in her third term on the Cordova City Council, and was Vice-Mayor for the City of Cordova in 2002 and 2003.

Nancy Bird's continued dedication to the Prince William Sound Science Center is apparent in her vision for its future. She sees a community-based research and education center with strong scientific credibility that promotes cost-effective, leading-edge measurement and modeling technologies. Her skill in promoting multi-disciplinary teams of researchers that work in partnership with other institutions is evident in new projects developing with the Gulf Ecosystem Monitoring program, the North Pacific Research Board, and the University of Alaska, Fairbanks. Nancy's ability to recruit and retain skilled researchers is the foundation for the Center's future successes.

It is impossible to measure the value of Nancy's involvement in the Center since its inception in 1989. In addition to continuity, she brings clarity and focus to the Center's future. She will not only seek out and listen to concerns and opinions from local residents, she believes they are essential to the objective application of scientific knowledge that will protect ecosystem integrity while providing for sustained use of ecosystem resources.

Meera Kohler is the President and CEO of the Alaska Village Electric Cooperative, Anchorage. Kohler has been the Chair of the PWSSC Board of Directors since 2002. A former Cordova city council member, Kohler resided in Cordova in the 1970s and 80s.

A Short History of Gary Thomas, Ph.D.

by Walter Parker

Dr. Gary Thomas served as Prince William Sound Science Center President from 1990-2002. In addition to leading the Science Center, Thomas also directed the Oil Spill Recovery Institute (OSRI) from its formation in 1992-2002.

Thomas came to Cordova from Seattle where he was on the faculty at the University of Washington's renowned School of Fiisheries and the Fisheries Research Institute. Throughout his tenure at the Science Center, Thomas strongly promoted the coordination of marine ecosystem assessments and fisheries management. In his early years at the Center, he helped organize the Sound Ecosystem Assessment (SEA) research program and, after support for that program declined, he instigated the design and implementation of the Prince William Sound Nowcast/Forecast (PWS N/F) system which developed a groundbreaking model for Prince William Sound and its adjacent waters. PWS N/F brought together oceanographic and atmospheric information into a near real-time model with numerous practical applications. The goal of Nowcast/Forecast is to have a model that fisheries managers, oil spill response managers, and scientists can use to read a complete pattern of existing conditions, and make forecasts based upon the most complete ecosystem model thus far developed for a region.

Dr. Thomas's greatest strength while directing the PWSSC and OSRI was his ability to recruit great research teams and provide the stimuli to accomplish the major goals he set for those teams. His work, and that of his recruited research teams, has been recognized in many national and international publications. In his 12 years at the PWSSC and OSRI, Thomas demonstrated to the world what regionally based science centers can accomplish, even with modest funding. In recognition of his work, the University of Miami offered him the post of Director for the Center for Sustainable Fisheries at the Rosenstiel School of Amospheric and Marine Science. He accepted the position in the fall of 2002 and is now working to replicate the Prince William Sound effort in many regions throughout the world.

Walter Parker has served on both the PWSSC Board and OSRI Advisory Board. He was Chair of the PWSSC Board for three years and continues to serve on the Executive Committee. Parker was Alaska Commissioner of Highways and Anchorage municipal assemblyman during the 1970's. In 1989, he was appointed Chair of the Alaska Oil Spill Commission by Governor Steve Cowper.

Prince William Sound Ocean Observing System

By G. Carl Schoch, Ph.D.

Alaska's Prince William Sound includes an intricate network of maritime glaciers, rain forests, offshore islands, and ocean. The Sound has about 4900 km of shoreline, is surrounded by the Chugach National Forest, and contains the most extensive system of tidewater glaciers descending from the highest coastal mountain range in North America. The Trans Alaska Pipeline terminates at the Port of Valdez, making the pristine environment of the Sound highly vulnerable to oil spills, as evidenced by the 1989 Exxon Valdez spill. The Oil Spill Recovery Institute (OSRI) and its partner organizations conduct research in Prince William Sound to enable detection and prediction of oil-spill related impacts and subsequent recovery. This mission led to the development of the Nowcast-Forecast modeling effort that consists of an atmospheric circulation model coupled to an ocean circulation model. In the event of an oil spill, NOAA scientific staff advise the U.S. Coast Guard (USCG) on probable spill trajectories based on modeled scenarios using available data on winds and currents. This information is used to decide among various techniques for oil-spill remediation, including deployment of diversion booms to protect sensitive habitats, mechanical removal, ignition of the spill, or application of chemical dispersants. OSRI's investment in the real-time model outputs of the Nowcast-Forecast Program are intended to inform the USCG and NOAA on prevailing atmospheric and oceanic circulation patterns so that more accurate trajectories can be predicted. This approach improves the assessment of risks versus costs, a key element in identifying the best oil-spill prevention and response technologies.

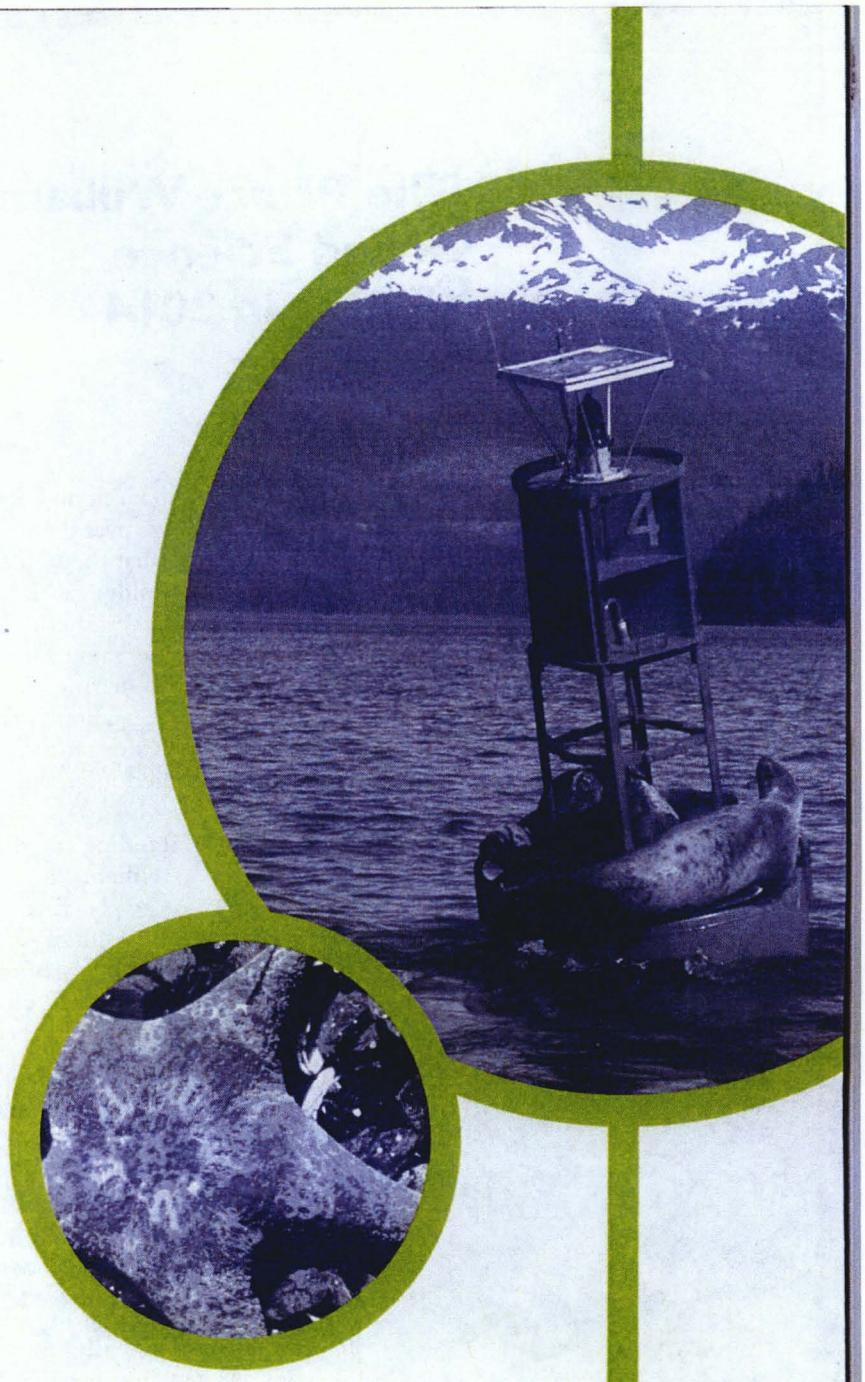
An extension of the Nowcast-Forecast modeling program has potential utility in fisheries oceanography and in gaining a better understanding of the PWS ecosystem. Therefore, the modeling program is evolving to take better advantage of real-time data streams from recently deployed meteorological sensor arrays and an enhanced observational oceanography program consisting of permanent moored buoys and seasonal hydrographic transects. This evolution of the program coupled with recent national initiatives to develop an integrated ocean observing system, is leading to the development of the Prince William Sound Ocean Observing System (PWSOOS). The goals of the national effort include improvements of 1) the safety and efficiency of marine operations, 2) predictions of climate change, 3) national security, and 4) to more effectively protect and restore healthy coastal marine ecosystems. While some government agencies already provide some of this information, regional ocean observing systems like PWSOOS can identify and work to fill observation and information gaps, and also supply tailored products to meet the needs of scientists, educators, industry, resource managers, search and rescue, and security agencies. For example, Prince William Sound and the Port of Valdez are considered by the USCG as high risks from a national security perspective. While the possibility of another accidental oil spill has been contemplated since the Exxon Valdez spill in 1989, only recently has the prospect of an intentional act of sabotage become significant. This demonstrates the need for being able to adapt real time data streams in unforeseen ways. This also requires that new instrument arrays and models be developed.

Future infrastructure expansion plans for PWSOOS consist of improving the consistency and data quality for the existing array of meteorological sensors, deploying precipitation gauges in the surrounding watersheds, redeploying a stream discharge on the Copper River, deploying real time water quality sensors at harbors in the communities of Whittier, Valdez, Tatitlek, Cordova, and Chenega Bay, and developing a synoptic wave model to predict wave heights, nearshore currents, and wave-induced turbulence. In 2004, a major program will begin to better understand the mechanisms and exchange rates of waters between the Gulf of Alaska and the Sound using fixed moorings and surface current mappers (CODAR) near Hinchinbrook Entrance and Montague Strait. Understanding the circulation and the patterns of water exchange will provide a solid scientific foundation for addressing fisheries and ecosystem management needs related to long term oceanic and climatic variability.

Long term funding to sustain key atmospheric and oceanographic components of PWSOOS will initially be provided by OSRI, but the PWSOOS is being designed to fully utilize the infrastructure contributed by a host of partner organizations including

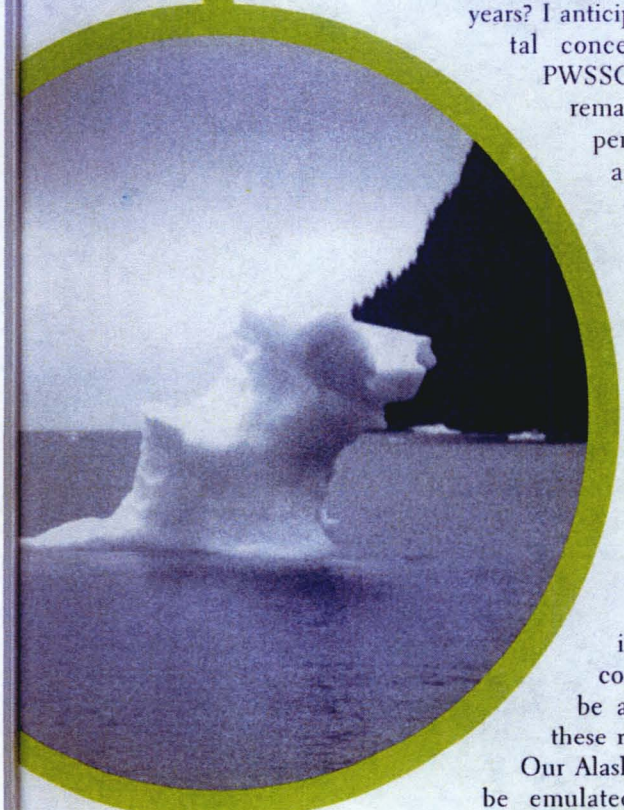
the Prince William Sound Regional Citizens Advisory Council, the National Data Buoy Center, the Natural Resources Conservation Service, the University of Alaska at Fairbanks, Anchorage, and Juneau, the U.S. Forest Service, the U.S. Coast Guard, and the Exxon Valdez Oil Spill Trustee Council. A steering committee will provide a forum for coordination within this consortium, and specialized sub-committees will provide technical oversight for both science and education components. This effort to coordinate local resources for the common goal of leveraging funds specifically to better understand the PWS ecosystem has captured the attention of the regional Alaska Ocean Observing System. AOOS has recently adopted the PWS effort as a pilot project for the development of a data management model to serve future Alaska nodes in Southeast Alaska, Lower Cook Inlet, the Bering Sea, and the Arctic Ocean.

Carl Schoch, Ph.D. is Science Director for the Oil Spill Recovery Institute. He is also a member of the Alaska Ocean Observing System's data management committee and is assisting AOOS in developing plans for the regional observing systems in Prince William Sound and Cook Inlet.



The Prince William Sound Science Center in 2014

by Charles P. Meacham



How will the Prince William Sound Science Center (PWSSC) change over the next ten years? I anticipate that the fundamental concept under which the PWSSC was established will remain the same: an independent marine research and educational facility dedicated to the sustained monitoring and ecological understanding of Prince William Sound, the Copper River, and the Gulf of Alaska.

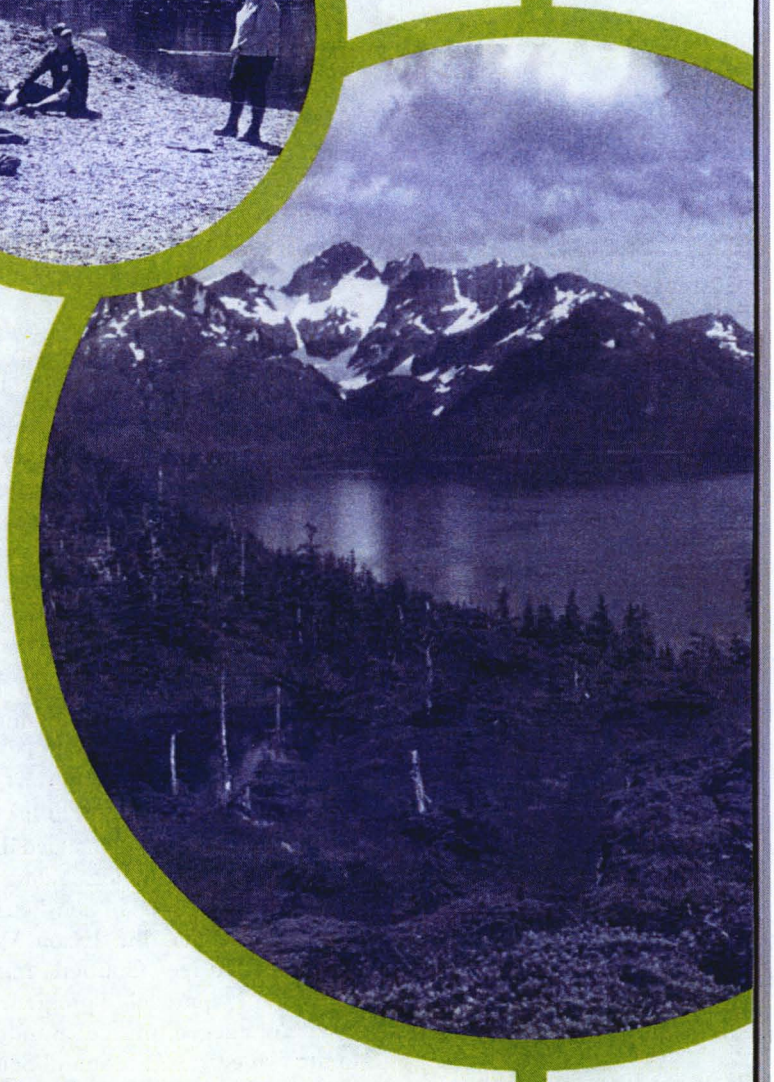
As for how the Center will change, I envision it becoming just one of a number of integrated, independent, marine research entities linking the 6,600 mile long coastline of Alaska. It will be a leader in establishing these regional science centers. Our Alaskan research model will be emulated nationally as other coastal states see tangible benefits from our long term, integrated, ecological monitoring and synthesis of physical and biological parameters. Synergistic benefits for all will come from coordinating with state, federal, and university research groups. Equally important will be our demonstrated success in linking with local community interests and in the collection and quantitative application of traditional ecological knowledge.

The developing national matrix of independent research organizations will focus on promoting maintenance of long-term biodiversity, productivity, and sustainable resources. Educational efforts will inform the general public and decision makers about ecological monitoring, and will increase understanding about the sustainable use of renewable resources that are so important to regional and national economies.

Fundamental to this vision of the Prince William Sound Science Center is the successful implementation of a Nowcast/Forecast program. This program is based on a numerical model that integrates physical and biological measurements, including meteorological information, ocean conditions (currents, temperature, salinity), and biological measurements (plankton, fish, birds, marine mammals). Scientific observations about present conditions and predictions about future states of these components can be available where directly measured, and calculated for locations where observational data are not available.

Dedicated professional staff, technology, and adequate funding are key to successfully accomplishing the Science Center's goals. The Board of Directors will continue to work diligently to provide the vision and direction that will successfully combine these elements over the next 10 years.

C.P. Meacham is President of Capital Consulting in Juneau and former deputy commissioner of the Alaska Department of Fish & Game. He is currently co-chair of the Public Advisory Committee of the Exxon Valdez Oil Spill Trustee Council. Meacham has been a member of the PWSSC Board of Directors since 1997, and has served multiple terms as 1st Vice-Chair.



PWSSC Contributions to the Sound Ecosystem Assessment (SEA) Program

by Ted Cooney, Ph.D.

Following the disastrous spill of crude oil into the waters of northeastern Prince William Sound by the tanker Exxon Valdez in late March of 1989, there was great concern among stakeholders of the area's fisheries resources about immediate and long-term effects on the region's pristine environment. While State and Federal agencies quibbled over who was in charge of cleaning the region, the fishing community of the Sound mounted an unprecedented campaign to protect as many of their important resources as possible. There is no question that their actions were responsible for successfully mitigating some of the early and most deadly effects of oil on pink salmon, and perhaps other resources.

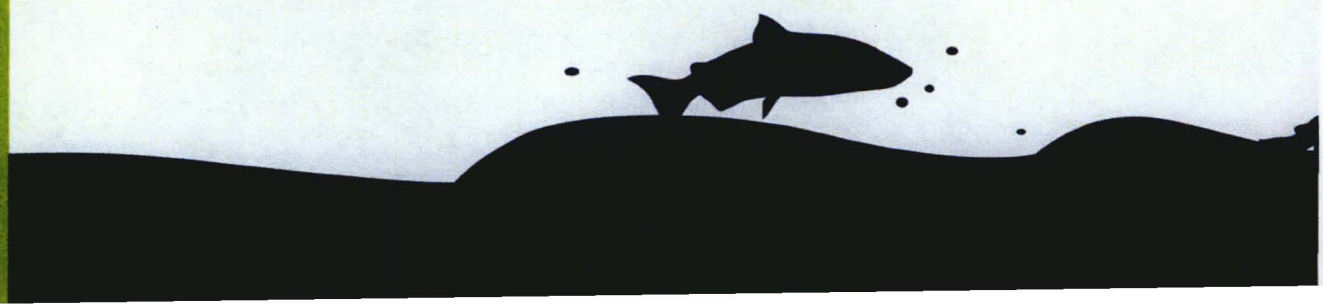
Four years later, following two years of dramatic failures in pink salmon and herring fisheries, these same stakeholders assembled a commercial fleet in Port Valdez to blockade the oil terminal as a way to bring national attention to the spill's lingering impact. Stakeholders demanded that greater effort be expended on understanding the long-term effects of oil on salmon and herring production. Shortly thereafter, the Exxon Valdez Oil Spill (EVOS) Trustee Council implemented an "ecosystem approach" program to undertake studies of alleged impacts. Funds were provided to the Prince William Sound Science Center to support a local planning effort directed at understanding the serious fisheries problems.

That September, the Science Center and local stakeholders of the herring and salmon resources convened a series of open meetings in Cordova to explore ways to pursue funds that would be used to solve the observed pink salmon and herring production issues. Representatives from the Alaska Department of Fish and Game, the Copper River Delta Institute, the Prince William Sound Aquaculture Corporation, and the Science Center were joined in this effort by faculty from the University of Alaska Fairbanks, and most importantly, by members of the fishing community and interested public. The group identified itself as the Fisheries Ecosystem Research Planning Group (FERPG) and created two working sub-committees: 1) a scientific committee chaired by Gary Thomas, President of the Science Center, and 2) a political action committee co-chaired by Tori Baker and Dan Hull. In the months that followed, the science committee would draft an extensive plan for a multi-year study of the Sound, while members of the political action committee would work behind the scenes to assure that the FERPG plan would receive serious and objective consideration by the EVOS Trustee Council.

In early December of 1993 the Trustee Council sponsored a proposal review in Cordova to examine the pink salmon and herring science plan – now referred to as Sound Ecosystem Assessment (SEA). The critical elements of this plan were presented by members of the FERPG scientific committee to an invited panel of nationally recognized marine scientists. Although no funding decisions were made as a direct result of the workshop, those who created SEA were encouraged to present their plan directly to the Trustee Council the following month.

A combined group of scientists and stakeholders presented the request for support to the Trustee Council in January of 1994. The Interior Department representative eventually moved to invite SEA to formally submit a detailed project description (DPD) to the Chief Scientist of the Department for funding consideration. The DPD was submitted in March of 1994. A month later the Trustee Council Executive Director announced that SEA would be supported for multiple years. Some elements of the study were in place three weeks later; others would follow soon after.

The Scientific Committee for SEA drew heavily on the results of past pink salmon research in



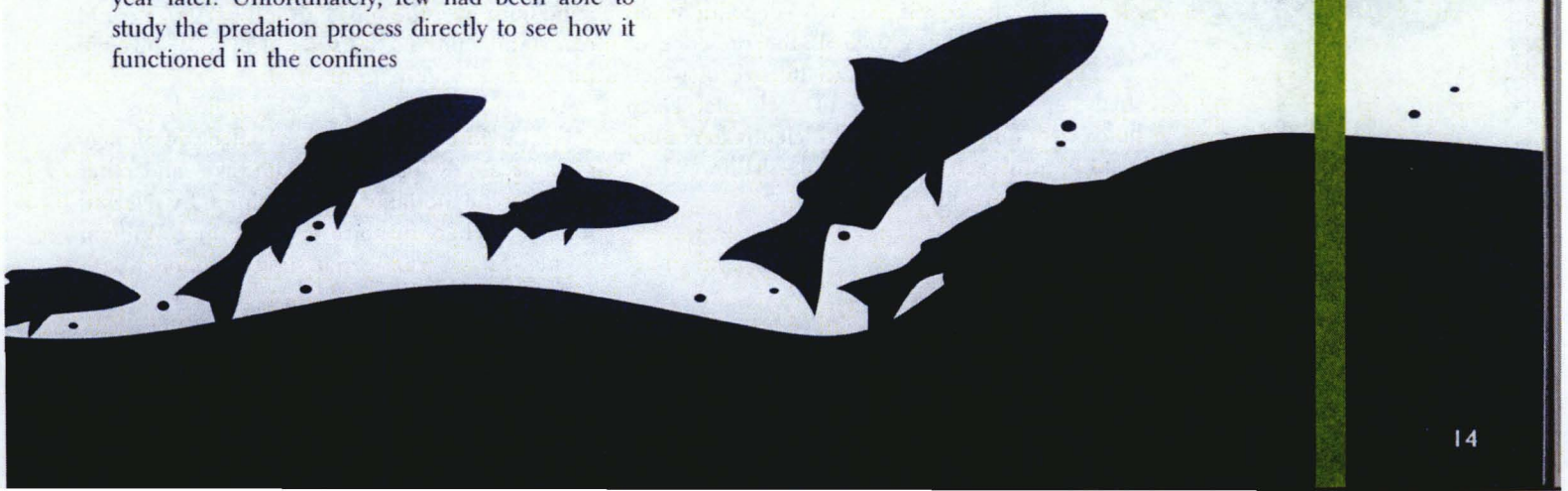
the Sound. Since the middle 1970s, the Prince William Sound Aquaculture Corporation (PWSAC) had worked in partnership with the University of Alaska Fairbanks to understand the food web supporting juvenile pink salmon in the Sound. From this early work, SEA investigators knew that juvenile pink salmon used the shallow edge-zone of the Sound as a rearing environment for six to twelve weeks each year, and that their principal food source was zooplankton. Additional work immediately following the spill confirmed that juveniles migrated along the edge of the deep western passages to staging areas in the south in late summer. Hatchery managers reported that fry were often harassed in pens and immediately after release by juvenile and adult pollock and cod.

At the time SEA was developed, less was understood about the life history of Pacific herring in the Sound, particularly the early life stages. Work conducted by Dr. Mary Anne Bishop at the Copper River Delta Institute provided information about the early lives of herring, but nothing was known of the juvenile stage except that overwintering stocks of age-0 fishes were often seen in bays and harbors during the winter and early spring. It was known, however, that the life histories of the salmon and herring were very different. Pink salmon feed continuously for about a year in the ocean before returning as adults to spawn and die. Herring, on the other hand, live for many years and are able to survive the winters by producing and storing fatty tissue to be used as an energy reserve when plankton stocks fall to seasonally low levels.

Because juvenile pink salmon and herring were accessible to direct sampling in PWS with relatively simple techniques, SEA investigators decided – as a principal strategy – to let the young fish point to important places in the region and times of the year for study. Previous work throughout the Pacific Northwest and Canada had demonstrated beyond reasonable doubts that losses to predation early in the marine residence of pink salmon were mostly responsible for setting the run strength a year later. Unfortunately, few had been able to study the predation process directly to see how it functioned in the confines of a natural ecosystem. SEA would have that opportunity. Researchers developed complementary studies of pink salmon and Pacific herring in Prince William Sound. Their goal was to determine if the EVOS had somehow distorted the system in a way that was compromising the production of these fishes.

