Kodiak Area Marine Science Symposium

Kodiak Harbor Convention Center
Kodiak, AK

April 9 - 12, 2011

Program and Abstracts

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Agenda - Kodiak Area Marine Science Symposium

Saturday - April 9

	Workshops and Keynote Address	
10:00-noon	Touring Alutiiq Museum - *Alutiiq Museum*	
noon-5:00	Seabird Mortality Monitoring for COASST - *FITC*	
2:00-5:00	Communicating Ocean Science - *Fishermen's Hall*	
8:00-5:00	Teaching the Alaska Seas and Rivers Curriculum - *KIBSD*	
7:00-7:45	Keynote Address The Physical Setting of the Gulf of Alaska Continental Shelf	**Dr. Tom Weingartner,** *University of Alaska Fairbanks, SFOS, Fairbanks, AK*
7:45-8:30	Keynote Address Islands in the Stream: Upwelling and Marine Hotspots around the Kodiak Archipelago	**Dr. John Piatt** *U.S. Geological Survey, Port Townsend, WA*

Sunday - April 10

11:00-1:00	Registration	
11:30-12:30	Brunch Available for Purchase	
1:00 -1:10	Welcome	
1:10-1:20	Why has Kodiak Supported Science?	**Jerome Selby,** *Mayor, Kodiak Island Borough, Kodiak, AK*
1:20-1:30	Why is science important for sustainable fisheries?	**Duncan Fields,** *North Pacific Fishery Management Council, Kodiak, AK*
1:30-1:40	Why is Kodiak important to UAF?	**Brian Rogers,** *Chancellor, University of Alaska Fairbanks, Fairbanks, AK*
	Session 1 - Physical and biological oceanography *Tom Weingartner - Session Chair*	
1:40 - 2:00	Measuring the pulse of the Gulf of Alaska: oceanographic observations along seward line, 1997-2010	**Russ Hopcroft,** *University of Alaska Fairbanks, SFOS, Fairbanks, AK*
2:00 - 2:20.	Preliminary Maps of Seafloor Geomorphology of Kodiak Island and Environs	**Jane A. Reid** *U.S. Geological Survey, Santa Cruz, CA*

2:20 - 2:40	Seaweeds of Alaska: Statewide Data Sets and Knowing What's on Your Coastline	**Mandy Lindeberg,** *NOAA Fisheries, Auke Bay Lab, Juneau, AK*
2:40 - 3:00.	Coastal Habitat Tools: I Can See Kodiak from My House	**Susan Saupe,** *Cook Inlet Regional Citizens Advisory Council, Anchorage, AK*
3:00 - 3:20	**Break - (Poster Setup Downstairs KHCC)**	
	Session 2 - Invertebrates *Robert Foy- Session Chair*	
3:20 - 3:40	Alaska CamSled: Benthic Habitat Research in the Kodiak Vicinity	**Gregg Rosenkranz,** *Alaska Department of Fish and Game, Kodiak, AK*
3:40 - 4:00	Field Studies in Support of the Stock Assessment of the Giant Pacific Octopus, *Enteroctopus dofleini*	**Christina Conrath,** *NOAA Fisheries, Kodiak, AK*
4:00 - 4:20	The Effects of Prey Density, Habitat Type, and Predator Density on Cannibalism in Red King Crab, *Paralithodes camtschaticus*	**William Long,** *NOAA Fisheries Kodiak, AK*
4:20 - 4:40	Ghost Fishing on King Crab in Womens Bay	**Peter A. Cummiskey,** NOAA Fisheries, Kodiak, AK
4:40 - 5:00	Increased Variance as a Leading Indicator of Reorganization in Gulf of Alaska Marine Ecosystems	**Michael A. Litzow,** *University of Tasmania, Hobart, Australia (Daniel Urban, Presenter)*
5:30 - 6:30	**Poster Session** Downstairs - KHCC	
5:30 - 8:30	**Reception and Ice Breaker: Hors d'oevres and No-Host Bar**	
Monday - April 11		
8:30 - 8:40	Announcements	
	Session 3 - Fishes *Doug DeMaster - Session Chair*	
8:40 - 9:00	Pacific Cod Predation on Tanner Crab in Marmot Bay, Alaska	**Dan Urban,** *NOAA Fisheries, Kodiak, AK*
9:00 - 9:20	Assessing Rockfish Abundance in Complex Habitats Using Acoustics and Cameras	**Darin Jones,** *NOAA Fisheries, Seattle, WA*
9:20 - 9:40	Movement Patterns of Acoustically-Tagged Black Rockfish