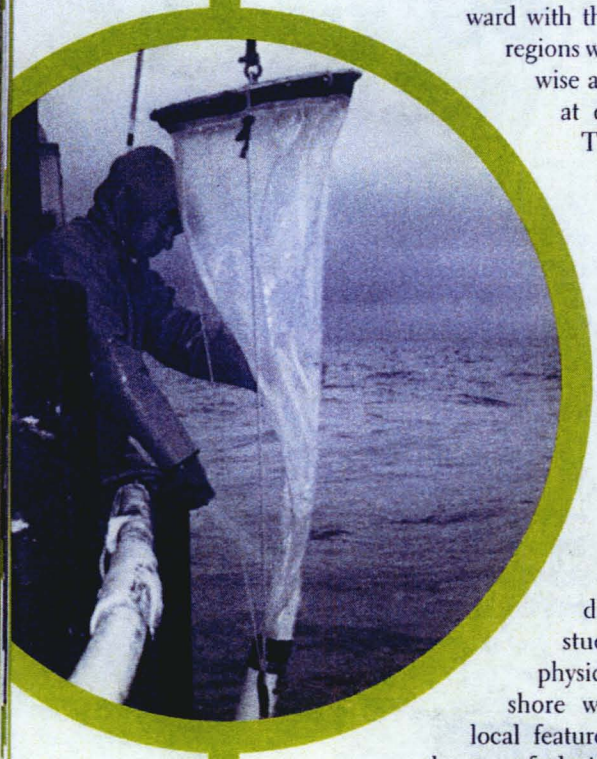
It would be important to understand how the various elements of the Sound interacted to support the annual production of pink salmon and herring. SEA launched a multi-disciplinary study to determine how the productive waters of the region produced and distributed food for the juvenile stages and, in the case of the pinks, who were the major predators of the young fishes. Since pink salmon are only residents for 3-4 months each year, a well-defined temporal focus was apparent for their studies. In contrast, juvenile herring rear continuously in the Sound for 2 to 3 years. Understanding the factors influencing their mortality would be sought over a broader time and space window.

Researchers at the Science Center played major roles creating a picture of how the Sound functioned. These roles included defining the seasonally-changing ocean state; measuring the distribution and abundance of zooplankton, adult pollock, and juvenile herring; describing the sources of plankton at the base of the food web; estimating the impact of birds feeding on juvenile salmon at hatcheries; and synthesizing the information into a series of numerical models. Over the course of the 5-year study, these contributions would be central to the essential results obtained.



Characterizing the Ocean State

First Dr. David Salmon, and then Shari Vaughan, P.I., led studies of the physical oceanography of the Sound to establish a context for understanding seasonal and longer-period changes. Frequent cruises over the 5-year study, and data from moorings, provided a vastly improved understanding of how wind and freshwater runoff influenced the 3-dimensional circulation and fields of temperature and salinity. Satellites tracked drifters released in and near herring spawning areas, and revealed complicated upper-layer circulation patterns that had not been previously described. Field studies also confirmed that during the late fall, winter, and early spring current flow was predominately inward at Hinchinbrook Entrance in the upper 150 m, and outward below that depth. This pattern generally reversed during the summer. Water column stratification initiating the spring plankton bloom was found to begin first in the northern reaches of the Sound, and then to move progressively southward with the season. The central deep regions were found to host both clockwise and anticlockwise circulation at different times of the year. These gyres retained and disperse larval herring at different times in the region.



Shelton Gay, P.I., described seasonal changes in the physics of the near-shore fjords and bays that served as rearing areas for juvenile herring. His important work established the cycles of temperature and salinity in these regions, and studied tidal currents as agents for introducing food to juveniles. The study documented that the physical oceanography of the near-shore was strongly dependent on local features such as the presence or absence of glacial inflow, the size of watersheds, and the bathymetry of each site. Deep fjords were found to stratify sufficiently to control plant growth each summer while shallower bays were more prone to mixing.

Hydroacoustic Measurements of Distribution and Abundance

Dr. Gary Thomas, Jay Kirsch, P.I., and others at the Center worked to characterize the seasonal aspects of the distributions of zooplankton, adult pollock and juvenile herring in the open Sound and near shore. Multi-frequency quantitative echosounders were employed to provide estimates of the biomass and distribution of macrozooplankton and pollock feeding in areas adjacent to juvenile salmon nurseries. This powerful sampling tool was capable of detecting and documenting aspects of distributions that could not be accomplished by net tows alone. Studies revealed that adult pollock occurred commonly in the upper 50 m of the water column throughout the Sound in association with layers and swarms of copepods and krill during April and May. Their work also provided real-time assistance for other investigators sampling juvenile herring; hydroacoustics were used to locate herring schools which were then sampled by other vessels in multi-ship surveys. Acoustic measurements of juvenile stocks were combined with net catches to estimate seasonal losses to mortality of young herring rearing in bays and fjords. All of these studies supported larger, integrated investigations of the factors that influenced the survival of juvenile pink salmon and herring.

Confirming Food-webs Using Stable Isotopes

Dr. Tom Kline used natural occurring biochemical indicators in a novel study of food webs supporting juvenile pink salmon and herring. The results constructed a picture of feeding dependencies, and more importantly, clues about the origin of carbon serving as the base of local food chains. This work unexpectedly discovered that a large percentage of the carbon found in food species for juvenile herring and salmon, and in the juveniles themselves appeared to have originated from "outside" the Sound. The new SEA measurements, coupled with the results of the physical studies of currents in Hinchinbrook Entrance, confirmed that some parts of local food webs were indeed supplemented by biomass washed into the region from sources outside the Sound. This meant that conditions over the broader Gulf of Alaska could cause variability in the survival of local juvenile pink salmon and herring.

Marine Birds as Juvenile Salmon Predators

Dr. David Scheel studied the effects of plunge-diving seabirds (principally Kittiwakes and other gulls) on the mortality of pink salmon fry released from a hatchery in northwestern Prince William Sound. Sound-wide aerial surveys coupled with field measurements of birds feeding on juvenile salmon near the hatchery suggested that bird predation may not be a particularly large component in the overall mortality structure of juvenile pink

salmon each year. Birds seemed far more interested in areas of herring spawning at the time fry were being released from net pens, buffering the impact around hatcheries. This study reported that up to 6 million fry (about 2.5% of the overall release) were consumed by plunge-diving birds at the hatchery where measurements were taken.

Modeling and Information Services

Vince Patrick and Jennifer Allen made some of the most important contributions to the overall SEA program. Data accumulation and archiving played an important role in the declining years of SEA when field sampling was phased out in favor of program synthesis and modeling activities. Their component of SEA provided graphic support for annual presentations to the Trustee Council, for web services, and for the ultimate creation of numerical models of pink salmon survival during early marine residence, and of the winter starvation physiology of juvenile herring. The late Charles Falkenberg provided important data base services to may SEA participants as they grappled with the presentation of overall results. Resulting pink salmon and herring models represent tangible research products with continuing value for stakeholders in the region. Plans are that these models become implemented routinely in continuing studies of the Sound.

Important SEA Findings

The combined results from the all investigators painted a vastly improved and remarkably detailed picture of factors influencing the mortality of juvenile pink salmon and herring. SEA determined that during the study years adult pollock and Pacific herring were probably the most prevalent predators of juvenile pink salmon, although young cod and pollock were close behind. In summary, a combination of the temperature of the rearing environment, fry feeding behaviors, and the sheltering of fry from predators afforded by seasonally abundant macrozooplankton are critical factors that interact to modify the survival of juvenile pink salmon. SEA estimated that about 75 % of all juvenile salmon entering the region during each year of the study were consumed by predators during the first 45 days of early marine residence.

Herring studies in SEA focused on the importance of juvenile feeding in the summer and fall as juveniles provisioned themselves for the winter. The herrings' body energy content was found to be the factor limiting survival when plankton stocks fell to seasonal lows in December, January and February. Measurements of body energy content in the fall demonstrated that some rearing areas were much better than others in provisioning the young herring. However, these same rearing environments were not consistently good from year to year. A numerical model of the starvation process produced results that generally tracked the field measurements of overwintering survival. The model did not account for winter feeding, although investigators found that aspect to be negligible.

In summary, SEA provided the first fully-integrated view of the subarctic ecosystem in Prince William Sound. The picture that emerged was one of oceanographic interaction between the protected inside waters and the open coastal and shelf environments beyond Hinchinbrook Entrance and Montague Strait. This exchange of water apparently introduces biomass of oceanic origin, and under some conditions may also export biomass to the bordering shelf. Characteristics of the early life history of pink salmon and herring – timing of spawning and ocean entry, the use of protected nursery areas for critical growth during early marine residence, and (in the case of herring) overwintering strategies that involve the production of lipid reserves - together assure that some juveniles of all year-classes will survive to adulthood. Year-to-year differences in survivals are thus tied, in large part, to cycles in ocean climate affecting these critical life history stages.

The information resulting from SEA provides a further stepping stone to build applications for more informed fisheries management and enhancement. These research successes would not have been possible without the aggressive support of Prince William Sound Science Center scientists working cooperatively with members of the entire SEA team.

R. Ted Cooney is Professor Emeritus at the Institute of Marine Science for the University of Alaska, Fairbanks. He serves on the Scientific and Technical Committee, Oil Spill Recovery Institute. Cooney was the lead scientist on the Sound Ecosystem Assessment research program from 1994 to 1999.

From Nowcast-Forecast to Operational Fisheries Oceanography – 1998-2002

By G.L. Thomas, Ph.D.

In the 1980's the fishery-dependent economy of Prince William Sound (PWS) was booming, peaking at over $80 million in 1988. Times were so good that fishers were paying $200,000-300,000 for limited entry permits for single-gear type fisheries (pink salmon or herring purse scene fisheries, salmon gillnet fishery) with the expectation to pay them off in a few years. Imagine the impact of the Exxon Valdez oil spill (EVOS) had on their lives.

Exacerbating the shock of the oil spill occurred when the answers to questions the public had about its effects became confidential due to litigation. It was in this environment that local fishers and the public banded together to incorporate the PWS Science Center (Science Center) in Cordova, Alaska. Furthermore, the founding Board worked with Senator Stevens to create the Oil Spill Recovery Institute (OSRI, Oil Pollution Act of 1990, Title V, Section 5001) as an independent funding organization in PWS with a shared regional-public and government participation in its decision-making.

Possibly one good thing that occurred after the EVOS event was that the residents of natural resource-dependent coastal communities in the region received a wakeup call about the status of their ecosystem. Expecting to find that the government stewards of the natural resources understood the marine ecosystem, they found that outside of the catch histories for a few commercial species there was little knowledge of the internal workings of the food web and its response to changes forced by climate. In fact, there wasn't even very much observational data available even on the basic variables, such as wind, temperature, etc. For example, not a single weather station existed along the vast track of the oil trajectory from deep inside PWS to the Pacific Ocean. Even after several years of extensive damage assessment and recovery studies, it was shown that the fish with the single largest biomass in the Sound's ecosystem, the walleye pollock, was completely ignored for its role in the food web (EVOS Trustee Council poster on the fish and wildlife of PWS, Thomas et al. 1996). This called to question whether the methods that were being used by science were adequate to the task of informing the public of changes occurring to their natural resources as a result of natural or man's influence. To make a long story short, many of the information acquisition methods are not adequate today, especially for gathering quantitative information on fish (Gunderson 1994; NRC 1998). Even where adequate, they are not used in a systematic fashion to observe changes at the PWS ecosystem scale (i.e. PWS weather stations and walleye pollock examples above).

Hence, enters the mission of the Science Center, which was to improve our understanding of the PWS ecosystem. The first step was obvious; build an ecosystem information system. Stealing a concept from the National Weather Service where data are collected and integrated into models to hindcast, nowcast and forecast conditions and science plans from the Global Ocean Ecosystem Dynamics Program (GLOBEC), the PWS Science Center set out to establish a nowcast-forecast program with goals that extended from atmospheric to ocean and even food-web conditions. Given that the nowcast-forecast program would provide currently-unknown information, which could contribute to the improved understanding of the resources-at-risk to oil spills, provide up-to-date information on physical conditions and biological status for future spill prevention and response activities, a partnership of convenience developed between the Science Center and the OSRI.

Between 1992-2002, the Science Center-OSRI partnership worked well. In the early years prior to the OSRI program funding, the Science Center worked to raise the research funds needed to develop the initial nowcast-forecast methods. This research provided the credibility that the Science Center needed as justification for the appropriation of OSRI program funds (Coast Guard Authorization Act of 1996). Subsequent, to OSRI funding, the Science Center had an experienced technical staff and partnerships with local agencies and industry to convert the recent research developments into a nowcast-forecast program for PWS. Today, the challenge is to find the resources to maintain the staff and partnerships needed to operate the nowcast-forecast system into the future.

In the late 1990s, there was growing recognition of the lack of information and understanding of coastal ecosystems (GLOBEC 1991). In the early 2000s, this evolved into a call for more operational oceanography (Mooers 2000). This movement has seen the development of over a dozen coastal nowcast-forecast systems in the lower 48 states and many new observing-system based initiatives. Today on the national level, there is the Interagency Ocean Observing Program (IOOS) and in State is the Alaska Ocean Observing System. The PWS nowcast-forecast has a fisheries ecosystem focus. The PWS nowcast-forecast system completes annual, echo integration-net winter surveys of the dominant fish stocks because it is feasible to produce a number of repeated surveys estimating biomass. The precision of these methods outperforms anything previously reported and is the foundation for integrating fisheries into the operation oceanography approach. I believe that the nowcast-forecast program's success as well as its meaningfulness to people in the coastal communities will depend upon the program's ability to provide new, higher quality information on the dominant fishes immediately, plankton and wildlife eventually, and understanding of how they interact and respond to the continuously changing climate, ultimately.

In conclusion, by serving the information needs of the coastal communities it will serve the needs to better manage and understand the marine ecosystems and fisheries resources of Alaska. The nesting of the coastal fisheries ecosystem observing programs into the larger, Gulf of Alaska and Bering Sea scale programs that are operated by centralized government agencies will further enhance the understanding of coastal fisheries ecosystems. I believe that the implementation of these coastal fisheries ecosystem programs represents a breakthrough of marine science into a new paradigm of operational fisheries oceanography, which is a key to sustaining our marine fisheries in Alaska, and eventually throughout the world.

Gary Thomas was President of the PWSSC and Director of the Oil Spill Recovery Institute from 1990-2002. He is now Director of the Center for Sustainable Fisheries, University of Miami.

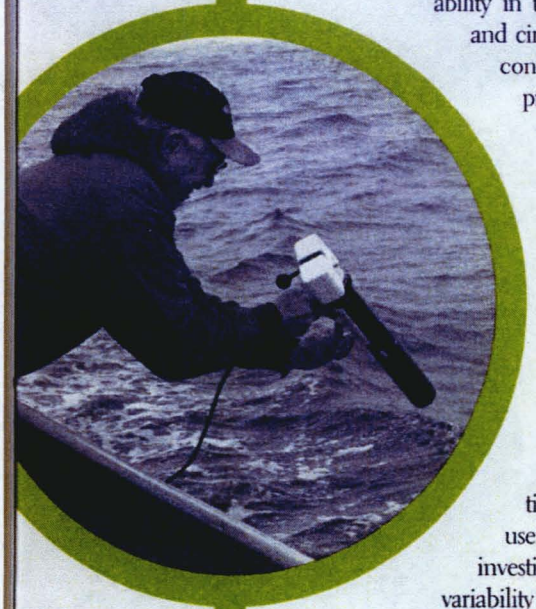
PWS Observational Oceanography Program

By Shelton Gay and Stephen Okkonen, Ph.D.

The Observational Oceanography program continues and expands work completed from 1999 to 2003 through support from the Prince William Sound Oil Spill Recovery Institute (OSRI) for a Nowcast/Forecast System for PWS (PWS NFS). The goal of the original project was to create a coupled ocean circulation, atmospheric, and oil fates and effects model capable of simulating ocean and atmospheric conditions in near real-time (nowcasts) and predicting conditions in the future (forecasts), and well as in the past (hindcasts).

The overall objectives of the ongoing Observational Oceanography program are to acquire measurements of currents and hydrography (temperature and salinity) necessary for validation of the coupled atmosphere/ocean model and for understanding and predicting circulation and water mass variability and their relationships to the PWS ecosystem. The program is also expanding its measurements to include the adjacent Copper River Delta.

Seasonal (winter, spring, summer, fall) cruises measure hydrography (temperature and salinity) and currents along existing transects in PWS to identify variability in the large-scale hydrographic structure and circulation within the sound. A Seabird conductivity-temperature-depth (CTD) profiler is used to acquire surface-to-bottom measurements of temperature and salinity. In addition, a downward-looking 150 kHz ADCP (acoustic Doppler current profiler) is towed behind the vessel to acquire continuous measurements of currents in the upper 300 m of the water column. A CTD mounted on the towing sled acquires continuous measurements of near-surface temperature and salinity. As additional measurements extend the observational record of conditions in PWS, the usefulness of the observational record for investigating and interpreting interannual variability increases.



For both oceanographers and biologists, it is critical to understand the exchange of waters between the Gulf of Alaska and Prince William Sound. Between 1999 and 2002, an acoustic Doppler current profiler was moored in Hinchinbrook Entrance collecting data on the temporal variation in ocean currents through the entrance. The velocity time series from these data showed a pattern of inflow in the upper half of the water column in fall and winter, with outflow below. The spring patter was either vertically uniform inflow and outflow, or outflow in the upper half of the water column, with inflow below. The summer pattern was weak, vertically uniform outflow. This contrasted to a velocity time series from the mid-1990s which showed summer outflow in the upper half of the water column with inflow below.

During the spring of 2004, four near-shore moorings (two in Hinchinbrook Entrance and two in Montague Strait) will be deployed to monitor near-surface (~10 m) temperature, salinity, and fluorescence fields at the two principal passages connecting PWS and the shelf waters of the northern Gulf of Alaska. These year-round moorings will provide biophysical data necessary for understanding the near-shore ecosystem. Also deployed will be two moored ADCPs, one at Hinchinbrook Entrance and the second at Montague Strait. Additional funding to support the deployment of additional ADCPs in both entrances to PWS is being sought from other sources and may occur during the fall/winter of 2004. Data from these moorings will provide an interpretive context for the near-shore observations. The observational oceanography program will also participate in the oil spill field experiments for PWS through the deployment of approximately 20 drifter buoys and the collection of data through hydrographic and current surveys during the experiment, tentatively scheduled in early August.

Shelton Gay, M.S, began work as a marine technician at PWSSC in 1994. He currently serves as co-Principal Investigator with Steve Okkonen, Ph.D., of the University of Alaska Faribanks, for the Obervational Oceanography Program.

Trophic Energy Transfer in Prince William Sound

by Thomas Kline, Ph.D.

Oceanographic processes connecting the northern Gulf of Alaska with Prince William Sound may affect fish nutrition. Prince William Sound fish populations may thus depend upon physical processes that regulate the availability of their macro-zooplankton forage. Accordingly, food webs are subject to changes in carbon flow occurring between the Gulf of Alaska and Prince William Sound. Shifts in carbon flow occurring as a result of variations in the physical environment represent fundamental changes in the way the PWS ecosystem supports commercially important species, and is a probable mechanism explaining the pervasive nature of regime shifts.

Stable isotope analysis (SIA) methods were used to show that a portion of variability of macro-zooplankton was ascribable to a varying subsidy of oceanic sources that are transported by currents in Prince William Sound from the adjacent Gulf of Alaska.

Stable Isotope Analysis

The SIA natural abundance approach, which uses stable isotope ratios of carbon and nitrogen, is unique in its ability to integrate time and spatial scales at mesoscale levels. The stable isotopes used as natural tracers involve differing ratios of two types of carbon (^{13}C and ^{12}C) and two types of nitrogen (^{15}N and ^{14}N) that are distinguished by their number of neutrons. The tracer aspect of SIA natural abundance is analogous to artificial tracer experiments without the burden of needing to generate signals or experimental artifacts.

The predictable relationship of the isotopic composition of consumers with that of their diet allows natural SIA abundance methods to effectively trace direct bottom-up effects in ecosystem studies. Isotope ratio shifts measured in consumers reflect changes in utilization of food sources. A regional stable carbon isotope gradient allows researchers to distinguish organic carbon generated within Prince William Sound from that generated in the adjacent Gulf of Alaska.

Organic carbon generated in the Gulf of Alaska is isotopically distinctive from that originating in Prince William Sound (Figure 1). There was a bi-modal distribution of $^{13}C/^{12}C$ values measured in individual copepods.

When there is a coexisting stable isotope gradient, SIA can reveal the relative contribution of these alternate production sources for consumers such as fishes over time.

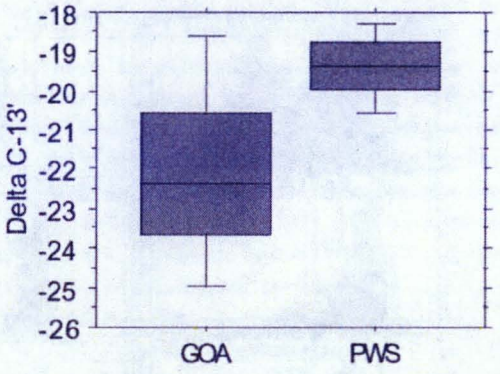


Figure 1. Box and whisker plots showing the distinctive $^{13}C/^{12}C$ ratios (the prime symbol signifies normalization for lipid content) measured in terminal feeding stages of Neocalanus cristatus copepods from 1995 through 2002 from Prince William Sound (PWS) compared to those from the north Gulf of Alaska (GOA). These data are from the SEA and GLOBEC projects.

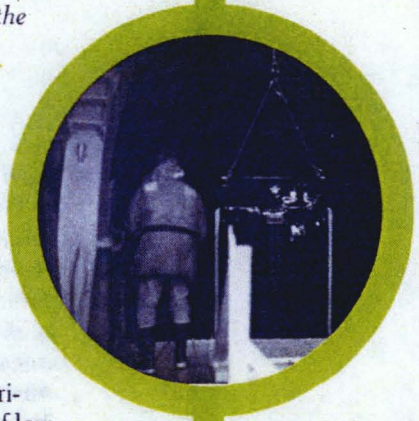


Figure 2. Landing the MOCNESS on the R/V Alpha Helix during GLOBEC. The MOCNESS was used to collect Neocalanus samples on which SIA was preformed.

Our studies at the Prince William Sound Science Center found that: 1) ^{13}C content in Prince William Sound biota was less variable than that in the Gulf; 2) the presence of low ^{13}C content carbon associated with Gulf sources in herring, pollock, and diapausing copepods (Figure 3) suggested a recurrent isotopic gradient in the Sound-Gulf region and a recurrent flux of Gulf carbon into the Sound; 3) the influx of carbon from the Gulf into the Sound varied from year to year; and 4) there were seasonal shifts in dependency on Gulf carbon by Sound biota.

Natural stable isotope abundance demonstrated that productivity derived from the Gulf can subsidize, and therefore be important for, biological production in adjacent coastal waters such as PWS. The inferred flux of Gulf zooplankton into the Sound fluctuated from year to year. Carbon flux across the continental shelf is a potential mechanism to explain how climate change affected

ecological regime shifts simultaneously throughout the coastal Gulf area. This research provided data that linked secondary production sources (zooplankton) with fish production by matching isotopic signatures of fishes with those of potential pelagic organic carbon sources.

Isotopic analysis may yield a greater understanding of how physical forcing impacts economically important species within the Prince William Sound pelagic ecosystem with the goal to further predictive capability needed for management. Further refinements in modeling the relationships between a seasonally changing physical environment and coastal plankton responses could provide valuable information for associated studies tracking the success of fish, bird and mammal populations in an ocean threatened by global change.

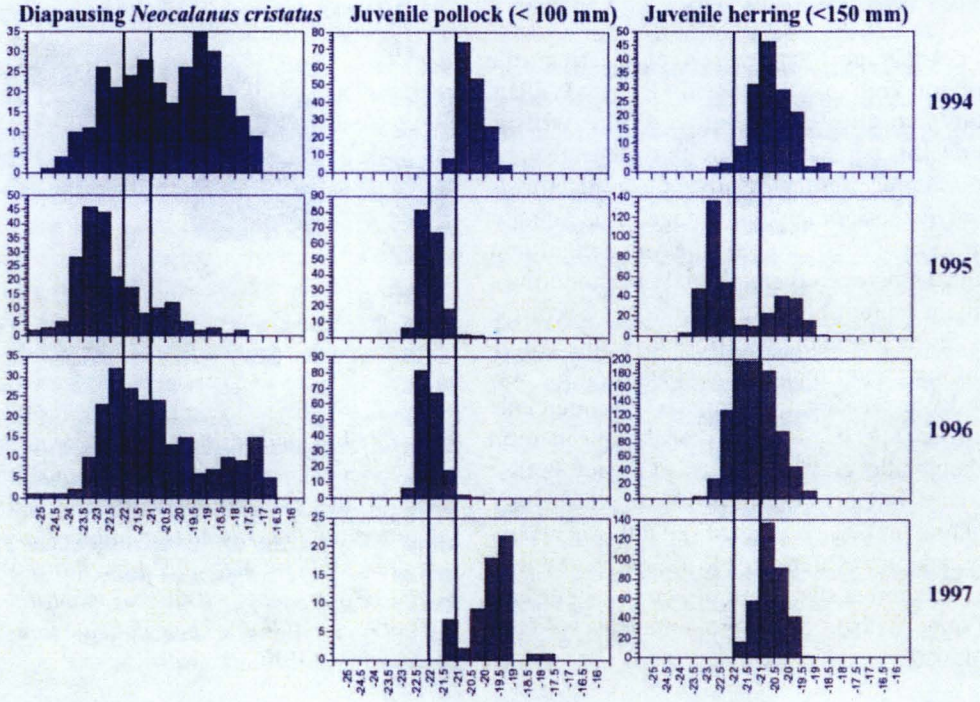


Figure 3. Frequency distribution histograms of the $^{13}C/^{12}C$ content of diapausing Neocalanus cristatus in the "Black Hole" of Prince William Sound, and juvenile pollock herring rearing in Prince William Sound, by year. Values to the left of the pair of black vertical lines in each panel are diagnostic for Gulf carbon, note the switch to almost all Gulf carbon during 1995. Spring 1995 herring consisted mainly of PWS carbon (right peak) whereas those that fall (left peak) had switched suggesting that the influx took place during the summer.

High-latitude systems such as Prince William Sound are driven by the seasonal solar cycle. Seasonal patterns occur not only in the generation of organic carbon by primary producers, but also in water column physics and circulation patterns. During the summer, the regional down-welling pattern subsides and upwelling prevails. It is during this period that exchange of deep Sound water with the Gulf is thought to take place. Deep-water exchange may explain how diapausing copepods and other zooplankton from the Gulf enters the Sound (Figure 3).

Thomas C. Kline, Ph.D. is a biological oceanographer who specializes in food web analysis using stable isotopes. He earned his doctorate at the University of Alaska Fairbanks and, since 1994, has been the principal investigator for numerous studies in Prince William Sound, the North Slope of Alaska, and the Gulf of Alaska regions. Currently, he is working on the Coastal Gulf of Alaska GLOBEC project.

Nowcast/Forecast Biological Monitoring in Prince William Sound

By R.E. Thorne, Ph.D.

For the past four years, the Prince William Sound Science Center (PWSSC) has monitored selected biological components of Prince William Sound as part of the Nowcast/Forecast (N/F) program supported by the Oil Spill Recovery Institute (OSRI). The biological components were selected according to two criteria: (1) importance to the PWS ecosystem, and (2) vulnerability to damage from oil spills. These factors were evaluated using historic data, including the extensive research conducted under the Sound Ecosystem Assessment (SEA) Program, supported by the Exxon Valdez Oil Spill Trustee Council (EVOS TC) from 1994-1998.

Two major impacted fishes and three dominant biomasses were identified. The fishes were Pacific herring (Clupea pallasi) and pink salmon (Oncorhynchus gorbuscha); the three biomasses were herring, walleye pollock (Theragra chalcogramma), and the large-bodied copepods of the genus Neocalanus. Neocalanus was also known to be a major factor in the survival of juvenile pink salmon.

Methods

Acoustic assessment techniques are the foundation of the monitoring programs because of their high sampling power and accuracy. Pollock and herring in PWS are surveyed during the late winter/early spring period when they are concentrated in pre-spawning configurations. Biological data are obtained by purse seine for herring and mid-water trawl for pollock. The zooplankton assessment is conducted during the spring and uses a multi-frequency acoustic system supported by plankton net tows.

Herring Monitoring

Historical estimates suggest that over 50,000 metric tons were annually harvested from PWS by the reduction fishery during the late 1930s. Between 1990 and 1992, a total of 40,000 metric tons were harvested in PWS, primarily for sac roe. However, in the spring of 1993 very few fish were found. This mystery led to the initiation of acoustic surveys in fall 1993. These acoustic surveys, which have been conducted each spring since 1995, are the basis for the current monitoring program.

The 1993 acoustic survey in PWS confirmed a population collapse to 16,000 metric tons. Subsequently the population rebounded to 37,000 metric tons before collapsing to about 7,000 metric tons after the fishery was restarted in 1997. Recently, the population appears to be recovering, and is currently over 10,000 metric tons (Fig. 1).

While the primary goal of this research is to monitor the herring population, the results have also shown that herring are the target of many predators. In particular, an infrared sensor was used to document intense foraging activity by Steller sea lions, humpback whales and various marine birds at night, an observation subsequently reported in the journal NATURE. Over the three-year period from 2000 to 2003, strong correlations ($r^2 = 0.94$ to 0.99) were found between the acoustic estimates of biomass and synoptic counts of Steller sea lions at various locations of overwintering herring. Subsequent comparisons between the annual estimates of herring in PWS and the long-term census data on Steller sea lion abundance in PWS taken at the major sea lion haul-out in PWS, also show a very strong correlation. The herring population declined by 88% between 1989 and 2000, while the Steller sea lion count declined 86%.

Pollock Monitoring

Walleye pollock is a valuable commercial fish, an important forage fish for marine fish and wildlife, and a dominant marine competitor and predator with other species. The importance of the commercial fishery for pollock off the coast of Alaska is highlighted by the six million metric ton catch in 1985, worth over $1 billion ($US) in ex-vessel income, making it the world's largest single-species fishery. Very little information was available about the abundance of pollock in PWS, but studies initiated after the 1989 Exxon Valdez oil spill indicated a large pelagic population. Acoustic surveys were conducted throughout PWS and the adjacent waters of the Gulf of Alaska in February and March of 1995, 1997, and 1998, and annual estimates have been incorporated into the PWS NFS programs since 2000. Large winter aggregations of adult pollock occur in Port Bainbridge, Lower Knight Island, and Hinchinbrook Entrance. The acoustic surveys in 1998 and 2000 showed the recruitment of a large 1994-year class into the spawning population. The recruitment of the 1994 year class compensated for the declining abundance of the previously dominant 1988 year class and the total biomass remained relatively stable until 2002, when a significant decline was observed (Fig. 2). The highly contagious distribution of these winter aggregations of adult pollock made it possible to repeat acoustic surveys with

high precision. Estimates were within 5-25% with the exception of 1998, when the 1994-year class recruited into the Hinchinbrook area and there was not enough replication of the survey effort.

Monitoring the Pink Salmon Food Supply and Predators

Several hatcheries annually release hundreds of millions of juvenile pink salmon into the waters of Prince William Sound. Previous research documented two critical factors in the juvenile salmon survival: 1) the availability of large calanoid copepods (genus Neocalanus), and 2) the abundance of walleye pollock. The large calanoid copepods reproduce at depth in late winter. Their progeny migrate to the surface layer to graze for a brief period in late April and May. They are an especially valuable source of food for many fishes because of their relatively large size and high energy content. Adult pollock feed on Neocalanus, thus are competitors of juvenile pink salmon for this food source. However, when Neocalanus abundance is low, pollock become piscivorous and are the dominant pelagic predator of pink salmon fry. Pacific herring exhibit a similar prey switching behavior.

The PWSSC surveys have been conducted annually since 2000 as part of the PWS NFS program. Copepods have dominated the zooplankton net catches both numerically and in biomass. Small copepods have numerically dominated the catch, but large copepods are typically the dominant biomass. There have been substantial differences in large copepod abundance among years. In particular, abundance in 2000 was appreciably higher than in subsequent years. Springs 2001 and 2002 were similar in overall magnitude. Adult pink salmon returns for 2001, corresponding to 2000 fry, were appreciably higher than those in 2002, and appeared to reflect the difference in the large copepod abundance (Fig. 3).

There was a major change in inshore and offshore trends during the three years. Fish distributions in 2001 and 2002 showed a strong and statistically significant orientation toward shorelines where pink salmon fry and other juvenile fishes were known to be concentrated. In contrast, the fish distribution in 2000 was more widespread and showed no detectable inshore or offshore trends. The pronounced near-shore orientation observed in 2001 and 2002, when zooplankton densities were low, most likely reflects piscivorous feeding.

The large differences in both zooplankton abundance and fish orientation relative to shore that were observed between 2000 and 2001 appeared to be reflected in the subsequent adult returns. However, while overall differences in large copepod abundance between years are undoubtedly important, the impacts of temporal and spatial variability in concert with wild stock fry distributions and hatchery release operations are complex. The intense temporal and spatial coverage that can be obtained with acoustic technology is critical in this regard. Ultimately, a more complete understanding of the complex environmental conditions that govern juvenile salmon survival will only be obtained through long-term acquisition of this type of information.

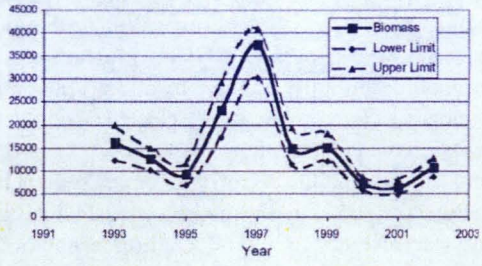


Fig. 1. Results of acoustic biomass herring estimates in PWS (dashed lines are 95% confidence limits).

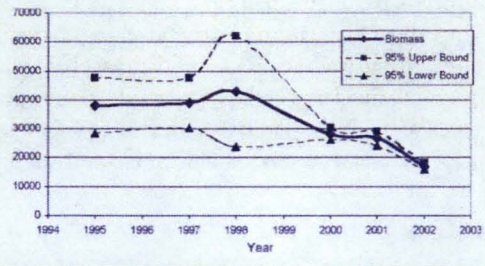


Fig. 2. Walleye pollock biomass in Prince William Sound, Alaska, 1995-2002.

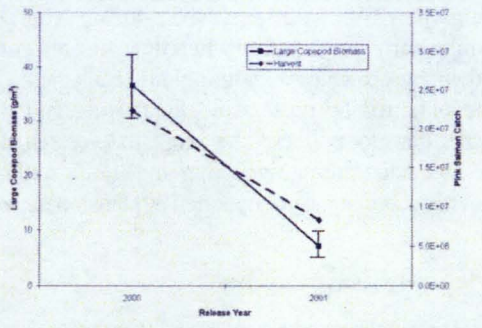


Fig. 3. Comparison of zooplankton biomass estimates (with 95% confidence intervals) and subsequent common property fishery harvest of pink salmon in Prince William Sound for release years 2000 and 2001.

R.E. Thorne, Ph.D. is a fisheries scientist who specializes in using hydroacoustics to measure fish and plankton populations. He holds a doctorate degree in fisheries and a masters degree in biological oceanography.

Estuaries as Essential Fish Habitat for Salmonids: Assessing Residence Time and Habitat Use of Juvenile Coho and Sockeye Salmon

by Mary Anne Bishop, Ph.D.

The Copper River Delta supports a substantial commercial and subsistence fishery that is an integral element of the local economy: more than 500 gillnet fishers commercially harvest 3 species of salmon (coho, sockeye, and king) in the estuarine portion of Copper River Delta. Subsistence fishing provides an important food source for residents of Cordova and the upper Copper River watershed.

Considerable variability in early life behaviors and migratory patterns of coho and sockeye salmon exists on both local and regional scales. Of particular importance for stock assessment are the ages and sizes of juveniles during outmigration. For both species, juveniles have been found in estuaries as age 0 fry, 0+, 1, and 1+ year-old smolt. Once in the estuary, an area seldom researched in salmon studies, 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). Because estuarine habitats are critical for osmoregulatory adjustment to marine waters, and offer rich foraging opportunities for smolt, they represent essential habitat for salmonid fisheries. Consequently, alteration or degradation of these habitats resulting from natural perturbations such as tectonic activity and climate regime shifts or anthropogenic perturbations such as oil spills and coastal development, may have serious consequences for sustainable harvest of salmonids.

Quantifying variability in both age at outmigration and the subsequent time spent in estuarine habitats is critical for stock assessments because both parameters have been shown to affect survival and growth of coho and sockeye. With funding from the North Pacific Research Board, Drs. Mary Anne Bishop (PWSSC), Sean P. Powers (University of South Alabama) and Gordie Reeves (US Forest Service) initiated a project in 2003 to assess juvenile residency of and habitat use by coho and sockeye salmon on the Copper River Delta. The project, which will be completed in 2005, couples intensive field surveys with otolith microchemistry analyses to quantify ages of outmigration and estuarine residence time for coho and sockeye salmon on the Delta.

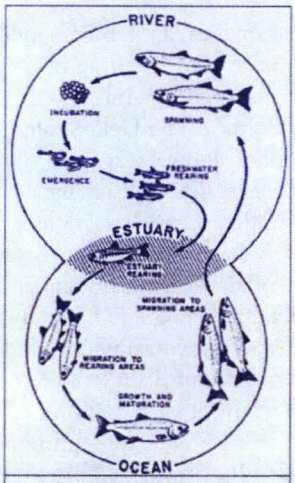


Figure 1. Generalized life-cycle of anadromous salmon.

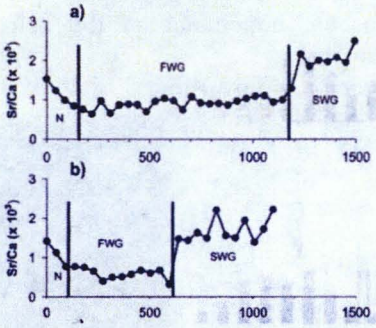


Figure 2. Life-history transects of otolith Sr:Ca ratios measured from a single primordium to the otolith edge of 2 (a & b) adult steelhead (Oncorhynchus mykiss). N= nucleus; FWG= Fresh-water growth region; SWG= saltwater growth region. From Zimmerman and Reeves 2000. Identical analytical procedures will be used for coho and sockeye otoliths as part of the proposed project.

Mary Anne Bishop, Ph.D. has been a research ecologist at the Prince William Sound Science Center since 1999. She holds a doctorate from the University of Florida at Gainesville. During the 1990's, Bishop led a variety of major research projects both on the Copper River Delta and in Prince William Sound. Her current research projects focus on the long-distance migration of small shorebird species in the Pacific Flyway, juvenile salmon habitat use, and the ecology of the soft-sediment communities of the Copper River Delta.

Ecology of the Copper River Delta

by Mary Anne Bishop, Ph.D.

One of the largest expanses of intertidal mudflats along the southcentral Alaska coastline occurs in the Copper River Delta and Orca Inlet (southeastern Prince William Sound). The Delta's intertidal mudflats and network of sloughs serve as a significant connection between the Gulf of Alaska and the vast expanse of wetlands, rivers, lakes and glaciers in the Copper River basin. Rich in benthic invertebrates, the mudflats serve as a critical link in the food web, providing foraging habitat for a variety of migratory and resident consumers including more than 4 million shorebirds in spring, and 3 species of commercially fished salmon. The Delta's tidal flats however, are vulnerable to offshore oil spills from tankers and upriver oil spills from the Trans Alaska pipeline. A spill could impact the food web of the delta, which could cascade to larger geographic impacts because of the importance of the delta to migratory species.

In 2000, Drs. Mary Anne Bishop (Prince William Sound Science Center), Sean Powers (University of South Alabama), and Charles H. Peterson (University of North Carolina at Chapel Hill) began a large-scale field study to test the hypothesis that the distribution, abundance and production of benthic invertebrates residing in intertidal sediments are controlled by a combination of predators (top-down processes) and bottom-up processes. Data are being collected on oceanographic conditions, nutrients, primary productivity (chlorophyll a), benthic invertebrates and their predators. The project is funded by the Prince William Sound Oil Spill Recovery Institute and the Exxon Valdez Oil Spill Trustee Council's Gulf of Alaska Ecosystem Monitoring and Research Program.

Bishop and her colleagues have documented a gradient of benthic communities from the more brackish, highly turbid areas influenced by the discharge of the Copper River, to the higher salinity and less turbid mudflats characteristic of southeastern Prince William Sound. Areas closer to the Copper River are characterized by low species diversity and are dominated by Macoma balthica. This small (up to 2 cm) bivalve reaches peak densities of up to 4,000 clams in a square meter! Numbers of Macoma decrease at lower tidal elevations as the environment becomes more hospitable to suspension feeders such as Mya arenaria, an invasive species of bivalve. At the higher salinity areas around Orca Inlet, more invertebrate species occur including several species of polychaetes and the mussel Mytilus trossulus.

Studies of food habits have shown that the major predators on the delta's benthic invertebrates include demersal fish and migrant shorebirds (in particular, the Western Sandpiper and Dunlin). Shallow-water trawls are demonstrating that the Copper River Delta serves as a nursery ground for a large demersal-fish community, dominated by flatfish, Crangon shrimp, sculpin, snake prickleback and Dungeness crab. Many of the species captured are of significant fisheries value, including Pacific halibut, Dungeness crab, and Lingcod. The results of this project will be synthesized in 2006, and a subset of key physical, chemical, and biological parameters will be identified for long term-monitoring.

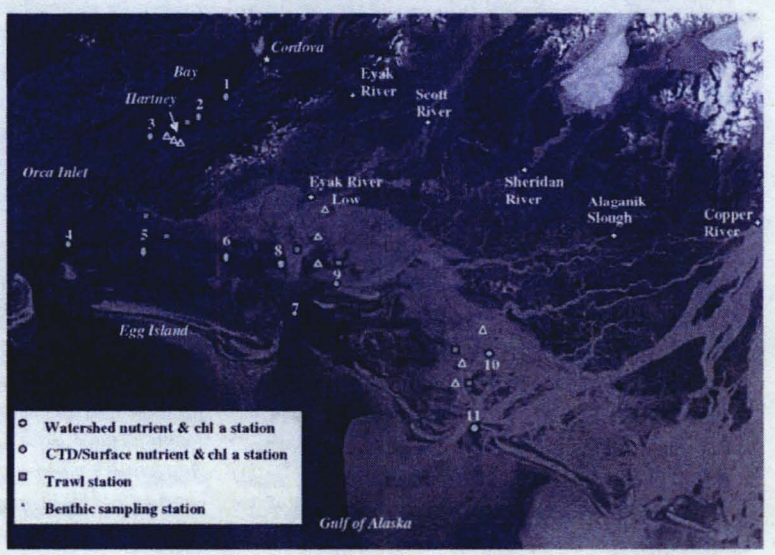
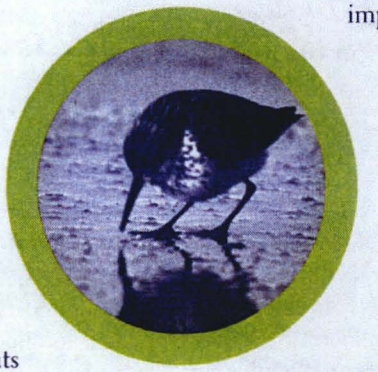


Figure 2. Satellite image of the western Copper River Delta showing the spatial extent of the Copper River outflow (cloudy, gray water vs. deep black water) and the network of mudflats throughout the brackish water portions of the delta and Orca Inlet.

Migration of Shorebirds Along the Pacific Flyway

By Mary Anne Bishop, Ph.D.



Shorebirds spend a large part of their yearly cycle migrating to and from their breeding and wintering grounds. With many North American shorebird populations in decline due to a loss of wetland habitat quality and availability, there is a need for information on which habitats shorebirds use during migration. With its vast expanse of intertidal mudflats, the Copper River Delta is considered one of the most important migration areas in North America, with over 4 million shorebirds stopping each spring. Over the past 12 years, Dr. Mary Anne Bishop of the Prince William Sound Science Center, along with Dr. Nils Warnock of Pt. Reyes Bird Observatory and Dr. John Takekawa of US Geological Survey San Francisco Bay Estuary Research Station have conducted pioneering research on shorebird migration over long distances. Together they have collaborated with biologists from more than 30 wetland areas to radio-track Dunlin, Long-billed Dowitcher, Short-billed Dowitcher, and Western Sandpiper from Mexico, California and Washington to western Alaska. Their detection rate of birds past their banding sites has been as high as 88%. For all four species, the Copper River Delta is the single most important stopover site with as much as 80% of their Pacific Flyway populations stopping there. The shorebirds spend an average of 2-4 days at the Copper before continuing on to their breeding grounds in western Alaska. Bishop and her colleagues plan to continue this important research in spring 2004 when they will tag shorebirds in Baja California and monitor their northward migration. Their research has revealed that shorebirds rely on an interconnected web of wetlands along the Pacific Fly The Copper River Delta was the single most important stopover site.

Because of the vast numbers of shorebirds using the Copper River Delta tidal flats and the vulnerability of the Delta to oil spills, Bishop and Dr. Sean Powers from Dauphin Island Sea Lab have been investigating shorebird use of the Delta's intertidal benthic resources. They found that food habits varied by year and species. For Western Sandpiper and Dunlin, the 2 dominant shorebird species on the Delta in spring, the bivalve *Macoma balthica* and the amphipod *Corophium salmonis* were the most important food items.

Science of the Sound: Community Science and Environmental Education

by Kate Alexander, Education Specialist
Allen Marquette, Education Specialist
and Katie Olson, Education
Coordinator 2001-2003

The Prince William Sound Science Center's (PWSSC) education program, Science of the Sound, was developed in 1991 to encourage inquiry into the natural world, to increase scientific and ecological literacy, and to foster responsible use of natural resources. The program uses hands-on learning and outdoor education to help children and adults make personal connections to the natural world and responsible decisions to sustain it.

Science of the Sound is a partnership program created and run by educators from the PWSSC, the United States Forest Service/Cordova Ranger District, and the Cordova and Chugach School Districts. Other program partners that donate in-kind services are the Alaska Department of Fish and Game and Prince William Sound Community College. Four core programs make up Science of the Sound:

The Discovery Room is a monthly science and environmental education program for elementary school students in Cordova, Alaska.

Outreach Discovery takes a modified version of the Discovery Room program to the isolated villages of Chenega Bay and Tatitlek in Prince William Sound.

From the Forest to the Sea summer camp offers field-based ecology programs for 7-16 year olds.

Community Education Programs consist of field trips, lectures, and citizen science projects for adults and families.

The Discovery Room: Science Education in Cordova

The Discovery Room has been the mainstay of Science of the Sound for thirteen years. Instructors from the PWSSC and US Forest Service plan and teach science and environmental education at the Discovery Room, housed in the Prince William Sound Community College. During the school year, every Cordova student in kindergarten through sixth grade visits the Discovery Room once a month. Topics change monthly, and include studies on wetlands, pollution, the ocean, food chains, weather, plant and animal adaptations, and energy. These topics often correlate with what is being taught in the students' classrooms.

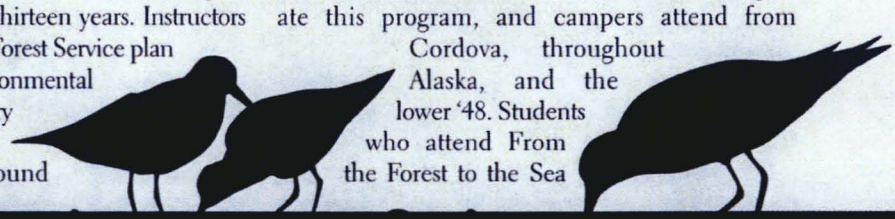
Students at the Discovery Room are divided into small groups and travel through several stations with an instructor. This small student-to-staff ratio allows for individualized and in-depth lessons. Kids learn through many styles, including hands-on experiments, demonstrations, take-home projects, puppet shows, and games. This multi-disciplinary approach to learning makes science fun and allows the students to understand science. Frequent field trips to related locations are the highlights of each year, according to students and instructors alike.

Outreach Discovery: Science Education in Chenega Bay and Tatitlek

PWSSC educators take Discovery Room to the rural villages of Chenega Bay and Tatitilek, adjusting topics to fit the school's curricula. During the visit, Discovery Room educators work with the entire student body for two to three full days. Recent trips to the villages have utilized the forests and beaches near the schools as outdoor classrooms. During the visits, science becomes relevant for students as they explore ecological principles in their own backyard.

From the Forest to the Sea: Summer Environmental Science Camp

During PWSSC summer camp, students from 7 to 16 years of age spend up to six days based at a camp near 25-Mile on the Copper River Highway outside Cordova. Students explore the major ecosystems of the region and study their interdependence. Human connections to, impact on, and dependence on the environment are also investigated. In addition to studying, students enjoy the all the fun of camping with games, campfires, songs, and s'mores. Educators from the PWS Science Center and US Forest Service operate this program, and campers attend from Cordova, throughout Alaska, and the lower '48. Students who attend From the Forest to the Sea



explore the rainforest, wetland, glacial, ocean, and intertidal ecosystems while learning to kayak, canoe, and survive in the outdoors. This approach develops a deep understanding of these ecosystems and the importance of human actions within them. Forest Service and Science Center researchers share their own projects with the campers, which gives the students an inside look at "real science."

Community Programs: Science Education for Adults and Families

Community programs are presented weekly at the PWSSC during the school year. The goal of community programming is to give Cordovans an understanding of the natural environment around them. Led by PWS Science Center educators and local researchers, community programs include field trips to the mud flats, night hikes, star gazing and astronomy, animal tracking and winter adaptation, and presentations on current research being conducted by local scientists. All community programs are free of charge.

Attendance and programs at the 2002-2003 community series increased 30% from the previous years. Families spend Saturdays with Science Center staff, attending seminars, hiking, or boating. Some of the most popular programs were the intertidal program, fossils, bear safety, and Dr. Dick Thorne's presentation on herring populations in Prince William Sound.

Additional Community Education Programs

The Orca Project: Skeleton Rearticulation of "Eyak" the Killer Whale

In July of 2000, a killer whale washed up onto the beach at Hartney Bay in Cordova, Alaska. The whale was butchered with help from the Native Village of Eyak, the Alaska Native Sea Ottor and Sea Lion Commission, the U.S. Forest Service and many volunteers. Science Center educators then worked with NVE staff on the extensive cleaning and re-articulation of the skeleton. It is only the fifth complete Orca skeleton in the world. Lee Post, a marine mammal re-articulation specialist from Homer, helped in the final stages.

The completed whale skeleton is hanging in the upper level of the new Native Village of Eyak Ilanka building in Cordova, and will eventually be complemented by educational and interpretive displays. The Science Center's share of supplies and staff for the project, including the development of the Orca Project website, was supported by the Christensen Fund and the Oil Spill Recovery Institute.

Plans for the Future of Science of the Sound include establishing a science base camp on the Copper River Delta for community programs and Discovery Room field trips. The staff plans to expand the number of field trips, and the amount of time spent with students during Discovery Room programs, especially time outside exploring the natural world.

Discovery Room educators look forward to more involvement with high school students in the future. Previous work with high school students included taking a team to the state-wide National Oceans Science Bowl, helping students with data collection and classroom presentations.

Finally, the Community Education team plans to expand educational and scientific resources through web-based programs for classrooms outside of Cordova, as well as creating links for the various research projects occurring in conjunction with the PWSSC.

Kate Alexander earned a Bachelor of Arts from Dartmouth College and joined the PWSSC Education Program in January 2003. She is co-director of the summer camp and organizes a variety of programs for high school age students.

Allen Marquette has a wealth of experience in assisting science and natural history programs in various Alaska rural school districts. He joined the PWSSC education staff in September 2002 and currently serves as co-director of the Discovery Room and organizer of the Community Programs.

Katie Olson was Education Coordinator for PWSSC from 2001 though 2003 and contributed the basis of this report before her departure.

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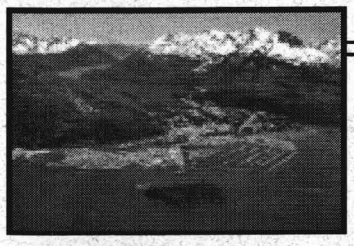
PRINCE WILLIAM SOUND SCIENCE CENTER
CORDOVA, ALASKA

the Breakwater

November, 2004

Newsletter of the Prince William Sound Science Center
P.O. Box 705, Cordova, Alaska 99574—www.pwssc.gen.ak.us



A view of Cordova from the air.

INSIDE

- Monitoring pink salmon food supply
- New Oceanographer joins Center
- Education update: Science Camp Overview, Community Programs, Discovery Room, and National Oceans Science Bowl
- Mark your calendars! !! Copper River Nouveau is June 11, 2005!
- Become a member!

Oceanographic instrument added to mid-Sound buoy

For the first time ever, real-time data describing ocean conditions in Prince William Sound is transmitting from the mid-Sound (West Orca Bay) NOAA buoy. At the buoy's website (address below), you'll find salinity, conductivity and water temperature data as well as the direction and speed of the currents at varying depths to 1200 feet.

The Prince William Sound Science Center purchased an acoustic Doppler current profiler (ADCP) to measure ocean conditions, and NOAA installed it last spring while doing regular maintenance on the buoy. Part of an effort to enhance ocean observations in Prince William Sound, the ADCP is the first of a dozen new instruments that will be deployed in the coming year. Eventually, all three NOAA buoys in Prince William Sound will have ADCPs attached to them, and an array of ADCPs will also be moored in an array across both Hinchinbrook Entrance and Montague Strait.

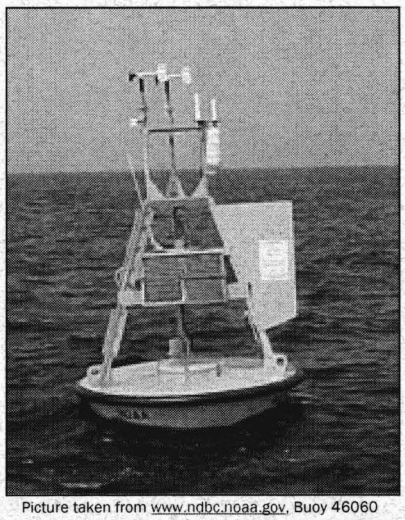
The information will answer questions about the mechanisms and exchange rates of water between the Gulf of Alaska and the Sound. This is critical to understanding the variation in ecosystem processes and the population dynamics of plankton and other biological communities.

While the NOAA buoys have built-in capability to transmit the data in real-time, the other instruments will collect and store data. Science Center staff will retrieve the information twice annually in conjunction with hydrographic surveys they will be doing on a quarterly basis.

This work is made possible through two NOAA grant awards in 2004 to support enhancement of the Prince William Sound Ocean Observing System (PWSOOS).

Now a pilot project for the Alaska Ocean Observing System, the PWSOOS is designed to increase efficiencies of existing ocean observing work and develop products useful to a wide variety of users including scientists, resource managers, search and rescue, educators, industry and security agencies.

(Continued on page 5)



Picture taken from www.ndbc.noaa.gov, Buoy 46060

COPPER RIVER NOUVEAU

Investigators look for better methods to dispose seafood waste

by Dr. Richard Thorne

The Science Center, in cooperation with the Copper River Watershed Project (CRWP), recently hosted a workshop on seafood waste discharge alternatives. The October 6 workshop, part of a Science Center Project funded by Exxon Valdez Oil Spill Trustee Council (EVOS TC), focused on the adverse changes in the Orca Inlet ecosystem caused by the Environmental Protection Agency mandate to grind fish waste.

Prior to the change, which occurred in the late 1970's, whole fish carcasses were utilized by larger fishes, crabs and even the now endangered Steller sea lions. The process of grinding waste to less than 0.5" effectively limited this potential food resource to bacteria, worms and gulls. Gulls attracted to the discharge have become a major nuisance, and potential health hazard, for Cordova. The EVOS TC-funded project seeks to document that larger grinds, heads, or whole carcasses can be effectively utilized by larger, commercially valuable species.

About 20 people attended the workshop, including local representatives of Alaska Department of Fish and Game, Native Village of Eyak, CRWP, PWSSC and seafood processors. Attendance included three individuals from outside

(Continued on page 6)

Hundreds of gulls are attracted to the current outfall pipes

OSRI News: Oceanography class hosted by USCG Cutter Sycamore

by Dr. Carl Schoch

Dr. Carl Schoch shows oceanography students how a CTD records information as it descends to the bottom of the ocean.

On October 16, the Coast Guard Cutter Sycamore hosted the Prince William Sound Community College oceanography class for a one-day research cruise to measure the temperature, salinity and density gradient of Orca Bay between the mid-Sound NOAA weather buoy and the Rude River (Fig. 1). Oceanographers Carl Schoch and Claude Belanger, and instructors Kate Alexander and Allen Marquette from the Prince William Sound Science Center accompanied the students for a day of hands-on experience with oceanographic sampling equipment and ship operations.

Allen also organized a Cordova community group to accompany the students on the research cruise. The ship's company was extremely accommodating and provided not only free range of the ship's bridge and buoy deck but also plenty of assistance with the sampling equipment.

The cruise departed Cordova at 8 am for the NOAA weather buoy where the water column temperature and salinity were measured to a depth of 250 meters. At the same time that the physical properties of the water were measured, plankton samples were collected using a fine-mesh net.

The mid-Sound NOAA weather buoy was recently fitted with an Acoustic Doppler Current Profiler (ADCP) and a surface temperature and salinity sensor purchased by a grant to the Science Center. This ADCP measures ocean currents through the entire water column and the buoy transmits these data along with weather data every hour to a web page (www.ndbc.noaa.gov, Buoy 46060).

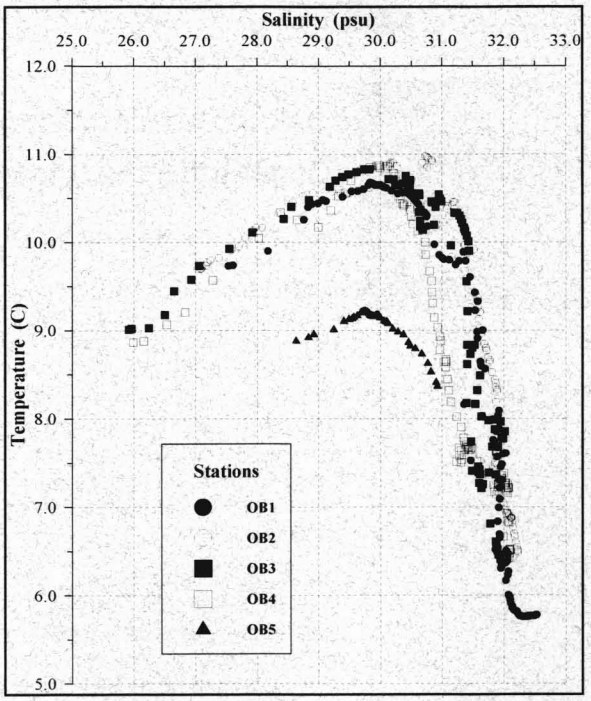


Figure 3. Temperature/salinity plots form CTD profiles.

Four more stations were sampled along the estuarine gradient of Orca Bay to measure the change in intensity of freshwater stratification. The bathymetry of Orca Bay shows a shallow sill at The Narrows, and four of our samples were collected outside of the sill and one inside near the mouth of the Rude River (Fig. 2).

We would expect our profiles to show that water becomes colder and less saline towards the head of Orca Bay where glacial meltwater enters via the Rude River. But surprisingly, inside of The Narrows, the water became colder and more saline (compare the plotted line for OB5 on Fig. 3). Our data suggests that relatively cold and fresh river water is mixed with more saline water that intrudes over the sill when tide floods. The cause of this mixing is not know, but possible mechanisms may include tidally driven flow over the sill creating turbulence that disrupts freshwater stratification, or a tidally generated internal wave at the sill may break causing mixing in the shallow basin at the mouth of the Rude River.

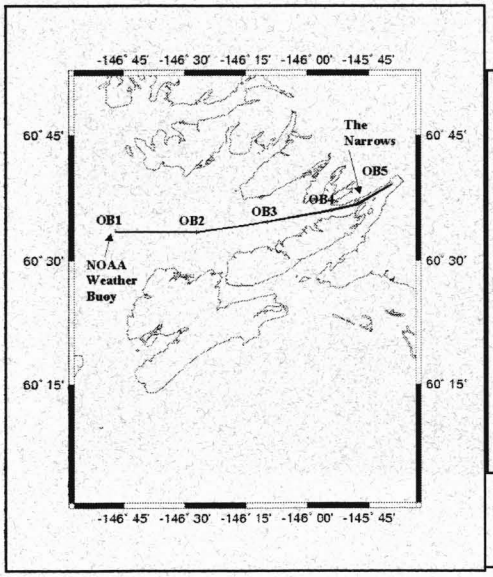


Figure 1. (left) The oceanographic transect on 10/16/04

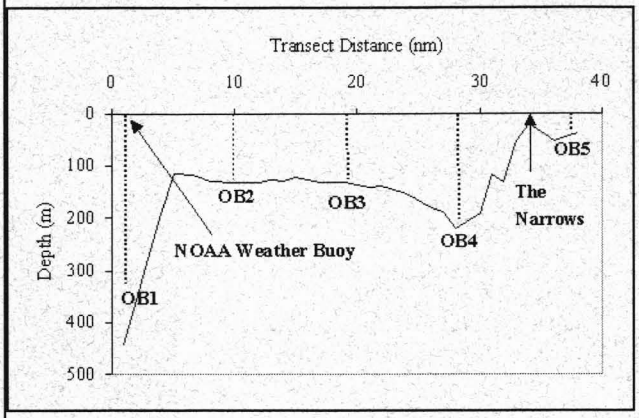


Figure 2. (above) Bathymetric bottom profile of the transect

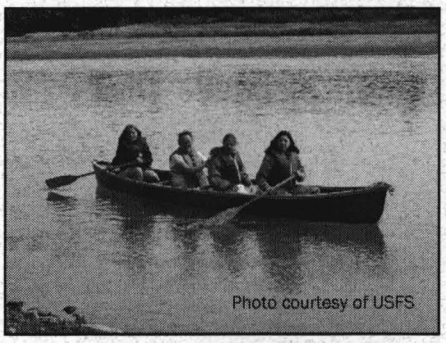
Science of the Sound

Update on the education programs of the Prince William Sound Science Center

Summer days full of sunshine and smiling faces: 2004 From the Forest to the Sea Summer Camp update

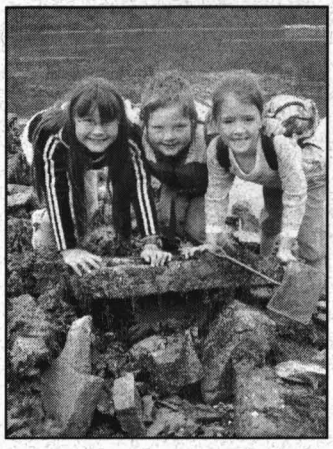
"From the Forest to the Sea" Summer Camp program saw a marked increase in participants from 62 in 2003 to over 150 people this summer. This is a result of an increased diversity of camp programs offered as well as a whole lot of sunshine!

The summer started with a Girl Scout camp for two local troops. We had nineteen 7-8 year old participants for one night and two days of science activities, arts and crafts, and games. We then hosted eighteen 6th graders for three days and two nights, helping the girls work towards earning six Girl Scout badges.

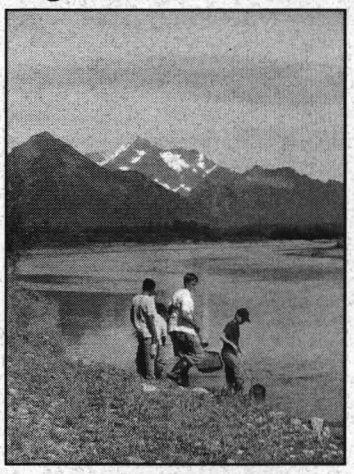


Girls Scouts paddle down Alaganik Slough.

Another new program held this summer was a week long day camp. Since we were not limited by sleeping space at our overnight campsite, we were able to enroll up to 20 participants. This program lasted a week and participants were split into an older and younger age group. Both groups ended the week with a group overnight.

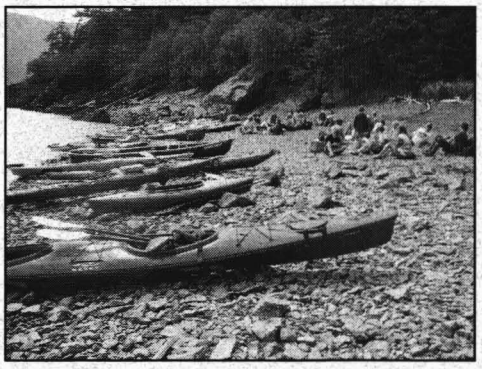


Day camp participants show off a sunflower star found on intertidal day.



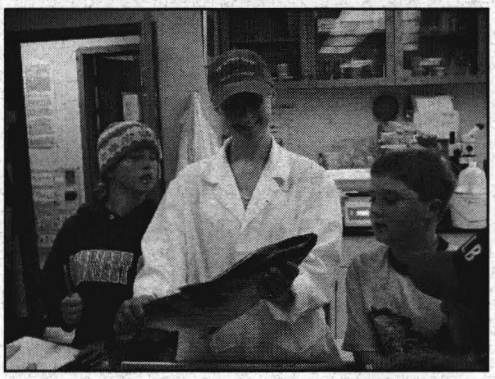
Camp participants collect benthic macroinvertebrates on wetland day.

Two Community Days were hosted as well for participants of all ages. These were a kayaking trip to explore intertidal ecosystems and a canoe trip to learn about the importance of wetlands. We had 40 participants on the kayak day and 45 attend the canoe day. These programs were made possible by community donations of time and equipment from organizations such as Cordova Auto Rental, Cordova Coastal Outfitters, Copper River Watershed Project, and individual members of the community.



Kayaks line Observation Island on Kayak Day.

Finally, three weeklong overnight programs were held for ages 9-14 and two single overnight programs were held for ages 7-9. The weeklong science camp programs filled immediately with participants from all over the state and even a few from the lower 48. Campers in these session were able to kayak, canoe, and hike while learning about wetlands, temperate rainforest, and glaciers on the Copper River Delta, and the intertidal zone of Prince William Sound. The two mini-camp programs organized for youth aged 7-9 focused on native plants and astronomy.



Science Center lab technician Signe Fritsch demonstrates how to get an otolith out of a salmon.

Camp staff included two summer interns for the Prince William Sound Science Center; Libby Rayburn and Hilary Papendick. Both women learned tremendous amounts about teaching and the local ecosystems and left Cordova excited to continue on their path of environmental education. The programs certainly wouldn't have been as successful without their hard work!

Plans are already in place for next summer programs . One new program will include a Leadership Training program for youth aged 15-18. We also hope to offer at least one more week long session in order to meet the increasing interest for these type of programs. For more information on our camp programs check out our website at http://www.pwssc.gen.ak.us/pwssc/educ/camp/camp.htm.

Seven campers' experiences were made possible by scholarships from the Carol Treadwell Scholarship Fund. Please contact Kate for information on how you can help provide this camp experience for a lucky applicant! Thanks to those who contributed to the scholarship fund this past summer.

For more information on these programs or to find out how to contribute to our education efforts, contact Kate Alexander (kate@pwssc.gen.ak.us) or Allen Marquette (allen@pwssc.gen.ak.us) at any time!

Discovery Room students explore the life of salmon

October spawned a new school year of exploration in the Discovery Room with salmon being the focus. Mt. Eccles Elementary School students learned what makes a fish a fish, how salmon find their way home to spawn, and the older students were introduced to a salmon habitat monitoring project.

Throughout the rest of the school year, students will learn specifics about salmon life cycles, anatomy, habitat, how and why salmon populations are managed and salmon/human interactions. Our last program of the year will again focus on the amazing shorebird migration that takes place each May.

The salmon habitat monitoring project is new this year and expands on the Copper River Watershed Project (CRWP) FishWatch program. It will offer students the opportunity to monitor a known salmon spawning location on the Eyak River. From May to September, monthly data is collected for CRWP by volunteers all over the Copper River Watershed in order to gain an overall understanding of the status of important salmon habitat.

Sixth grader Craig Bailer works his way through snow drifts with the net used to sample benthic macroinvertebrates on the November sampling day.

The Discovery Room monitoring program will continue these tests on one site throughout the winter months to see how salmon habitat changes during the winter. Each month, eight to ten Eccles students will accompany Science Center educators to record air and water temperatures, precipitation, dissolved oxygen content, nitrate and phosphate levels, pH, and benthic macroinvertebrates. A series of photographs will also be taken of the same area each month to provide visual images of how the area changes throughout the year. Different students each month will be selected by Science Center educators and Mt. Eccles teachers to give different students the opportunity to participate in this unique program.

Another aspect of the salmon habitat-monitoring program includes the villages of Tatitlek and Chenega Bay. Students and teachers in these remote villages will also be collecting similar data around their village and will share this data with students in Cordova. All students will be able to make comparisons between other communities located around the Prince William Sound, allowing for a greater understanding of the whole ecosystem rather than an

(Continued on page 6)

Community Program series kicks off in September

The Community Education Program started up in September with great attendance for the first exciting programs of the season. One of the recent topics included, *Mushrooming around Cordova*. Forty-two people attended the mushroom presentation, which included many samples of poisonous as well as edible mushrooms.

After the program, all of the edible mushrooms were sautéed in butter and served to the many visitors. A few attendees braved the torrential rains to go mushroom collecting up Power Creek Road. Many edible varieties of mushrooms were discovered and harvested by the group.

Another popular program with over forty people in attendance focused on the Geology of Denali National Park. Recently, Allen Marquette of the Prince William Sound Science Center participated in a field trip with Cordova High School geology teacher Adam Low and fifteen geology students on a five-day field trip to explore the geology of interior Alaska. Besides Denali Nat'l Park, students also learned about the geology of coal deposits near Healy, the Independence gold mine at Hatcher Pass and received a tour at the Alaska Volcano Observatory in Anchorage.

Students taking the class gave a presentation for the Community that included a Power Point program showing the extent of the field trip as well as rock and fossil specimens collected on the trip. Lastly, students split a few large specimens of shale collected on the trip, exposing beautifully preserved fossil leaves for members of the audience to take home.

Other programs included a nine-hour cruise on the Coast Guard Cutter Sycamore performing oceanography experiments. Participants included seven students enrolled in an oceanography course at the local college and thirteen community members. Plankton nets were towed to capture plankton and other microorganisms, which were viewed through microscopes on the Cutter. Students also dropped a CTD and the data downloaded onto computers for participants to observe.

Oceanography student Ezekiel Brown, brings up the plankton net .

Science Bowl participants tackle local affects of global climate change

Kate Alexander will again have the honor of coaching a team of local high school students in the Tsunami Bowl, the regional competition of the National Ocean Science Bowl. This year's team includes six students: Lee Collins, Chris Hager, McKenzie Herring, and Leif Stavig of last year, as well as new members Ezekiel Brown and Beth Locklar.

The research topic for this year's competition is "The effect of climate change upon Alaska's marine ecosystems and the communities they support." The Cordova team will call on experts in the field of climatology, glaciology, and ocean circulation in order to speculate how global warming may affect the physical environment surrounding Cordova. The students will then focus on how these effects are manifested in the marine food chain, including salmon species that Cordova relies so heavily on for commercial and subsistent purposes.

A majority of the team members are also enrolled in the oceanography class offered at the PWS Community College. This course will help prepare the students for the quiz bowl competition that will take place in Seward from February 18-20th, 2005.

2004-2005 Science of the Sound Sponsors: OSRI, State of Alaska; Coastal Impact Assistance Program, ConcocoPhillips, Alaska Conservation Foundation, BP
Local Sponsors: Cordova Telephone Cooperative, Cordova Electric Cooperative, Alaska Marine Lines
Thanks for your support!

PWSSC completes fifth year of monitoring the juvenile pink salmon food supply

By Dick Thorne

In 2000, the Science Center initiated a spring survey of zooplankton abundance in PWS to help understand the factors impacting juvenile pink salmon survival. This spring marked the fifth year of the program.

Pink salmon return as adults after slightly more than one year at sea, so this year also saw the fourth year of returns that resulted from nursery ocean conditions that were monitored by the surveys. Two of the pink salmon returns were relatively large, 2001 and 2003, while the returns in 2002 and 2004 were disappointing. The two high returns were associated with nursery conditions with high abundance of large copepods, while the two low returns came from poor spring nursery conditions (Figure 1).

The return in 2003 was unusually high even for the relatively high abundance of large copepods that were observed during spring 2002. There were two possible factors in this exceptional pink salmon survival. One was a late spring increase in large copepods, the other was an unusually high abundance of euphausids (or krill) (Figure 2). Both euphausids and large copepods probably act as a prey shelter, diverting pollock away from predation on juvenile pinks.

Spring 2004 was characterized by relatively high large copepod abundance, but relatively low euphausid abundance. Consequently, the adult pink salmon return next summer should help clarify the relative importance of these two zooplankton components.

Figure 1. Comparison of adult pink salmon returns to PWS with the average plankton net catch of large copepods during the previous spring.

Figure 2. Comparison of adult pink salmon returns to PWS with a combined index of large copepod and euphausid abundance during the previous spring.

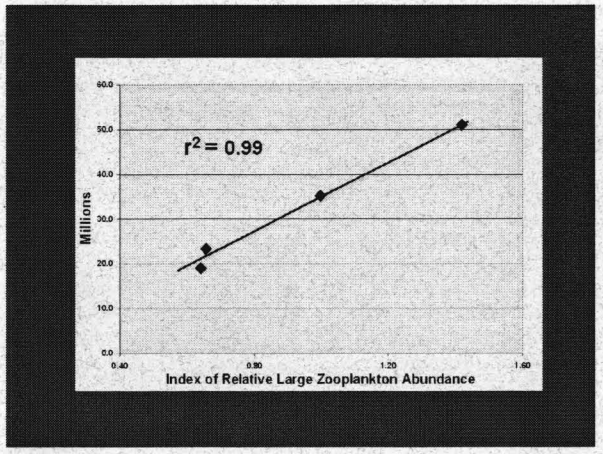


Figure 1

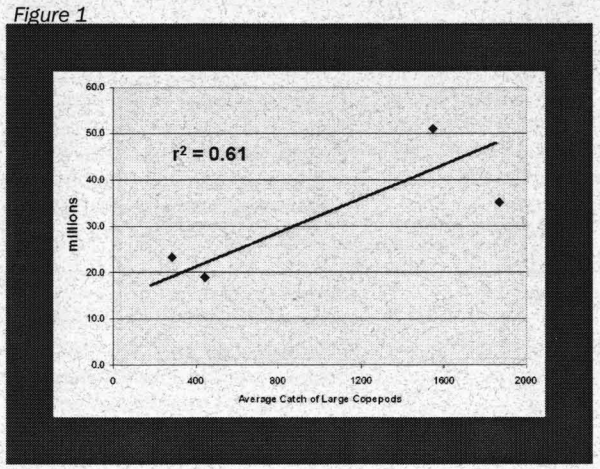
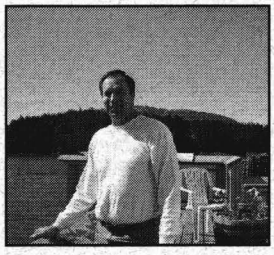


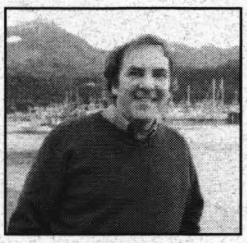
Figure 2



Happy Holidays from the crew here at the Science Center!!!

New staff join the Center

Lindsay Butters has joined the education staff as education intern from November through May, 2005. She will be helping with the Discovery Room, Community Programs, Outreach Discovery, and high school programs during her time here. Lindsay is from Blue Mountain Lake, New York and she graduated this spring from Johnson State College in northern Vermont. Most recently Lindsay served as a backcountry caretaker for the Green Mountain Club in Vermont, providing education and assistance to hikers and groups using the Long Trail, the oldest long distance hiking trail in the U.S. The 273 mile Long Trail runs the length of the state from Massachusetts to Canada via the spine of the Green Mountains. During her second season as caretaker she became somewhat of an expert at composting, and enlightened many hikers about the finer details of composting human wastes at high use sites in the backcountry.



Dr. Claude Belanger joined the Prince William Sound Science Center as a post-doctoral oceanographer in July 2004. Under the advisement of Dr. Steve Okkonen, he will be the lead investigator on the OSRI grant to the Science Center for the oceanographic monitoring of Hinchinbrook Entrance and Montague Strait. He will also look at the problem of differentiating the freshwater flowing into Prince William Sound as rain and melting snow from the volume that discharges into the Sound from melting glaciers. In his spare time, he plans to study the frequency and magnitude of water renewal in the deep basins of the Sound.

Claude recently completed his doctoral studies in physical oceanography at the Institute of Ocean Sciences of the University of Québec at Rimouski. His dissertation focussed on understanding the tidal and subtidal circulations in the Saguenay Fjord, a large embayment off the St. Lawrence River in Québec. He conducted a large observational oceanography program and observed an unexpected summer episode of deepwater renewal and succeeded in developing a three-dimensional numerical model of this fjord to explain the tidal and subtidal variations in density and current before, and during, the period of renewal.

Since finishing that degree he has been a research assistant on the Canadian Coast Guard Ship Amundsen in the Arctic. Prior to 1993 he was a research assistant in physical oceanography at McGill University in Montréal. In 1993, he moved to Norway with his Norwegian wife and two daughters. While studying Norwegian, he also participated in research projects at the Norwegian Polar Institute and at the Norwegian Institute for Forestry Research.

Now living a spartan life in Cordova, he contemplates why he accepted a post doc 6500 km from his wife and children, reads esoteric English novels, develops plans for moving a piano to Cordova, and is humored by the efforts of the Science Center staff in teaching oceanography at the local community college.

NOAA buoy cont'd

(Continued from page 1)

Another part of the project will improve the meteorological data available from multiple locations around the Sound. The six stations installed two years ago by the Oil Spill Recovery Institute are being upgraded this spring and, in some cases, the locations moved. In partnership with the Natural Resources Conservation Service (NRCS), the new stations will be part of a network that uses meteor burst communications technology for transmission of its data. In addition to improved consistency and data quality, the upgraded weather stations will include precipitation gauges.

Additional work funded through the NOAA grants to the Science Center includes development of both a wave model and a real time data assimilation ROMS ocean circulation model. Those models will be developed, respectively, by Texas A&M University and the Jet Propulsion Laboratory.

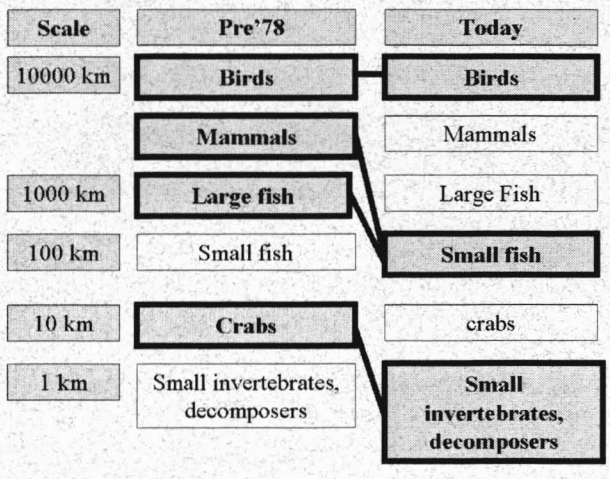
Visit these web sites for more information about the buoys, AOOS or PWSOOS: www.ndbc.noaa.gov ; www.aoos.org ; www.pwsoos.org.

Discovery Room cont'd

(Continued from page 4)

isolated picture of one community. This collaboration between schools will also provide cultural and social exchanges among isolated communities. It will serve as a pilot for future collaborations with schools located throughout Alaska and in the lower 48.

Seafood waste cont'd



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Cordova: Kenwyn George of Department of Environmental Conservation (Juneau), Gary Thomas of Rosentiel School of Marine and Atmospheric Science (Miami), and Dick Dworsky, Science Coordinator for EVOS TC (Anchorage). Kenwyn George has conducted related studies in Ketchikan and is a major collaborator on the project. Gary Thomas, former president of PWSSC, presented a model on seafood waste dispersal that documented the role of biological transport of waste products. According to Dr. Thomas, the change to a fine grind discharge actually intensified the problem by limiting utilization to smaller, less mobile organisms. The study is planned over three years, depending on future funding. The 2004 final report is available through the internet at www.EVOSTC.state.AK.US in annual reports 2004, principal investigator Thorne.

The change from whole carcasses to a fine-grind discharge changed the utilization patterns from large fishes, mammals and crabs to smaller, less mobile organisms, resulting in less effective disposal.

PWSSC and OSRI Board News

Policies and programs were reviewed during mid-September Board meetings of the Prince William Sound Science Center and the Oil Spill Recovery Institute. The two Boards met jointly on Sept. 13 in Cordova and held separate meetings as well to elect officers and approve budgets and work plans for the new fiscal year.

A report on the drifter buoy experiment conducted in early August was presented to the joint Board session. The unusually calm weather conditions during the first two weeks of August assisted the "no-loss of drifter buoy" results. A written report on the experiment is expected by late October and will be posted at the websites.

The Science Center's Board unanimously re-elected existing officers including Meera Kohler, Chair; Edward Backus, 1st Vice-Chair; Charles Meacham, 2nd Vice-Chair; Ed Zeine, Secretary; and Gale Vick, Treasurer. Walter Parker was also re-elected to serve on the Executive Committee.

Also elected to three-year terms on the PWSSC Board were Steve Smith (Cordova fisherman), Jerry Gallagher (ConocoPhillips), and Mead Treadwell (Venture Ad-Asta)

OSRI's Executive Committee for 2004-2005 was elected to include John Calder, Chair; Douglas Mutter, Vice-Chair; Mark Fink, Secretary; R.J. Kopchak, Treasurer; and Carol Fries and Douglas Lentsch as members at large. Michael Bronson joined the OSRI Board as an alternate oil and gas industry representative.

The OSRI Board will next meet on Nov. 19 in conjunction with the OSRI Scientific and Technical Committee. The draft Science Plan will be the focus of this meeting, in Anchorage. The OSRI Board plans to approve the plan at its Feb. 10-11, 2005 meeting.

The next PWSSC Board of Directors meeting is June 10, 2005.

Current research projects listed by the principal investigating scientist

Learn more about these projects at www.pwssc.gen.ak.us *or contact the Principal Investigators listed below.*

Richard Thorne, Ph.D, is a fisheries scientist with many years of experience using hydroacoustics to measure fish and plankton populations. Current projects he is leading include:

—Monitoring the juvenile pink salmon food supply and predator populations in Prince William Sound

—Investigation of the role of Pacific herring as winter forage for Steller sea lions

—Impacts of Seafood Waste Discharge in Orca Inlet. (co-PI Dr. Mary Anne Bishop)

Thomas C. Kline, Jr., Ph.D. is a biological oceanographer who specializes in food web analysis using stable isotopes. Current projects include:

—GLOBEC —A long-term observation program using stable isotope abundance for detecting coastal Gulf of Alaska zooplankton source fluctuations.

—Salmon Derived Nutrients

Mary Anne Bishop, Ph.D. is an ecologist who has conducted a variety of studies on the Copper River Delta and Prince William Sound region since 1991. Her current studies include:

—Spring Migration of Shorebirds in Pacific Flyway: Wetland Quality, Bioenergetics, and Connectivity

—Ecology of Copper River Delta Flats

—Estuaries as essential fish habitat for salmonids: Assessing residence time & habitat use of coho and sockeye salmon on the Copper River Delta.

Oceanographer Claude Belanger, Ph.D. works with *Shelton Gay, M.S.* on physical observations oceanography programs. *Steve Okkonen, Ph.D.,* as an OSRI Senior Research Fellow, works in collaboration with Belanger, Gay and also the OSRI Science Director. Current programs include:

—Observational Oceanography in Prince William Sound

—Enhancements to the PWS Observing System

—Copper River Delta hydrography: oceanographic support

Become a Member

The mission of the Prince William Sound Science Center is to:

Contribute to the comprehensive description, sustained monitoring and ecological understanding of Prince William Sound, the Copper River and Gulf of Alaska;

Promote the goal of maintaining long-term, self-regulating biodiversity, productivity and sustainable use of renewable resources;

Educate and inform the youth and the general public about the critical interdependence of the biology and regional economies of Alaska.

The Prince William Sound Science Center is an independent, nonprofit research and education organization. Your membership is important. Although much of our research is grant-funded, our education, communications and research planning programs are not. Membership contributions help us continue to serve the public as an information resource and acknowledge your support for ecosystem monitoring.

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Please check the membership level of your choice. THANK YOU!

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PRINCE WILLIAM SOUND SCIENCE CENTER CORDOVA, ALASKA

Membership is tax-deductible.

Benefits include a 10 percent discount on the purchase of T-shirts, posters, and other logo merchandise. You will also receive a membership decal.

THANKS FOR YOUR SUPPORT!

Newsletter of the Prince William Sound Science Center
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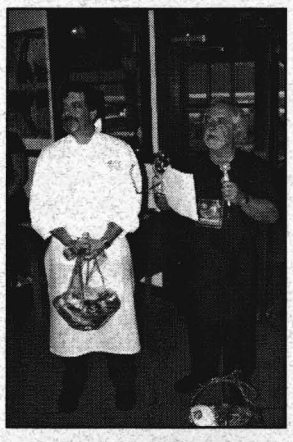
Mark your calendars! Annual fundraising dinner is June 11, 2005

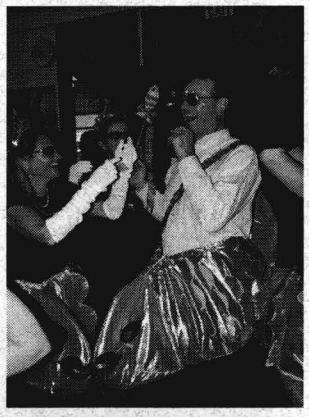


The Copper River Nouveau 2005 will be at the Reluctant Fisherman Inn dining room, Cordova's most elegant banquet location, with a grand view over the harbor and the PWS Science Center building. Local residents Sylvia Lange, Greg Meyer and family have worked hard this fall to restore the hotel and restaurant to its full potential.

Will there be salmon? Oh yes, always Wild Copper River Salmon! At Copper River Nouveau we promise you the finest seafood menu, carefully selected wines, and the most boisterous company within a thousand miles.

Tickets go on sale May first for the June event. If you would like to participate as an entertainer, kitchen slave, arts or fresh fish donor, please let us know.

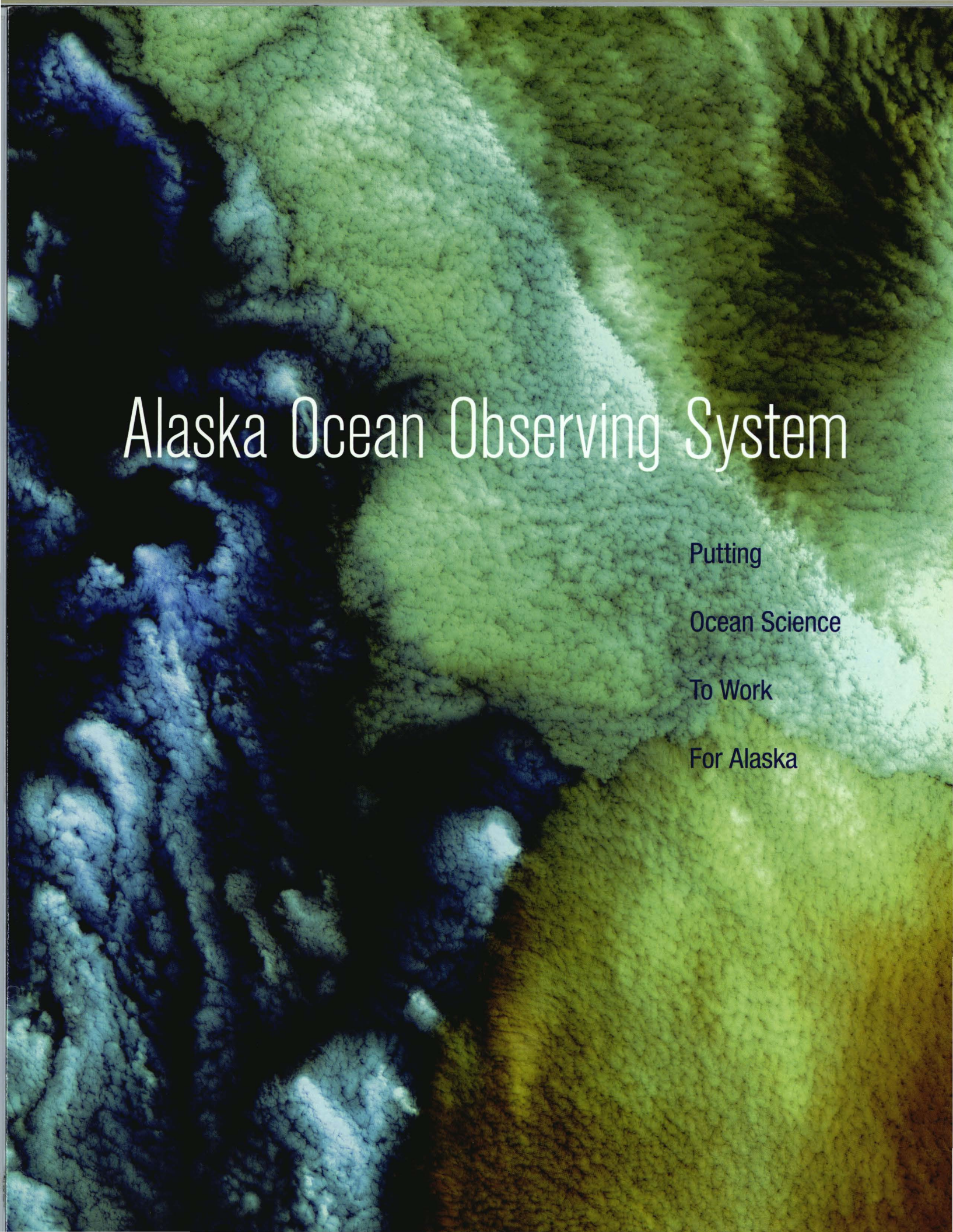
Copper River Nouveau logo merchandise is available at the Science Center. The logo is reminiscent of an old salmon can label and printed in red, copper and white on black fabric. The popular 2 pocket server's apron with the Nouveau logo ($20) initially sold out just days after the summer 2004 event but we've replenished our supply of these one-size-fits-all aprons that are perfect for Christmas presents! Black cotton logo T-shirts in men's and women's styles are also in stock in the full range of sizes ($15).



Jack and Van (above left) from the Marx Bros Café in Anchorage were responsible for this year's wild salmon feast! Senator Arliss Sturgelewski (left) served as honorary hostess for this year's festivities.

The Cordova Alutiq Ikumat Dancers perform on the Science Center dock during the early evening reception (left).

One lucky winner was crowned a Copper River Queen for a day (above right). Science Center intern Libby Rayburn (right) displays one of the yummy treats from the Dessert Auction. The 2004 event raised almost $20,000 for Science Center programs.



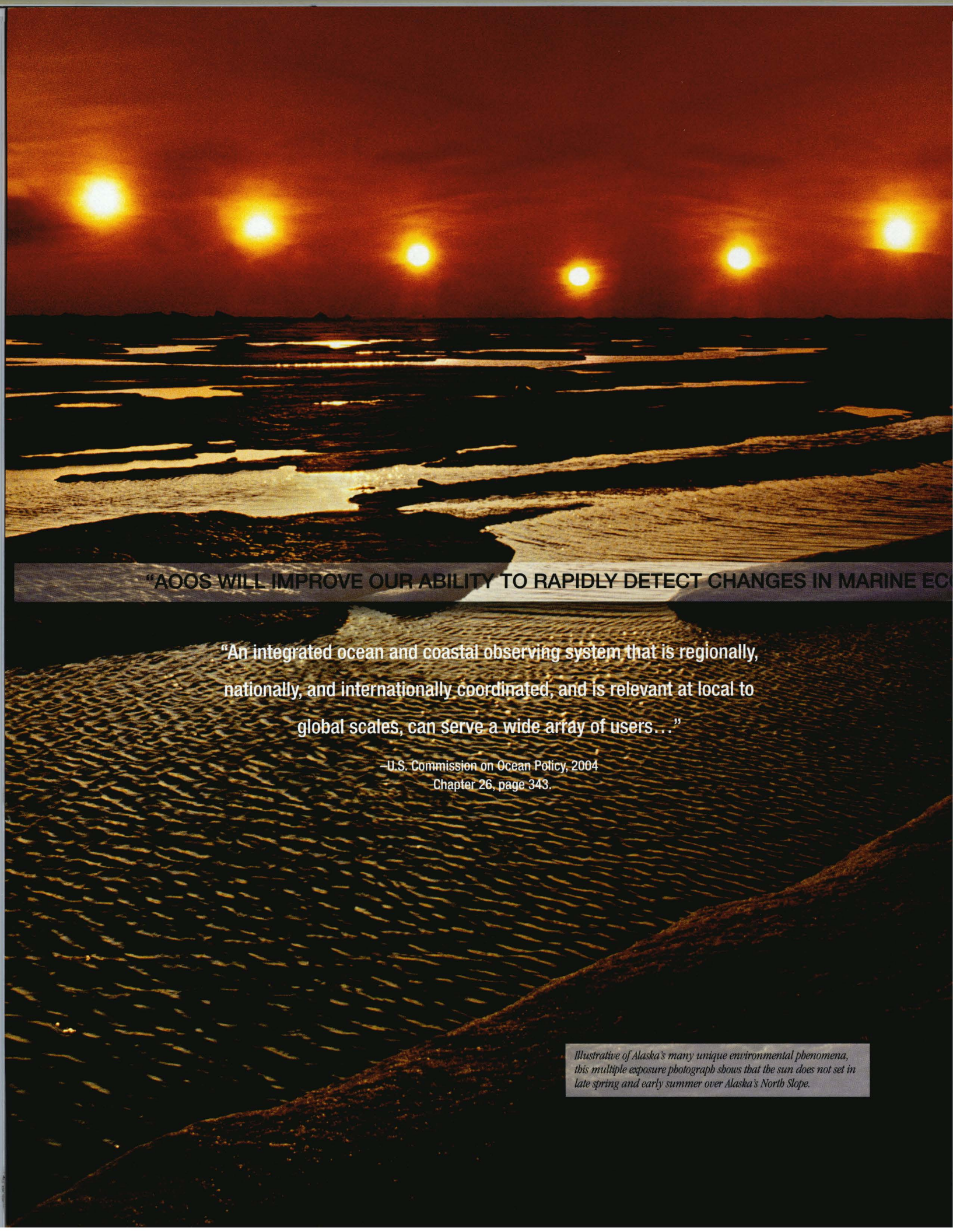
Alaska Ocean Observing System

Putting

Ocean Science

To Work

For Alaska



"AOOS WILL IMPROVE OUR ABILITY TO RAPIDLY DETECT CHANGES IN MARINE EC

"An integrated ocean and coastal observing system that is regionally, nationally, and internationally coordinated, and is relevant at local to global scales, can serve a wide array of users…"

–U.S. Commission on Ocean Policy, 2004
Chapter 26, page 343.

Illustrative of Alaska's many unique environmental phenomena, this multiple exposure photograph shows that the sun does not set in late spring and early summer over Alaska's North Slope.

What Is the Alaska Ocea

Imagine the Benefits of Forecasting Conditions on Alaska's Seas as Routinely as Meteorologists Forecast the Weather.

- Maritime shippers would be able to take advantage of favorable currents while avoiding heavy seas, ice-choked straits, and strong headwinds.
- Fishermen could pinpoint the likely location of nutrient and temperature "hotspots" to find fish more efficiently.
- Subsistence users would have better forecasts of sea ice conditions.

Such benefits are the goal of the Alaska Ocean Observing System (AOOS)—a federal, state, and private partnership that will collect coastal and ocean observation data and make it available in useful ways to a broad audience of Alaska stakeholders.

A network of tsunami-sensing buoys, known as DART, deployed by NOAA in the North Pacific Ocean, is a component of AOOS.

AOOS will help scientists understand, integrate, and track changes in sea ice, and convey their information to marine industries.

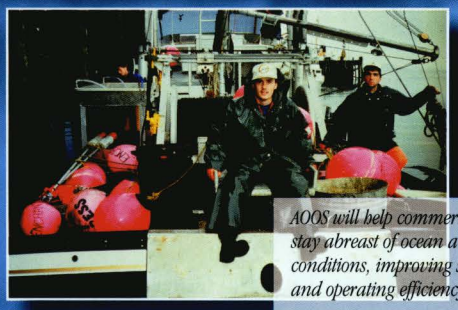
SYSTEMS AND LIVING RESOURCES AND PREDICT FUTURE CHANGES AND THEIR CONSEQUENCES

- Shellfish farmers would be able to take steps to protect their crops when ocean conditions become ripe for spawning crop-damaging diseases.
- Resource managers would see changes occurring in the ocean in "real time," and be able to respond with better management.
- Coastal communities could be better warned and prepared for conditions that cause coastal erosion.
- Detailed maps of currents would allow for faster, more efficient cleanup of oil spills.
- Search and rescue teams could save lives by having more detailed information about winds and currents.

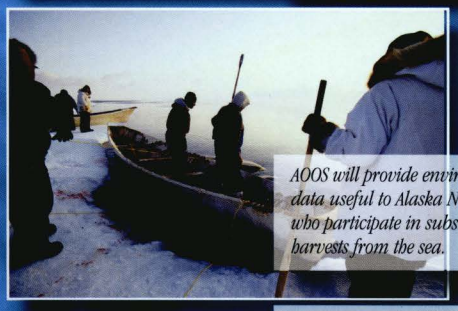
What Is the Alaska Ocean Observing System?

AOOS is a network of air-, land-, and sea-based instruments that collect a host of valuable oceanographic, atmospheric, and biological data, which are then turned into information and tools for Alaskans to use.

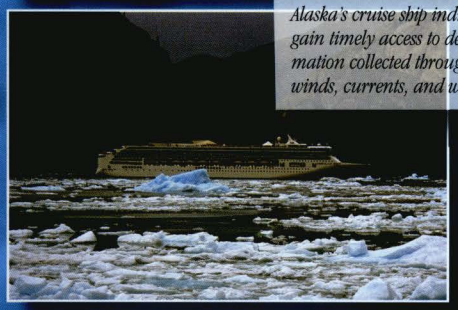
Moorings and buoys already in place, as well as other sensors envisioned for the future, will collect information about winds, currents and wave height, salinity, sea ice, precipitation, and other parameters. Satellites and land-based radar will monitor sea temperature, seasonal and fast-ice extent and thickness, cloud cover, and springtime



AOOS will help commercial fishermen stay abreast of ocean and weather conditions, improving safety at sea and operating efficiency.



AOOS will provide environmental data useful to Alaska Native groups who participate in subsistence harvests from the sea.



Alaska's cruise ship industry will gain timely access to detailed information collected through AOOS about winds, currents, and waves.

n Observing System?

plankton blooms. Researchers on ships will feed their data into the AOOS information system. Direct observations by Alaskans themselves, as well as the local and traditional knowledge kept by Alaska Natives, will play vital roles.

AOOS will deliver real- and near real-time information—call them ocean "nowcasts" and forecasts—about our ever-changing marine environment. Over time, the information can reveal long-term trends about Alaska's ocean ecosystem and marine life.

The vast amounts of data collected by AOOS partners will be offered as tailored products—ocean forecasts, maps, and images—to meet the needs of mariners, fishermen, subsistence users, scientists, resource managers, coastal planners, educators, emergency response officials, and many others who use and depend on the sea.

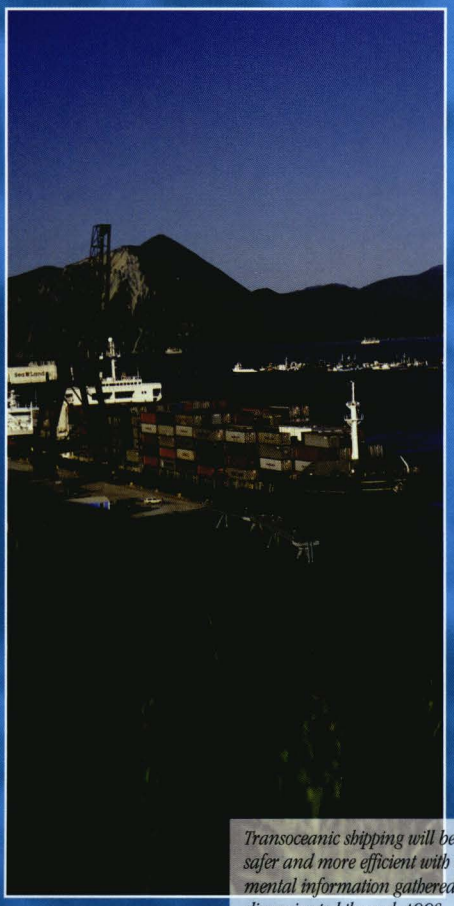
Why Do We Need AOOS?

Alaska has 44,000 miles of tidal shoreline, more than twice that of the rest of the United States combined. Vast, often dangerous seas flank the state on three sides. More than 80 percent of Alaskans reside along the coast and make their living directly or indirectly from what the sea provides. Indeed, our seas are our lifeblood. Approximately 40 percent of the U.S. seafood catch is harvested from Alaska's waters. The sea yields other resources as well. About 15 percent of the nation's oil supply comes from within Alaska's coastal zone. Cruise ships ply our seas, bringing more than one million wide-eyed visitors to the state each year.

The sea also brings natural disasters. Tsunamis, undersea earthquakes, storm surges, shoreline erosion, and sea ice all pose threats to Alaska coastal communities. Scientists agree that the global climate is warming, and that the Arctic and subarctic, including Alaska's seas, are experiencing major changes as a result. Many of these impacts, such as coastal erosion already being experienced by some Alaska communities, are the direct result of Alaska's changing marine environment.

While much information is collected about our oceans today, there is no coordinated effort to package the information in practical, useful ways that can help Alaska stakeholders cope with the multitude of changes they now face and will face in the future. AOOS will serve as a centralized program to gather, sort, store, and share ocean observations to help us better understand, prepare for, and respond to our changing seas, including the potential to save lives and benefit the Alaska economy.

S FOR THE PUBLIC GOOD." – MOLLY MCCAMMON, DIRECTOR, ALASKA OCEAN OBSERVING SYSTEM



Transoceanic shipping will become safer and more efficient with environmental information gathered and disseminated through AOOS.

Our Vision

To provide easy access to information about the physical, chemical, and biological states of Alaska's oceans and coastal ecosystems.

Our Mission

To develop and maintain a network of ocean and coastal observations for Alaska stakeholders, used to generate informational products and tools for informed decision-making to ensure sustained use of the marine environment.

Science Working for You, and Alaska's Oceans.

AOOS will facilitate dissemination of information collected by the National Polar-orbiting Operational Environmental Satellite System (NPOESS), which collects data on oceanic, terrestrial, atmospheric, and near-space environments.

How Will It Work?

AOOS will organize around three regions: the Arctic, Bering Sea/Aleutians, and Gulf of Alaska. Observing platforms will be established in each region to collect and send data to the University of Alaska Fairbanks. Because Alaska is so remote and conditions are extreme, setting up and maintaining observing stations will be a challenge. But once they are established, AOOS will join a growing worldwide network of ocean observing systems.

The U.S. Commission on Ocean Policy strongly supports the creation and funding of a national network of regional ocean observing systems. In Alaska, AOOS will be driven by the needs of a diverse group of stakeholders which includes shippers, Alaska Native communities, oil and gas developers, fishermen and women, resource managers and regulators, and others.

Who Will Make AOOS a Reality?

A broad-based partnership of state, federal, university, and private organizations has been formed to meet the needs of Alaska's marine stakeholders. Partners include the University of Alaska, National Oceanic and Atmospheric Administration, North Pacific Research Board, Alaska SeaLife Center, Arctic Research Commission, Barrow Arctic Science Commission, Alaska Sea Grant, Prince William Sound Science Center, and industry groups such as fisheries and shipping associations. Federal funding is expected to finance a national ocean observing system composed of regional systems, including one in Alaska. Internationally, the Global Ocean Observing System is working to link U.S. efforts with those of other countries as part of the Global Earth Observing System of Systems.

Oceanographers aboard a NOAA research ship prepare to deploy data-gathering instrumentation attached to a subsurface mooring buoy.

For more information:

www.aoos.org

Alaska Ocean Observing System
1007 West Third Avenue, Suite 100
Anchorage, Alaska 99501
Phone: 907-644-6703

For additional ideas see:

www.oceancommission.gov/

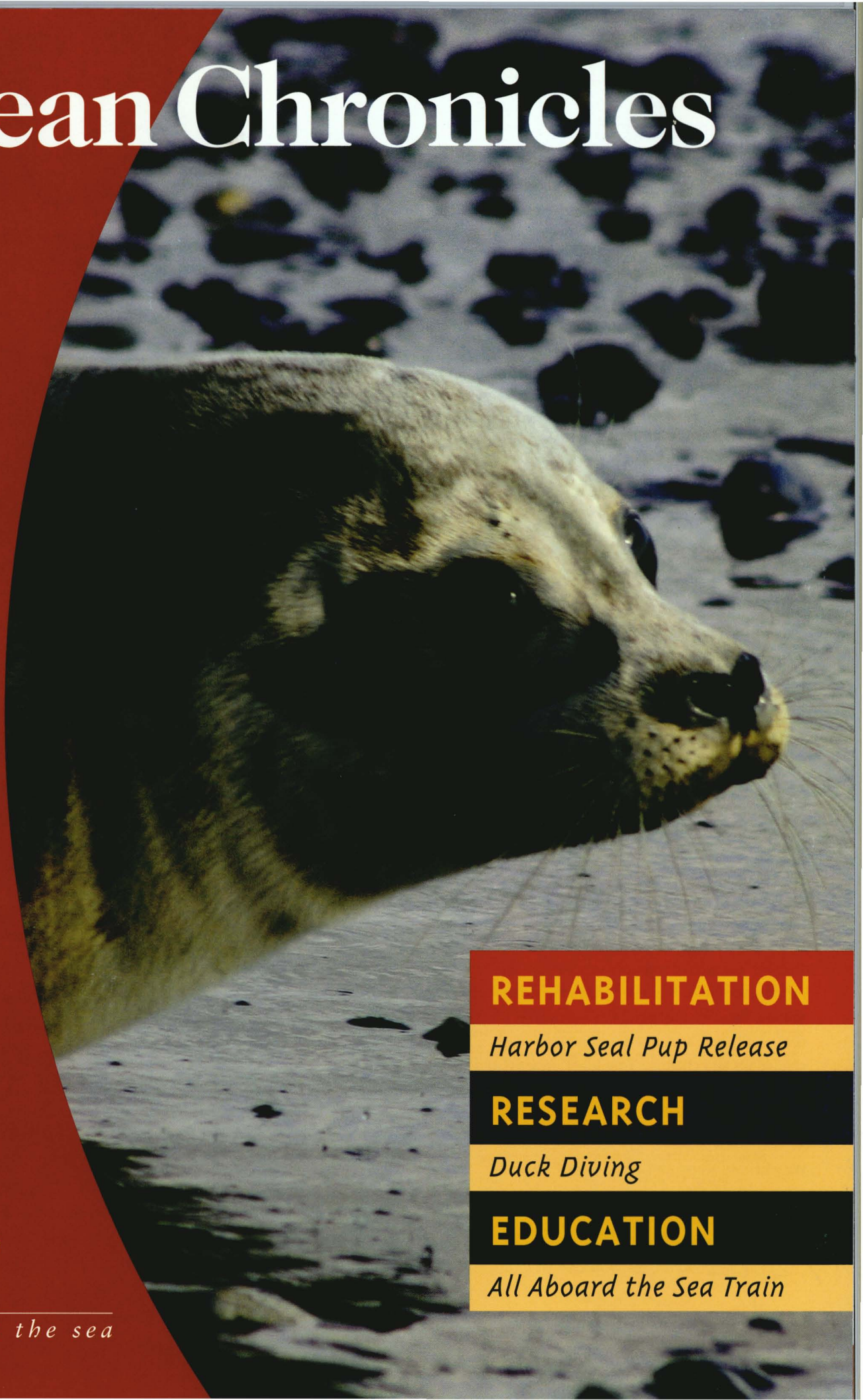
The cover illustration is a satellite image of clouds over the western Aleutian Islands. Color variations are likely due to differences in air temperature and the size of water droplets in the clouds. Image was acquired by the Landsat 7 satellite, and provided by the USGS EROS Data Center Satellite Systems Branch.

Midnight sun: ©2005 Arend/Soucek/Alaska Stock.
Tsunami buoy: National Data Buoy Center.
Two fishermen: Photo by Kurt Byers/Alaska Sea Grant.
Pan ice & oil rig: ©2005 Chris Arend /Alaska Stock.
Native group: ©2005 Oakley Cochran/AlaskaStock.
Cruise ship: ©2005 Mark Kelley/Alaska Stock.
Container ship: ©2005 Chris Arend/Alaska Stock.
Mooring buoy: Photo by Terry Whitledge, UAF/IMS.
Text by Doug Schneider, and editing and photo research by Kurt Byers, Alaska Sea Grant College Program.
Design by Phil Raymond, Genesis Design and Media.

AOOS
Alaska Ocean Observing System

Ocean Chronicles

Winter 2005



REHABILITATION

Harbor Seal Pup Release

RESEARCH

Duck Diving

EDUCATION

All Aboard the Sea Train

Alaska SeaLife Center®

windows to the sea

The Director's Perspective

Season's Greetings from the Alaska SeaLife Center:

Photo by Clark James Mishler

In the midst of this season of giving, celebration, and reflection, I would like to take the opportunity to thank our members, visitors and supporters for their efforts, contributions, and continued interest in the Alaska SeaLife Center and our work on behalf of Alaska's marine ecosystems.

The Alaska SeaLife Center reached a number of milestones this past year, but one of the most memorable was the opportunity I had to welcome a couple from Kalamazoo, Michigan celebrating their 50th wedding anniversary.

Photo by Jason Wettstein

This was a special occasion for Franklin and Joan Van Oosten, and a landmark for the Alaska SeaLife Center. The Van Oosten's arrived at 2:41 p.m. on Thursday June 16, 2005 as customers 1,000,000 and 1,000,001 respectively.

As the millionth customers, they were greeted with a standing ovation from the majority of the Alaska SeaLife Center staff, were treated to a special meeting with the birds in our avian department, and shook arms with the Pacific giant octopus, "Thing."

The Van Oosten family also became lifetime members. They captivated our staff as we worked to enhance their special vacation. Instances like these remind us that the Alaska SeaLife Center works with individual people and families as it promotes its mission of environmental stewardship, research, education, and rehabilitation. Through our efforts and your support, we are introducing children and adults to the wonder of science, research and nature in the context of a small community and a marine environment full of challenges and change. Your ideas, interest and support are integral to the success of our mission of research, rehabilitation, conservation, and education.

We wish you Merry Christmas, happy New Year, happy holidays, and many happy returns to the Alaska SeaLife Center.

Tylan Schrock
Executive Director

Cover Photo Credit: Chris Wettstein

***The Alaska SeaLife Center** is a marine science facility that combines a research mission with an animal rescue and rehabilitation program, conservation and public education. The Center incorporates exhibits that immerse the visitor in the marine ecosystems of Alaska and provide opportunities to watch animals in naturalistic habitats and research settings.*

UPCOMING EVENTS AT THE ALASKA SEALIFE CENTER

SENIOR SUNDAY! Enjoy complimentary coffee and the Sunday paper with your friends in the Center's lobby each Sunday from October through March. No admission required. Seniors 55 and older can tour the exhibits at half the admission price. Offer not valid with other promotions. Call Rebekah at 907-224-6312 for more information.

JANUARY 20 - 22 Celebrate Seward's Annual Polar Bear Jump-Off at the Alaska SeaLife Center! Special Activities and crafts for the whole family. Call Jason at 907-224-6311 for more information.

MARCH 10 - 12 & MARCH 24 - 26 It's all about animals during spring break at the Alaska SeaLife Center! Special presentations, activities and crafts for kids of all ages. Call Rebekah at 907-224-6312 for more information.

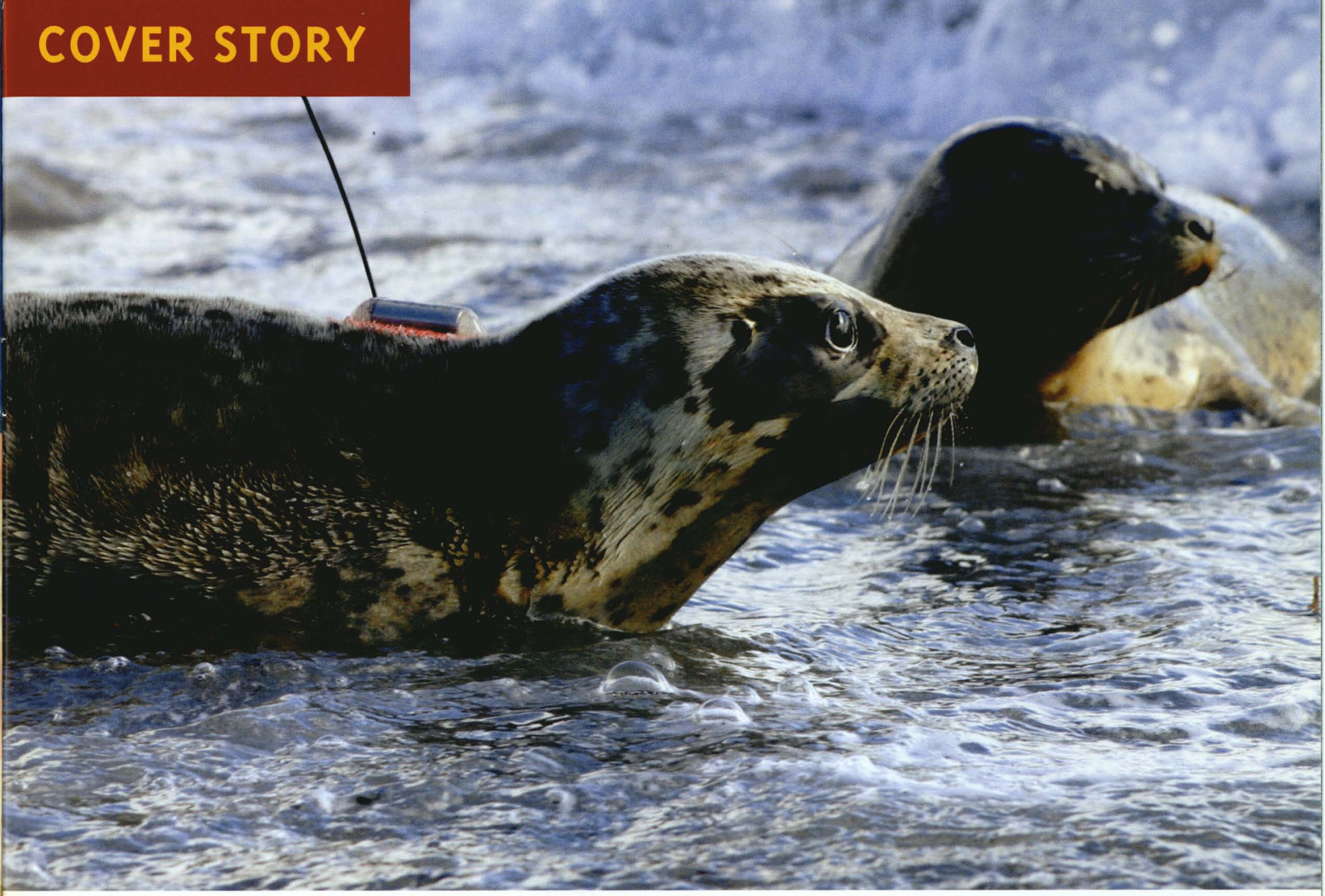
Feature Creature

Yelloweye Rockfish

Photo by Deanna Trobaugh

The SeaLife Center is pleased to house their first Yelloweye Rockfish (Sebastes ruberrimus). This animal had to be brought to the surface slowly and once aboard, aquarists carefully purged the remaining air in its swim bladder to allow this animal to adapt to its new environment.

Often mistakenly called Red Snapper, the adult Yelloweye Rockfish is easily recognizable by its large size, bright orange body and golden yellow eyes. Although quite different in appearance from the adult, juvenile Yelloweyes are also easy to identify with two bold white stripes down each side. Yelloweye Rockfish have internal fertilization and give birth to live young. Rockfish are unique in their reproductive strategies as most other bony fish fertilize eggs externally. This is one of the largest rockfish species often weighing more than 20 pounds and one of the longest lived, frequently living more than 100 years. You can see this beautiful animal in the Bird Habitat in Underwater Viewing.



Pup release: Homer, September 6, 2005 Photo by Chris Wettstein

HARBOR SEAL PUP RELEASE

September 6, 2005 was a big day for three harbor seal pups and the rehabilitation staff of the Alaska SeaLife Center. In conjunction with the Islands and Oceans Visitor Center, the SeaLife Center staff released three harbor seal pups that were treated in the SeaLife Center's Rescue and Rehabilitation Program over the summer.

In an effort to educate the public about the rescue and rehabilitation component of the Center's mission, the three pups - Blackjack, Keno and Yo-Yo - were brought to Homer to be released on Bishop's Beach, which is open to the public. Because this release was the first to include spectators from the general public, it was unlike others in the Center's history.

The pups had been rescued four months earlier. Upon entering the SeaLife Center they were all less than a week old. Blackjack and Yo-Yo were found near Homer dehydrated, emaciated and injured and Keno was found stranded in Nikiski.

The day of the release at Bishop's Beach, Rich Capitan and Darin Trobaugh, education specialists for the Alaska SeaLife Center, gave a presentation highlighting the work of the Center's rehab program and gave the audience tips on what to do if they found a stranded marine animal. Volunteers from the Homer Stranding Network and the Alaska SeaLife Center also were on location to hand out brochures and answer questions.

Each seal sported a blue flipper tag for future identification and Blackjack was fitted with a satellite tracking device that will monitor his diving behavior and location. Data from the device will provide valuable information to researchers at the Center investigating declines in Alaska's wild harbor seal population. The tag will fall off when Blackjack molts in the spring.

Then it was time for the trio to be released from their traveling containers. Keenan Remele, who found Keno and reported his stranding, was honored to be chosen to open Keno's crate door to freedom. To the cheers of the large group of onlookers, the three seals then undulated (our technical term for how seals move) to the water's edge and swam into the rough waters of the bay.

The day's educational events and the opportunity to watch three successfully rehabilitated seal pups begin their life in the wild was a rewarding experience for all involved. The Alaska SeaLife Center looks forward to more collaborative efforts of this nature in the future.

Call 1-888-774-SEAL if you spot one of the tagged seals. Call 1-800-224-2525 ext. 6304 and join the Wildlife Rescue Team to financially support rescue and rehabilitation efforts.

For more information contact Amy Haddow at amy_haddow@alaskasealife.org • (907) 224-6304

RESEARCH

Duck Diving: New ASLC Research

Eiders are a unique group of sea ducks that spend the majority of their lives in some of the most extreme and remote environments on Earth such as the Bering Sea and Arctic Ocean. One of four eider species, common eiders are relatively abundant. Common eiders are found across Alaska and the northern latitudes of North America. The common eiders' relatives, however, have experienced dramatic population declines over recent decades. The Alaska breeding populations of Steller's eiders and spectacled eiders have been listed as threatened under the Endangered Species Act since 1997 and 1993, respectively.

Because of the extreme environments in which eiders live, very little is known about them, especially Steller's and spectacled eiders. Researchers have begun to investigate the potential of technological developments such as implanted satellite transmitters to identify eider migration patterns, characterize populations, and locate breeding and molting areas that would otherwise be inaccessible. Implanted satellite transmitters will ultimately provide data about the different species of eiders, particularly where they live and gather. First, researchers need to know to what degree these transmitters will affect behavior, foraging strategies, mobility, or survival.

Researchers at the SeaLife Center are investigating the accuracy, precision, and effects implanted transmitters have upon the captive flock of common eiders. The Center, in collaboration with the U.S. Geological Survey's Alaska Science Center, developed a unique dive column and floating platform that was placed in the seal habitat, one of the deeper exhibit tanks. This self-contained dive column eliminates physical interaction between harbor seals and eiders. There are no other dive columns of this type found elsewhere in North America that monitor the diving behavior of eiders.

The birds and column are now visible at the Alaska SeaLife Center. Researchers have found that the eiders are comfortable in their new environment. It was uncertain whether the common eiders would dive to the bottom of the habitat for food. Until they were placed in the column, they were only accustomed to diving at 2 ft (0.6 m). These initial tests proved successful with the birds diving and utilizing the floating platform comfortably.

The eiders have been fitted with implanted satellite transmitters. Researchers in the Eider Research Program are now monitoring them for physiological and behavioral effects that the transmitters might have upon the eiders and to assess whether the eiders are expending more energy swimming and foraging with the device implanted. Once perfected, transmitters used in the field will provide critical insight into the behavior and biology of eiders, while also expanding our knowledge of where eiders live and gather.

Because of the extreme environments in which eiders live, very little is known about them

Eiders dive for research

Divers examine dive column

SCIENTIST SPOTLIGHT

Tuula Hollmen, *Eider Research*

Tuula, how did you get into your field? Via parasites: as a veterinarian, I was asked to collaborate on an eider parasite survey, which I did. By the end of the survey, I had developed a keen interest in the host of those parasites, i.e. the eider.

What is the fondest memory you have working with the animals you study? Well, on July 6th at 6 pm I was watching the spectacled eiders from the Outdoor Research Lab overlook and noticed that the blue female was standing in one of the nests and looking a little funny. I kept my binoculars aimed at her and she started to dip up and down.....and, this went on for a while, then she was tilting forwards and after some effort, laid an egg! The final delivery was very quick and smooth. Having never seen an eider deliver an egg before, this was a pretty exciting experience!

Since then, I have also seen a Steller's eider hatch – I've been very lucky to see a lot of "firsts" this year!

What is the best thing about working with protected animals? Significance and meaning of current issues, and linkages between my work and multiple other parties.

What advice would you give to aspiring marine biologists? Stay focused, respectful, and open-minded. If you get an opportunity to participate in something you feel enthusiastic about - go for it!

Chewing the Fat: Harbor Seal Pups Participate in Long-Term Diet Study

New to the harbor seal habitat in 2005 are four female harbor seal pups, Susitna, Qilak, Atuun, and Miki. Visitors have been captivated by the curiosity, upside-down swimming, and playfulness of these pups. Besides providing visitors and staff with an opportunity to observe harbor seals in a simulated natural environment, these four yearlings are valuable research subjects helping us understand how harbor seals survive in the wild.

At the end of June, the Harbor Seal Program brought in four additional female pups, recently weaned, to complete the resident collection of harbor seals at the Center. The four new seals were collected from Prince William Sound, an area which has experienced population declines over the past 30 years. For the first time, the SeaLife Center has a sample of animals from the same genetic stock as the dramatically declining Alaskan populations of harbor seals.

Harbor seal training session
Photo by Jason Wettstein

Though the global population of harbor seals is stable, Alaskan populations have declined significantly in some areas. The Prince William Sound area has experienced roughly a 63 percent decline since monitoring began in 1983. In both Aialik Bay and Prince William Sound, numbers still remain low compared with counts in the early to mid 1980s.

It has been difficult for researchers to accurately determine how or why these populations declined, especially without the ability to sample animals from specific locations. Scientists remain unsure as to changes that may have occurred in these environments during the 1970s and 1980s. One hypothesis is that changes in diet may have played a role in the harbor seal decline. Young seals are the best subjects for nutrition and development studies because researchers can track their rates of development as they grow. The Harbor Seal Program, using the newly acquired harbor seal pups, is attempting to identify critical life stages and diet conditions that may affect ability to survive.

Having harbor seal pups in-house at the Alaska SeaLife Center has allowed scientists to begin a long-term study contrasting the overall condition of seals on high fat diets versus those on low fat diets. Four of the pups are being continuously fed a low-lipid diet (low-fat) while the remaining four were placed on a high lipid diet and the development of all animals is carefully monitored. The Center is particularly interested in whether high lipid (fat) diets or low lipid diets affect the physiological condition, reproduction, and the immune or endocrine systems of these pups.

As the Center continues to mature and grow, so will these new faces in the harbor seal exhibit. Susitna, Qilak, Atuun, and Miki and now, Shila, Tikanni, Siku, and Anya will undoubtedly continue to delight and entertain visitors and staff.

Puffin Eggs Hatch, Young Puffins Grab Fish and Avian Enthusiasts' Hearts

Few people know it from visiting the Alaska SeaLife Center's bird exhibit, but behind the scenes are sets of comfortable black boxes in rows — rows of bird condos — that served as nesting sites for the Centers' puffins.

For the first time, the Alaska SeaLife Center adult puffins successfully hatched and raised tufted puffin chicks. The first eggs began to hatch in mid July and now young puffins are diving and learning to forage for fish on their own. The Center had seven puffin chicks, including three horned puffins and four tufted puffin chicks.

By pre-reserving a place in a special Puffin Encounter tour, visitors can help feed the Center's birds in an exclusive behind-the-scenes environment.

To learn more visit www.alaskasealife.org or call 907-224-6394 for information on Puffin Encounter tours.

Photo by
Jason Wettstein

SCIENTIST SPOTLIGHT

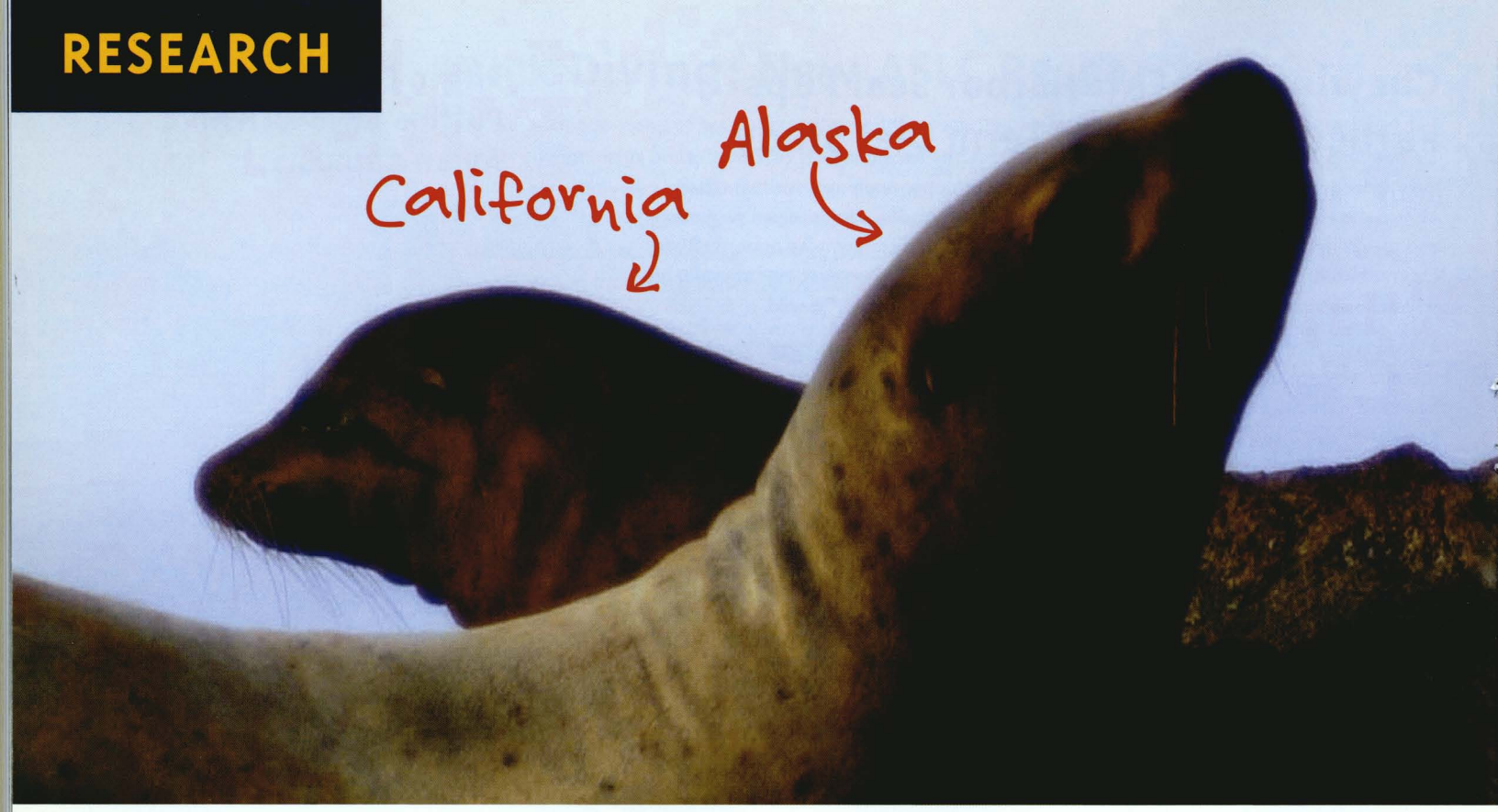
Lori Polasek, *Harbor Seal Research*

Lori, how did you get into your field? My brothers encouraged me to dive when I was 12. This is when my passion for the ocean began.

What is the fondest memory you have working with the animals you study? My fondest memory is one that is quite recent We have four new resident harbor seal pups. Three came in together and one came in several days later. When the last animal was introduced to the first three it was amazing to watch them interact together, play and explore their surroundings.

What is the best thing about working with federally protected animals? I do not usually think of my work in terms of federal protection. If I had to come up with an answer I would have to say it is working with an animal not readily available to the average person and the uniqueness of the long term research goal.

What advice would you give to aspiring marine biologists? Get involved by volunteering or interning with as many projects as possible. The field is highly competitive. Any opportunity that will place you ahead in experience and/or breadth of knowledge will be advantageous.



SeaLife Center Researcher Asks

"Why are California Sea Lions Turning Up in Alaska?"

Typically California sea lions make their homes off the shores of California, or so one might surmise from their name.

Increasingly, however, Alaska SeaLife Center researchers are finding these animals are migrating northwards, even as far as Prince William Sound, Alaska.

"apparent increase of California sea lions in Alaskan waters may be a result of long-term changes as opposed to interannual variations. . ."

Scouring field notebooks and documented sightings, archeological data spanning 3,000 years, textbooks, records and reports, Alaska SeaLife Center researcher John Maniscalco has noted a trend: an increase in sightings of male and female California sea lions in Alaska.

While sightings of California sea lions in Alaska are not unprecedented, they have been rare in the past, with the first documented sighting of a lone male in 1973. Since 1973, more than 50 additional animals have been recorded in Alaska, from Forrester Island in southeast Alaska as far north as St. Matthews Bay in Prince William Sound, and as far west as St. Paul Island.

"While it is possible that we are just becoming better at recording and observation," says John Maniscalco, a researcher at the Alaska SeaLife Center, "most indications are that California sea lions are starting to become far more prevalent in new areas and in more northern latitudes."

Maniscalco first began to track California sea lions in 2002 when he noticed both males and females appearing on traditional rookeries of endangered Steller sea lions at Chiswell Island in the North Gulf of Alaska. "Finding female California sea lions was especially surprising," says Maniscalco. "We always thought that the females did not stray far from their breeding grounds centered around southern California."

One hypothesis explaining the northward movement is that Californian sea lion population growth in traditional habitats has become denser as a result of the animals' federally protected status.

It is also possible that warmer waters off Alaska have helped lay the welcome mat. As noted in "The Occurrence of California Sea Lions (Zalophus californianus) in Alaska", authored by Maniscalco and colleagues in the December, 2004 issue of Aquatic Mammals, the shift did not correspond with the periodic and warmer El Niño years. Instead, the "apparent increase of California sea lions in Alaskan waters may be a result of long-term changes as opposed to interannual variations . . ."

"The leading factor is still population change," says Maniscalco. California sea lions have become numerous in their native habitat and have moved north, he adds. "It is also noteworthy that their greater presence in Alaska corresponds with a shift in their prey base."

Whatever the root causes, both male and female California sea lions appear to be migrating north during all seasons of the year – more in the spring, fewer in mid-winter, and their increasing presence is providing evidence of changing marine ecosystems.

Platform for Research: Steller sea lion haulout

A successful haul-out buoy ... could provide substantial assistance to scientists collecting data on the endangered ... Steller sea lions.

The distinctive scents and sounds attributed to California and Steller sea lions are familiar to many North Pacific coastal residents. Though their natural haul-outs are typically protected rocky outcroppings, sea lions have been known to haul out on docks, boats, buoys and other navigational aids. Unfortunately, it is unclear what makes these unconventional haul-outs attractive to the sea lions.

In 2003 the Alaska SeaLife Center researchers deployed a buoy in hopes of attracting transient Steller sea lions. The buoy, located at the head of Resurrection Bay, resembles a floating dock and is modeled after one pioneered a decade ago by the National Marine Fisheries Service and used successfully in Puget Sound, Washington. With help from the National Marine Fisheries Service, the Alaska SeaLife Center adapted the design to construct a buoy for Seward, Alaska.

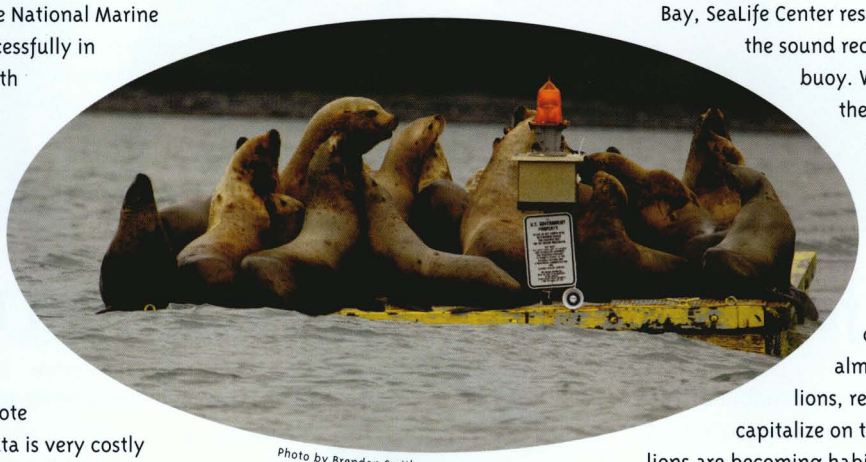


Photo by Brendan Smith

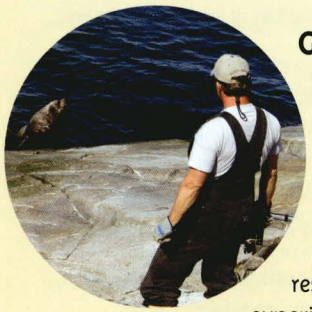
A successful haul-out buoy nearby could help scientists collect data on the endangered, western stock of Steller sea lions. Travel to remote locations for Steller sea lion data is very costly and requires significant staff time. The savings will free up resources for further research. For projects like the Transient Juvenile Project, where wild sea lions are held for short-term studies, time spent transporting the animals to the Center, as well as stress to the animals during these long commutes would be significantly reduced if animals can be captured nearer the Center. Additionally, buoys reduce the need for direct human contact and immobilizing drugs that are commonly used to capture animals for research. Ultimately, the buoy is one of the least invasive approaches for capturing free-range animals.

Despite the many advantages of using a buoy, it does leave researchers at the mercy of the sea lions, hoping they take notice of the new haul-out. Fortunately, SeaLife Center scientists were very patient. For almost two years the capture buoy remained occupied only by the soft, droning playback of pre-recorded vocalizations of Steller sea lions at rookeries (locations where sea lions give birth). Attempts to attract sea lions were heightened by planting Steller scat on the buoy as an olfactory stimulus, and by the use of a Steller sea lion decoy.

Finally, in May of 2005, researchers were rewarded for their persistence. Anticipating the seasonal influx of forage fish and salmon into Resurrection Bay, SeaLife Center researchers increased the volume of the sound recordings and added more scat to the buoy. Whether this increased stimuli did the trick, or if it was a result of especially good fish runs, the Center could now observe a buoy teeming with sea lion activity. As many as twenty animals were seen hauling out onto the buoy, with an estimated 10 to 15 rafting or swimming nearby. After having almost given up hope of attracting sea lions, researchers are now planning how to capitalize on this success. Presently, Steller sea lions are becoming habituated to the buoy so that once the next step, adding a cage to the structure, is implemented, there should be little change in haul out behavior.

Following up on their success with the Resurrection Bay buoy, the Center has begun fabricating a similar structure that can be transported to different locations rather than being a fixed, stationary object. Using the sophisticated video technology, researchers will be able to monitor attendance on the platform while simultaneously observing any effects that might be incurred by individual sea lions or the nearby haul-out populations.

SCIENTIST SPOTLIGHT



Greg Spencer, *Field Coordinator, Steller Sea Lion & Northern Fur Seal Program*

Greg, how did you get into your field? I got into this field when I was very young. My interests and enthusiasm brought me in direct contact with government biologists and other researchers who mentored me and offered experiences that I would come to realize were nearly unprecedented and served to contribute enormously to my understanding of ecology and natural resource management and my desire to pursue knowledge.

What is the fondest memory you have working with the animals you study? I am always happy when I see that the work we do with wild animals clearly benefits those animals in obvious ways and more importantly when management policies are adopted based on sound scientific findings.

What is the best thing about working with federally protected animals? I find a lot of gratification working with federally protected species due to the peril that these species are experiencing and because there are generally a series of mysteries surrounding their lifestyles. Protected species tend to be less visible to most observers, and so there is a personally enriching element to working closely with these species.

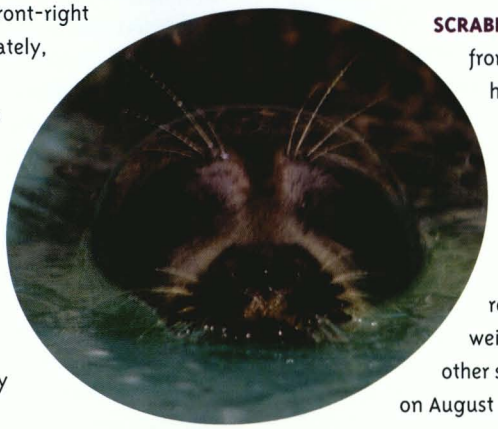
What advice would you give to aspiring marine biologists? My advice to any aspiring marine biologists would be to take full advantage of opportunities to participate in any and all types of studies that interest you. Do not be afraid to move around — the oceans are vast and the more flexible you can be, the more exposure to the marine environment you will receive and the greater range of experiences you will likely incur. Feel confident sharing your interests with researchers. Enthusiasm and the willingness to learn are enormous attributes which reflect self-motivation and commitment. Use all the means available to you to stay abreast of what is a rapidly evolving and diverse field of study.

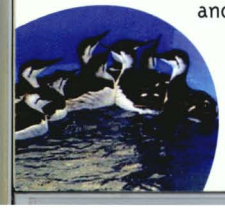
Record Year for the Rescue & Rehabilitation Program

The Alaska SeaLife Center's Rescue and Rehabilitation Department treated and released or relocated a record number of animals this year. Over 100 animals were cared for by the Center's staff in 2005. Each year, the rehabilitation staff chooses a theme for naming the animals and this year's theme is "games." Although the Rehabilitation Department receives patients year-round, their busiest time is during the spring and summer months due to the number of stranded, orphaned and ill mammal pups brought into the program. Here are some highlights of some of this year's Rescue and Rehabilitation Program patients.

Over 100 animals were cared for by the Center's staff in 2005

UNO, a stranded adult male sea otter, arrived January 29 on the shore of Resurrection Bay in Seward. Uno was found to be suffering from puncture wounds, broken bones in his front-right paw, and a broken rib. Unfortunately, Uno was also diagnosed as having toxoplasmosis, a protozoan parasite. The parasite is widespread in sea otters in California but Uno is the first sea otter in Alaska to be diagnosed with the illness. Uno responded well to the medications that eventually rid him of the parasite. During his convalescence, the 46 pound sea otter ate approximately 16 pounds of squid, clams and crabs per day! On May 20, Uno was released sporting a blue flipper tag and has been spotted several times looking healthy and socializing well with other otters.





JENGA, an abandoned female sea otter pup, arrived from Valdez on March 26. Like all sea otter pups, Jenga required around-the-clock care, including frequent feedings and lengthy grooming sessions. The amount of time spent with human caretakers allows sea otter pups to become imprinted on humans and therefore hinders their release. A permanent home for Jenga was found at the Shedd Aquarium in Chicago, and she left on May 23.

POGO, an abandoned female ringed seal pup, arrived April 23 from Kotzebue. She was treated for lice, dehydration, injuries, and a marine parasite similar to the heartworm parasite that can affect dogs. The treatment for this parasite is lengthy but Pogo responded well and was released in Kotzebue on August 14 with a temporary satellite tag.

TWISTER, an orphaned female harbor seal pup arrived from Unalaska on May 20. Although Twister was slow to gain weight and was treated for a skin rash, she was released in Unalaska with Lego on September 19 with a temporary satellite tag.

SCRABBLE, an abandoned female harbor seal pup arrived from Cordova on May 22. Other than being treated for a high white blood cell count indicating an infection, Scrabble was a model rehab patient and was released with Candyland in Aialik Bay on August 20.

CANDYLAND, an abandoned female harbor seal pup, arrived from Cordova on May 24. Not suffering from injuries or illness, Candyland's rehabilitation experience was "simply" gaining weight, learning to forage for fish and socialize with other seals. She was released with Scrabble in Aialik Bay on August 20 with a temporary satellite tag.

YO-YO, a female harbor seal pup found tangled in fishing line near Homer, arrived on June 1 very emaciated. She quickly gained weight and was released in Homer with harbor seals Keno and Blackjack on September 6.

BLACKJACK, a stranded male harbor seal pup also from Homer arrived on June 4, dehydrated and emaciated, and suffering from a puncture wound to a front flipper. He was the smallest seal of the season but finally reached his release weight. He was released in Homer on September 6 along with Yo-Yo and Keno.

LEGO, a male harbor seal pup, was found tangled in a fishing net on the Egegak coast and rescued by local fishermen on June 7. Lego was very emaciated and dehydrated but recovered quickly with treatment. He was released with Twister in Unalaska on September 19. Ironically, a few days later he became caught in another fishing net but was freed unharmed.

KENO, an abandoned male harbor seal pup from Kenai arrived on June 14. Keno gained weight quickly and learned to forage for fish and be social with other seals. He was released in Homer September 6 wearing a temporary satellite tag along with Yo-Yo and Blackjack.

BOARDWALK, a stranded female Steller sea lion estimated to be two years old was rescued in Haines on June 23. After finding air transportation adequate to move her 400 pound crate, Boardwalk arrived at the Center underweight with parasites and multiple infected puncture wounds and lacerations around her neck. She was released in October.

BOCCE, an abandoned female walrus pup, was rescued in Kivalina and arrived at the Center on June 28. Walruses are extremely social animals and walrus pups require constant tactile attention from their mothers. Therefore, in a rehabilitation situation, walrus pups become imprinted on their human caretakers and are not releasable. After spending 10 days at the Center, she was transferred to her new home at Sea World, San Diego.

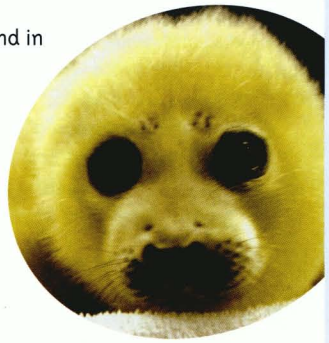
MANCALA, the Center's first albatross patient, was admitted to the program in July after being found in Sitka. These large birds live far out at sea so it's believed that Mancala must have stranded on a fishing boat for the ride into Sitka. Mancala had foot and leg injuries, complications from a poor molt, a chronic infection, and poor blood work results. Although she fought a tremendous battle against her injuries, her condition began to severely decline and she was humanely euthanized on September 8.

YAHTZEE, a stranded male harbor seal pup rescued in Ketchikan, arrived on July 21. It is believed that Yahtzee was born later in the pupping season and was weaned before he was prepared to forage for fish and survive on his own. Though weak and dehydrated upon arrival, Yahtzee has responded well to rehab efforts and was released in October.

CRICKET, a Cassin's auklet was discovered in Dutch Harbor with waterproofing problems. Once this bird's waterproofing returns to normal, it will be released.

BOGGLE, an underweight horned puffin, was found in the Homer area. After gaining sufficient weight and proving his foraging skills to Center staff, he was released September 30.

PARCHEESI, a Leach's storm petrel, was found in Seward's small Boat Harbor with waterproofing problems and dehydration. Once the bird began preening properly, it re-established its waterproofing and was released.



Rehabilitation photos by Jason Wettstein

For more information on our rescue & rehabilitation projects visit www.alaskasealife.org

SeaLife Center Launches Wildlife Rescue Team Program

The Alaska SeaLife Center has a new opportunity for those interested in supporting our Rescue and Rehabilitation Program: the Wildlife Rescue Team. If you join the team you will receive a glossy photo, case history and fact sheet of one of our recent rehab residents and monthly updates on all the animals recuperating at the Center.

You can join the Wildlife Rescue Team by sending in the form below to Alaska SeaLife Center, PO Box 1329, Seward, AK 99664. You can also go to www.alaskasealife.org or call Amy Haddow at 907-224-6304.

Join the Wildlife Rescue Team!

My contact information is *(please print clearly)*:

Name: _____

Address: _____

E-mail address (for updates) _____

City: _____ *State/Province:* _____

Zip/Postal Code: _____ *Country:* _____

Phone Number (required): _____

Species chosen for information (check one)

☐Walrus ☐Ringed Seal ☐Harbor Seal ☐Sea Otter ☐Sea Lion

Donation level: ☐$25 ☐$50 ☐$100 ☐$500 ☐$1,000

☐ Include a stuffed animal of your species for $10 (plus $2 postage)

Payment Method:

☐ Enclosed is my check made payable to the Alaska SeaLife Center

☐ VISA ☐ MasterCard ☐ Discover ☐ American Express

Card #: _____ *Exp. Date:* _____

Signature: _____ *Amount:* _____

☐ **Please send this as a gift to:**

Recipient's Full Name: _____

Address: _____

E-mail address (for updates) _____

City: _____ *State/Province:* _____

Zip/Postal Code: _____ *Country:* _____

Gift Message: _____

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From: _____

Please use a separate form for each contribution. For more information or to sign up by phone, contact 1-800-224-2525, ext. 6304, or visit our web site at **www.alaskasealife.org**. Allow 7-10 business days for delivery.

Thank you for joining the Alaska SeaLife Center's Wildlife Rescue Team!

EDUCATION

Encounter Tours

The Alaska SeaLife Center has introduced an exciting educational series of Encounter Tours. The Octopus Experience includes an opportunity to meet hand to arm with a resident octopus. The Puffin Encounter brings visitors into the aviary where they help bird keepers feed the birds. All encounter tour costs are in addition to general admission. **Visit www.alaskasealife.org for complete information and to book your tour!**

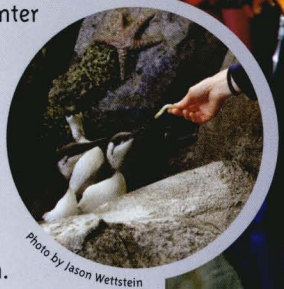


Photo by Jason Wettstein

Photo by Jason Wettstein

Wyland Kicked Off West Coast Tour at the Alaska SeaLife Center

Marine life artist, Wyland, drew hundreds of visitors with the start of his West Coast tour at the Alaska SeaLife Center on June 25, 2005. In partnership with local conservation groups like the Alaska SeaLife Center, Wyland joined children and adults in creating a marine animal themed mural.

The tour kicked off with live ocean-themed music from Good Dog, a film presentation, an ocean theme art contest for local artists, and information booths hosted by conservation groups. Wyland also painted and talked with visitors who participated in creating a community mural to celebrate the ocean.

Wyland's artwork has landed in collections of everyone from Ronald Reagan to Pierce Brosnan, and his huge Whaling Wall murals adorn buildings in 70 cities around the world. The Wyland Foundation estimates that Wyland's work is seen by 1 billion people annually. Together with community education partners, Wyland took his message of water conservation to 12 cities along the West Coast, ending the tour in La Paz, Mexico.

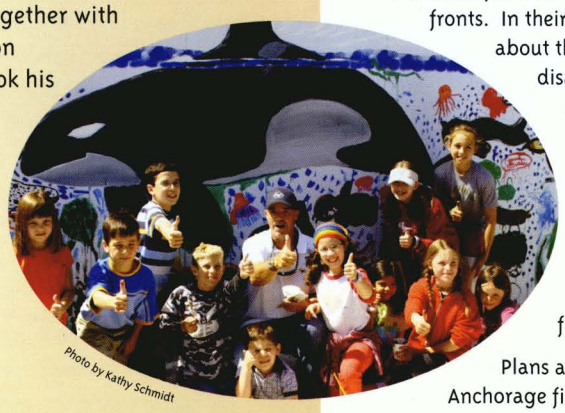


Photo by Kathy Schmidt

Education Department Cruises a New Track: Collaborating on "Sea Train"

On Thursday, May 5th, the Alaska SeaLife Center hosted nearly 400 fifth-grade students from the Anchorage School District as a part of the new Carol Treadwell Memorial "Sea Train" program. Developed by the Anchorage School District, the Alaska SeaLife Center, and the Alaska Railroad Corporation, this pilot was designed to reinforce classroom science education and encourage educators to make use of regional science facilities.

The day's activities were planned to match classroom curriculum which, according to Anchorage School District Superintendent Carol Comeau, "focuses on energy and ecosystems."

On the train ride from Anchorage to Seward, students completed numerous tasks in a log book with the help of their teachers and Center educators and participated in exciting, hands-on educational programs presented by Center staff. A National Forest Service ranger was on hand for much of the train journey and offered excellent commentary about Portage Glacier.

The train ride alone was a highlight for many students. Janeisha Henderson wrote in her thank you letter, "The train ride was very graceful and nice." Another student from Muldoon Elementary School was overheard saying, "Riding on the train made me feel like a king." In his speech before the departure, Pat Gamble, Alaska Railroad's President and CEO remarked, "The Alaska Railroad Corporation is pleased to be able to continue its partnership with the educational development of Alaska's students."

Upon their arrival at the Alaska SeaLife Center, students were split into groups and explored the marine habitats, the Bering Sea exhibit, and the Discovery Touch Pool. Dive Officer Bob Hicks made an appearance to explain the basics of SCUBA diving equipment and procedures. In the Discovery Classroom, educators conducted another activity book exercise entitled "Think Thermal," designed to reinforce the students' knowledge of thermal conductivity and how it applies to animals.

Feedback from the students' sojourn in Seward has been overwhelmingly positive on all fronts. In their correspondence with the SeaLife Center, the students had much to say about their likes and dislikes, with dislikes mainly focusing on their disappointment at having school-packed lunches. On the other hand, Woody, Aurora the octopus, and the Discovery Touch Pool were great hits with the students. The teachers agreed that participating in Sea Train was a positive learning and life experience for both students and adults.

"The Alaska SeaLife Center is a fantastic science education resource," said Dana Sitzler, education director. "We are looking to build partnerships and programs that create opportunities for all Alaskan students. The Sea Train provides a powerful learning experience that that fifth graders in Anchorage will never forget."

Plans are underway to expand the Sea Train program to include many more Anchorage fifth-graders over the next few years.

Hi! I'm a Grunt Sculpin (color me)

My scientific name is *Rhamphocottus richardsonii*

I am a small fish – only three inches in length as a full grown adult. My short, stout body is a creamy yellow color with reddish brown bands across my back and down my sides. My large pectoral fins and tiny tail are bright orange and I have a long spotted snout. All of the different colors and patterns on my body help camouflage me from predators. Although I can swim, I prefer to use my large pectoral fins to crawl and hop among the rocks and seaweed searching for food. My diet consists mainly of zooplankton, larvae and a variety of small crustaceans. Grunt sculpins live in shallow water along rocky shores ranging from Alaska to southern California to Japan. Our common name is inspired by the grunting noise we make when scared or removed from water. While resting, I usually take refuge in a giant barnacle shell or in a rock crevice to shield me from predators.

TRUE OR FALSE

1. I enjoy swimming to search of food.

2. I am a colorful fish.

3. I have a short snout.

4. I live in very deep water.

WORD SEARCH

CRAWL
HOP
GRUNT
SNOUT
SPOT

G	C	X	T	Q
Y	R	K	U	S
H	A	U	O	P
O	W	Z	N	O
P	L	J	S	T

FILL IN THE BLANK

1. My large _____ and tiny _____ are bright orange.

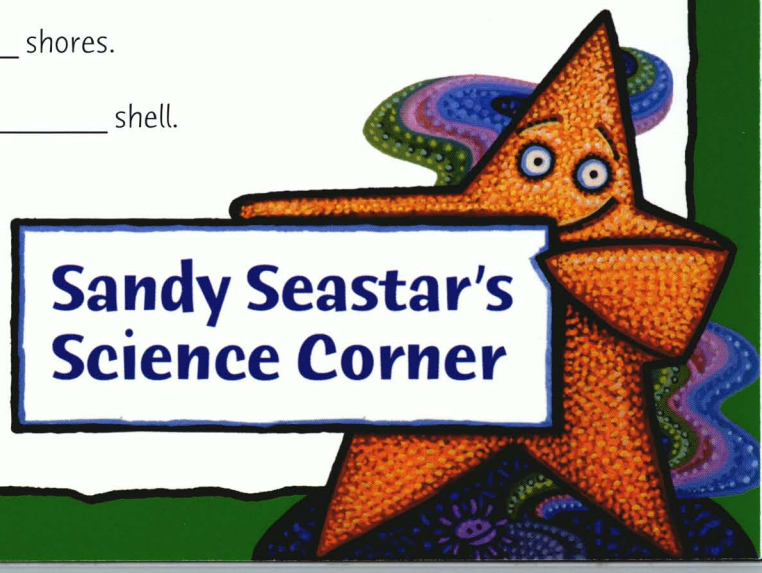
2. The different colors and patterns on my body help _____ me from predators.

3. Grunt sculpins live in _____ water along _____ shores.

4. While resting, I usually take _____ in a giant _____ shell.

Photo by Darin Trobaugh

ANSWERS:
TRUE OR FALSE
1. F 2. T 3. F 4. F
FILL IN THE BLANK
1. pectoral fins, tail
2. camouflage
3. shallow, rocky
4. refuge, barnacle



Sandy Seastar's Science Corner

Join the Alaska SeaLife Center SeaLife Society and help support our mission of understanding and maintaining Alaska's marine ecosystem through research, rehabilitation, conservation and public education. Membership includes one year admission and other Center discounts.

SeaLife Society Membership Application

Name: _____ *Spouse:* _____

Address: _____ *Apt.#:* _____

City: _____ *State:* _____ *Zip:* _____

Day phone (Please include area code): _____ *Evening Phone:* _____

E-Mail address: _____

Membership Levels & Annual Dues: ☐ Individual $36 ☐ Student $28 ☐ Couple $70

☐ Family or Grandparent $110 (please include a list of all children names between ages 6 and 18, including birth dates)

☐ Additional donation to the Center's mission of research, rehabilitation & public education $_____

CONTRIBUTING MEMBERS: ☐ Sponsors $250 ☐ Patron $500 ☐ Corporate $2,500 ☐ Founder $5,000

PAYMENT METHOD: ☐ Check (Payable to ASLC) *Total amount:* $_____

☐ Visa ☐ MC ☐ Discover ☐ AMEX

Account # _____ *Exp. Date:* _____ *Signature:* _____

Mail to: Alaska SeaLife Center, Membership Department, P.O. Box 1329, Seward, AK 99664

Alaska SeaLife Center
windows to the sea

301 Railway Avenue, P.O. Box 1329, Seward, AK 99664-1329
1-800-224-2525 • (907) 224-6300 • Fax (907) 224-6320
www.alaskasealife.org

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Research on animals is conducted under authority of the Marine Mammal Protection Act.

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September 16 - April 14: 10am - 5pm

Admission: Adult $15, Youth $12 plus applicable tax
Family and Group Discounts Available • Children 6 and Under Free

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Regional Citizens' Advisory Council

The Observer

VOLUME 16, NO. 1/JANUARY 2006

AK Chamber of Commerce - AK Wilderness Recreation & Tourism Assoc. - Chugach Alaska Corp. - Cordova District Fishermen United - OSREC - PWS Aquaculture Corp.

Council system will monitor tankers in Sound

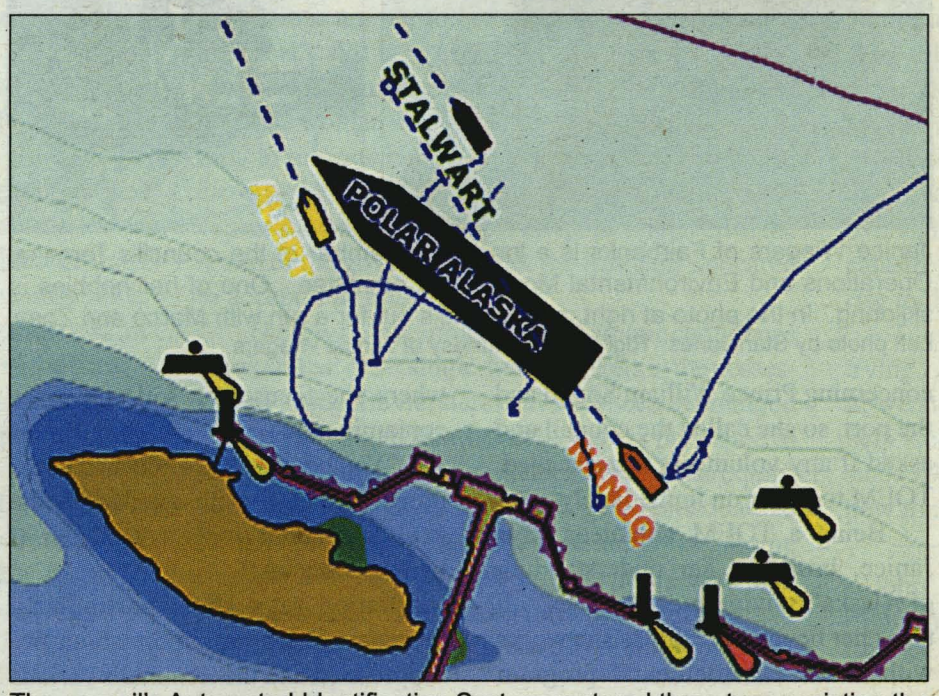
The citizens' council is now equipped with the latest technology for tracking ship movements.

In late December, a Furuno-brand Automated Identification System was installed in the council's Valdez office. The system will enable the council to track the course, speed and heading of oil tankers, escort tugs, and other vessels as they move through Port Valdez and some areas of Prince William Sound.

"Most importantly, we'll be able to archive the data from the system," said Rhonda Williams, the council project manager who oversaw its acquisition and installation. "That way, we'll be able to go back and review vessel track information even if an incident doesn't come to light immediately."

Most ocean-going vessels now carry Automated Information System equipment. It radios the ship's name, position, and other information to AIS-equipped vessels within VHF radio range, and to AIS ground stations like the one operated by the council.

On ships, the AIS information is usually overlaid on the vessel's radar screen for display. The council's Furuno system is connected to a conventional Windows computer, which produces the display and makes it possible to archive the data.



The council's Automated Identification System captured three tugs assisting the Polar Alaska as it left a loading berth at the Valdez terminal on Jan. 4.

VHF radio is a line-of-sight technology, which limits the areas of the Sound that can be monitored by the council system. At present, Williams said, it provides good coverage in Port Valdez – the part of Prince William Sound nearest the city of Valdez. It provides more limited coverage near Bligh Reef, site of the Exxon Valdez spill, and at Naked Island in the central Sound.

Eventually, Williams said, it should be possible to make the system's output available over the Internet so that it can be viewed from locations other than the council's Valdez office.

December was a milestone month for Alyeska

The last few weeks of 2005 saw two big milestones for Alyeska Pipeline Service Co.

On Dec. 14, Alyeska's Ship Escort/Response Vessel System escorted its 10,000th loaded tanker through Prince William Sound since the system was formed after the Exxon Valdez spill of 1989.

The 10,000th load was carried by ConocoPhillips' double-hull tanker, the Polar Resolution. It left the Alyeska terminal in Valdez at 7:01 a.m. under the command of Captain Ray Geisler, bound for Ferndale, Wash., with 900,000 barrels of North Slope crude aboard. It was escorted by the tugs Alert and Nanuq, commanded by Captains Dave Sweeny and Grady Harker, respectively.

Before the Exxon spill, only one escort tug accompanied each tanker, and it turned back after the tanker passed through Valdez Narrows, several miles north of the spill site. Today, escorts are required until the tanker leaves the Sound through Hinchinbrook Entrance and enters the Gulf of Alaska.

Alyeska's other December milestone was the Dec. 21 arrival of the 15 billionth barrel of oil at Pump Station One, where North Slope crude begins its journey south. Oil flow through the pipeline today is around 900,000 barrels a day, well below the peak of 2.1 million barrels a day.

Because some oil is taken out by refineries along the 800-mile pipeline to Prince William Sound, the 15 billionth barrel will not be loaded onto a tanker until about December 2007, according to Alyeska.

More oil has moved through the pipeline since the Exxon spill than did so before the accident. According to Alyeska figures, just under 7 billion barrels passed Pump Station One from pipeline startup in 1977 through March of 1989, meaning just over 8 billion barrels have passed it since.

Wilderness group backs citizen oversight

An international environmental forum last fall gave a ringing endorsement to the concept of citizen involvement in preventing and responding to oil spills and other man-made disasters.

The 8th World Wilderness Conference, meeting in Anchorage, passed a resolution calling on extractive industries to support citizen advisory groups for every project started.

"Local citizens have the most to lose," the resolution states. "It is in the best interest of industries to work with the citizens of the areas affected by their projects."

The resolution was proposed by John Devens, executive director of the citizens' council, and adopted by the Congress during its meeting Sept. 30-Oct. 6.

"We're getting more and more requests for information and presentations from interested citizens and industries around the world," Devens said. "This resolution will hopefully be one more tool people elsewhere can use to establish citizen oversight."

Rick Steiner, a University of Alaska professor and international advocate for conservation and citizen oversight, said the resolution should help in his efforts to persuade governments, industry, and non-governmental organizations to support the concept.

"We want to drive home the point that all large extractive industry projects throughout the world should establish citizen oversight bodies similar to the Prince William Sound Regional Citizens' Advisory Council, but adapted to local conditions," Steiner said. "I'm optimistic we can get there."

The World Wilderness Congress is the world's longest-running public international environmental forum, according to the organizers. The group said the Anchorage event drew some 1,200 delegates from 55 countries.

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Volunteer Profile

Long-distance TOEM member keeps eye on Sound

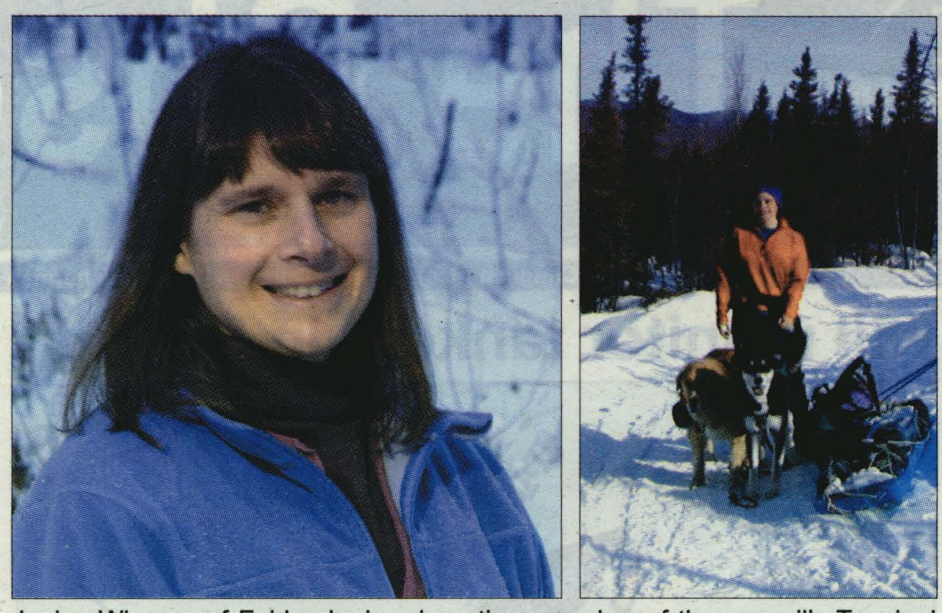
By SUSAN SOMMER
Project Manager

Janice Wiegers lives in Fairbanks, but Valdez holds a special interest for her.

Since 1999, she has been a member of the council's Terminal Operations and Environmental Monitoring Committee, learning about and weighing in on oil terminal issues via teleconference during meetings that originate nearly 400 miles from her home.

TOEM, as the committee is usually called, identifies actual and potential sources of pollution at the Valdez Marine Terminal. Most of its work focuses on ballast water treatment and its impact on water quality in Port Valdez, and on air quality issues stemming from hydrocarbons emitted during tanker loading and other facility operations.

One of Janice's projects when she was a graduate student at Western Washington University involved a comprehensive look at environmental aspects of Port Valdez after many years of oil being transported through the area. After earning her master's degree in applied ecology and moving back to her hometown of Fairbanks, she wanted to stay in touch with environmental issues



Janice Wiegers of Fairbanks is a long-time member of the council's Terminal Operations and Environmental Monitoring Committee. One of her hobbies is skijoring. In the photo at right, above, she's out for a run with Marco and Zoey. Left photo by Stan Jones. Right photo courtesy of Janice Wiegers.

concerning Prince William Sound and the port, so she called the council and asked if any volunteers were needed. TOEM took her on immediately.

Being a TOEM volunteer, says Janice, broadens her understanding of Alaska's environmental issues. It takes her beyond the things she works with as an environmental program specialist with the Alaska Department of Environmental Conservation, where she focuses on soil and water contamination.

"You become so entrenched in the things you deal with regularly," she explains, "and it's only a small part of what's going on."

Janice says she's particularly interested in learning more about fire suppression and the terminal's various operating permits, topics less familiar to her than more traditional TOEM issues such as air and water quality.

Janice received the TOEM Volunteer of the Year Award in 2001.

In December, Janice participated in the council's volunteer workshop, a gathering of committee volunteers, board members, and staff to share ideas and brainstorm better ways of working toward common goals. She was impressed by the number of people who brought both knowledge of marine oil transportation issues and concern for the Sound to the meeting.

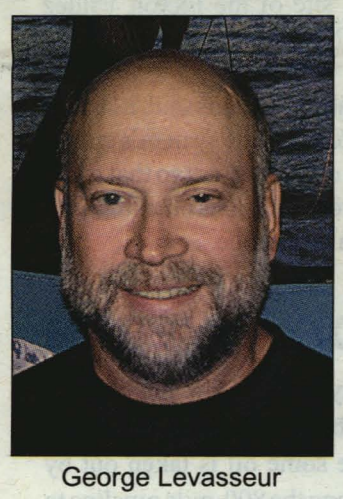
An outdoorswoman and life-long learner, Janice lives with her husband and two dogs. She's trained the younger animal to skijor, or pull her on skis. She also spends lots of time exploring trails with a local hiking club. Lately, she's been practicing tai chi, a Chinese martial art.

With work, family, and plenty of other pursuits to keep her busy in Fairbanks, Janice doesn't get to visit Valdez as often as she'd like. Volunteering on TOEM, though, keeps her in touch with this community at the pipeline's terminus. "I'm impressed with RCAC – the number of projects and the level of commitment the organization maintains. And trying to work with industry is a great thing," she says.

Long-time Valdez resident takes board seat

George Levasseur, a commercial fisherman and retired official of the state Department of Transportation, has joined the citizens' council board as one of two representatives of the city of Valdez.

Levasseur was nominated by the Valdez city council in July and seated at the board's September meeting in Seward. He replaces Dr. JoAnn McDowell, who left the board last summer to move out of state. She had served on the board for over eight years.



George Levasseur

In applying for the seat, Levasseur wrote the city council that he was an avid sportsman who loves to fish and hunt, and knows "that protection of these resources and environmental issues is vital to us and to future generations."

He has lived in Valdez for over 30 years. He participated in the response to the Exxon Valdez spill of 1989, as well as a spill in Thompson Pass the previous year and in the more recent Windy Bay spill in Prince William Sound.

Levasseur worked for the state transportation department for 20 years ending in 2004. He was a manager and maintenance engineer.

He is a commercial fisherman and, with his wife, owns halibut and black cod quotas, and runs charters for halibut and salmon. In addition, he has long served on the board of the Valdez Fisheries Development Association and is a past board member of the Prince William Sound Aquaculture Association.

The other Valdez representative on the council board is Connie Stephens.

Council's online presence given a makeover

By SUSAN SOMMER
Project Manager

If you haven't checked out the council's website in a while, now is the time to revisit www.pwsrcac.org. A major overhaul has vastly improved the site, making it easier to find important information.

The general look remains the same, but we've improved many features. You'll find updates, new photos, smoother navigation, and new sections and pages. Favorite features, such as the alphabetical list of projects, are now accessible from even more pages.

And there are many other changes. An enhanced menu across the top of each page lists main topics, and also appears in the left column. The Search feature has been improved and is prominent on each page. Updated project information can be found under the main heading "Projects." Our Outreach section also has new pages. The About section is now more streamlined for first-time visitors. Observer newsletters dating back to 1991 are now online as PDF files. PDF files are labeled as such and include file size. New photos fill both the main photo gallery and the Outreach photo gallery. Each is enlargeable for easier viewing. A comprehensive Site Map is now accessible from the bottom of each page. And our Help page has been updated to facilitate assistance with downloads, requests for hard copies of reports, or other questions.

Two brand new sections add depth to our Web site: FAQs, or Frequently Asked Questions, and Resources, a compendium of tools for visitors that includes maps, photos, links to other sites of interest, a glossary, a list of acronyms used on the site, fact sheets, and more.

Some page names have changed; so if you've bookmarked our most popular pages, you'll be redirected to the new page. You can also visit the Home page or Site Map to find your favorite pages.

Spill response facility being proposed for Cordova area

Federal officials are seeking comments on plans for a deep-water port and equipment depot for responding to oil spills on the east side of Prince William Sound.

The Bureau of Indian Affairs, which released a Draft Environmental Impact Statement on the project, recommends building the facility at Shepherd Point, about six miles north of Cordova. The project arises from a legal settlement in the early 1990s between the State of Alaska, the U.S. Government, and Alyeska Pipeline Service Co., according to the draft statement. Besides serving as a storage depot, it would be a staging area for equipment arriving by air for a spill response.

BIA developed the plan in cooperation with the Native Village of Eyak, the U.S. Army Corps of Engineers, and the Federal Highway Administration, according to cordovaresponsefacility.com , the project website.

Comments must be filed by Feb. 6. For more information contact Kristin K'eit, Bureau of Indian Affairs, Alaska Regional Office, Division of Environmental and Resource Management, PO Box 25520, Juneau AK 99802-5520, or visit the website.

Two staffers leaving council

This winter saw the resignations of two of the council's project managers.

Tony Parkin resigned in early December. He had worked out of the Valdez office since 2002, dealing primarily with drills and other aspects of oil-spill preparedness.

Rhonda Williams, also based in Valdez, resigned this month to take a job with the Bureau of Land Management at the Joint Pipeline Office in Valdez. She will be an operations and management specialist.

Williams had been with the council since 2000.

The council is recruiting to fill the vacant positions.

From the Executive Director

As citizen oversight spreads, much work lies ahead

The main mission of our council is monitoring crude-oil transportation in Prince William Sound and the Gulf of Alaska.

But the federal Oil Pollution Act of 1990, which gave us much of our authority, also gave us and our sister organization in Cook Inlet another responsibility: to serve as demonstration projects, with the hope that other citizen oversight groups would be formed as time went by.

Over the past year or so, it has come to seem that hope is being fulfilled. The seeds of citizen oversight are sprouting everywhere:

• Last year, legislators in Washington state set up an Oil Spill Advisory Council, primarily in reaction to a spill in Puget Sound.

• Here in Alaska, a citizen oversight body was set up for the Pogo gold mine near Fairbanks.

• This fall, I was invited by the Aleutians East Borough to speak in Cold Bay about the possibility of setting up a citizen group to deal with the risk of spills from oil and natural gas drilling in the area.

• Also last fall, I was invited to Murmansk, Russia, for a conference on oil development in the Barents region.

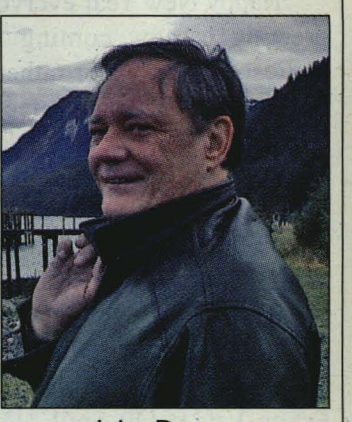
• And, in October, the 8th World Wilderness Conference in Anchorage *(see story, page 1)* endorsed the idea of citizen oversight on a worldwide basis, whenever an extractive natural resource project is launched.

These are all encouraging developments, but we need to be aware that getting to the point we've reached in Alaska may be a slow and difficult process in other places. Our council has adequate funding and is accepted as legitimate and credible by industry and regulators. At the state level, Alaskans have a government reasonably willing to enforce laws and regulations, a substantial budget for environmental protection, close monitoring of oil tankers, and a press free to criticize government and industry when regulations are not followed.

That's not true everywhere, however, and the Murmansk conference provided some examples.

One woman told the group that Russia was planning to relocate her entire village to make room for an oil terminal. Many Norwegians at the conference expressed shock that people could be relocated at the whim of the government, but the Russians appeared to accept it as a fact of life.

There was widespread concern among conference speakers that older single-hulled tankers in the possession of former Soviet states have not been maintained and are not safe to transport oil. Papers presented in Murmansk suggested a great lack of response equipment in the region, as well as budgets inadequate to support prevention and response activities. Some Russian oil-spill response organizations have had to wait months to get their pay. One of them had only three tugs to cover thousands of miles of coast, and one of those had to be put on lease elsewhere for financial reasons. Many speakers indicated there was inadequate enforcement of environmental laws and inadequate funding for prevention and response efforts. We were told of oil spills never cleaned up and spillers never fined.



John Devens

Will the citizens of Russia, the Aleutian Islands, and other areas be able to establish effective citizen oversight without the prod of an environmental catastrophe like the Exxon Valdez spill that gave rise to the Alaska citizens' councils?

I hope so, but the road is apt to be long and trying. As our fellow citizens elsewhere start down it, we stand ready to do the one thing we can do to help: continue sharing the lessons we've learned since 1989 about the value of citizen oversight, and how to make it work.

• John Devens is the executive director of the Prince William Sound Regional Citizens' Advisory Council.

Alyeska Viewpoint

Focus will be on safety and system reconfiguration

I'm very excited about my return to Alaska and the opportunity to serve as Alyeska's President and CEO. I've spent the last 10-15 years in executive management roles within BP working in a wide variety of locations from Wych Farm in England to the North Sea to Columbia and the Gulf of Mexico. From this experience I've learned the importance of people to the ultimate success of a company. I've also incorporated a respect for safe operations and environmental performance. I've learned the tremendous importance of the relationship between a company and the stakeholders who have an interest in the company. I raise these issues with you to give you some sense of how I'm going to approach running this great company. It's my goal to bring a level of transparency to the decisions we'll make as a business.

Since my arrival on TAPS, I've traveled to all of the pump stations, Fairbanks and Valdez several times. My goal was to get to know the people who run TAPS and to find out what issues and challenges they're facing in their daily work. This will continue.

I'm taking time to learn the issues of interest to our various stakeholders, including the citizens' council. We'll meet regularly to discuss the issues we're facing and provide insight into the decisions Alyeska is making about how we're approaching the business in Valdez. And, in my limited time here, I know there is a lot of interest in the issues and challenges that we face.

As Alyeska moves into 2006, we're going to focus on a few key priorities. First and foremost is our commitment to safe operations. I've challenged our company to get to best in class performance on safety – especially when compared with our industry peers in Alaska. This is a core value to me and I know it's a core value throughout TAPS.

We're also going to spend a lot of time and energy ensuring we have a successful transition to the reconfigured pipeline. This has been a major project for the organization and is the right investment for the next 30 years of operation. We will also continue our analysis of how we're conducting business in Valdez. I'll use this column and my discussions with the leadership of the citizens' council to share information through the year.

Kevin Hostler

I'm very enthusiastic about Alyeska. We run a very safe and reliable pipeline, terminal, and tanker escort system. We understand the importance of our business to Alaskans and the wide spectrum of issues we face.

• Kevin Hostler took over as president and chief executive officer of Alyeska Pipeline Service Company on Oct. 1.

Council backs budget change at spill agency

The citizens' council is supporting a move to change how Alaska's Division of Spill Prevention and Response is funded.

Until now, the division has been financed primarily by a tax of three cents per barrel on crude oil produced in the state. But that revenue is declining as oil production drops and can no longer support all of the spill division's work.

As a result, Gov. Frank Murkowski has proposed an appropriation of $725,000 from the state general fund next year to pay for some division programs unrelated to crude oil operations. Crude oil programs would continue to be financed as in the past.

"We believe this is the best way to maintain Alaska's high-quality oversight programs for both crude and non-crude-oil operations," council Executive Director John Devens wrote in a Jan. 11 letter to lawmakers. With the state enjoying record-high oil prices and a large revenue windfall, Devens noted, the appropriation "is a very wise investment of a very tiny portion of the budget surplus."

The letter was recommended by the council's Legislative Affairs Committee, which is chaired by Tom Jensen. The other committee members are Pete Kompkoff, vice chair, and Sherri Buretta, John Allen, George Levasseur, and Steve Lewis. All committee members are members of the council board.

DAWN DUTY – This workboat from Alyeska's SERVS fleet towed boom for an early-morning dispersants exercise near Valdez in mid-September. Photo by Roy Robertson, citizens' council.

Community Corner

With new year comes a new job title

Happy New Year everyone! This greeting is now coming from the Outreach Coordinator rather than the Community Liaison. I feel the new title better explains what I do (and it's easier to say.) And I wanted to tell you a little about it.

The Outreach Coordinator position provides a tool (currently me) for sharing information between the council and the communities affected by the Exxon Valdez Oil Spill. I represent the council at conferences, trade shows and activities sponsored by member organizations. Other responsibilities include assisting with outreach for council projects (such as geographic response strategies and aquatic invasive species), recruiting and orienting volunteers, and coordinating the participation of council volunteers and staff at public events.

Linda Robinson

A birthday in France

Last fall was an especially busy time. Board member Patience Andersen Faulkner, who represents Cordova District Fishermen United, and I were invited to make presentations at the planetarium in Pleumeur-Bodou, France on the 25th anniversary of Vigipol. Vigipol (formerly Syndicat Mixte) was established following the 1978 Amoco Cadiz spill, when approximately 1,589,000 barrels damaged 224 miles of coast in Northern Brittany. After fighting for 14 years to receive compensation, the citizens won a court case against Amoco and were paid more than $42 million. This penalty was used to fund Syndicat Mixte, the Center for Documentation, Research and Experiments on Accidental Water Pollution (CEDRE) in Brest and the Regional Operation Center for Surveillance and Rescue, based in Paris. In 2000, Syndicat Mixte was renamed Vigipol.

Other presenters at the anniversary event came from the Shetland Islands, Finland, Corsica and many dignitaries represented Brittany. It was a true honor to visit with many people so dedicated to the protection of coastlines. One speaker noted that lands may be privately owned, but the ocean belongs to everyone.

Following the anniversary event for Vigipol, we traveled to Brest to visit CEDRE, a large non-profit facility that warehouses response equipment. CEDRE tests equipment in three ponds on-site, conducts scientific testing, and conducts practical training with its artificial beaches and equipment. They also collect documents on spills and research. During the Exxon Valdez oil spill cleanup, CEDRE sent power washers to be used on the oiled beaches.

On the road again

In November, the council sponsored a reception for the Kenai Peninsula Borough Assembly. Staff members John Devens, Susan Sommer and Mary Schonberger attended as well as board member Blake Johnson, committee volunteer Jerry Brookman and representatives from the Cook Inlet Regional Citizens' Advisory Council.

The council's information booth was set up at the Society for Environmental Toxicology and Chemistry's annual conference in Baltimore, Maryland in mid-November. Former staff member Tony Parkin presented a poster, and volunteers John French and Dick Tremaine participated in sessions. November 17-19 found the booth at the Pacific Marine Expo in Seattle. Board member Nancy Bird assisted staff members John Devens, Marilyn Leland and me in tending the booth.

And on December 2, the council held its annual Volunteer Appreciation Party. Guest speaker was Sylvia Earle, renowned marine biologist and currently "Explorer in Residence" for the National Geographic Society, and music was provided by Flutissimo and Melissa Bledsoe Fischer.

In mid-December, staff member Lisa Ka'aihue and I visited Steller school in Anchorage to give a presentation on invasive species with Denny Lassuy of the US Fish and Wildlife Service. Anyone interested in a school presentation on invasive species or any of our other projects should contact me.

The council will be participating in several conferences in the new year: January 23-26, the Marine Science Symposium in Anchorage; February 6-10, the Alaska Forum on the Environment in Anchorage; March 1-3, the Alaska Wilderness, Recreation and Tourism Association Conference in Seward; March 9-11, the Alaska Natural Resource and Outdoor Education Conference in Anchorage; and March 24-26, the Kachemak Bay Science Conference in Homer.

Again, I wish you all a happy and safe new year.

Council Meeting Schedule

The citizens' council board of directors meets three times annually. Here is the schedule for the coming year:

May 2-3, 2006 (rescheduled): Valdez
September 21-22, 2006: Homer
January 25-26, 2007: Anchorage

For more information, visit the council website, www.pwsrcac.org

Prince William Sound Regional Citizens' Advisory Council

The Prince William Sound Regional Citizens' Advisory Council is an independent, non-profit corporation formed after the 1989 Exxon Valdez oil spill to minimize the environmental impacts of the trans-Alaska pipeline terminal and tanker fleet.

The council has 18 member organizations, including communities affected by the Exxon Valdez oil spill and groups representing Alaska Native, aquaculture, environmental, commercial fishing, recreation and tourism interests in the spill region.

The council is certified under the federal Oil Pollution Act of 1990 as the citizen advisory group for Prince William Sound, and operates under a contract with Alyeska Pipeline Service Co. The contract, which is in effect as long as oil flows through the pipeline, guarantees the council's independence, provides annual funding, and ensures the council the same access to terminal facilities as state and federal regulatory agencies.

The council's mission: Citizens promoting environmentally safe operation of the Alyeska terminal and associated tankers.

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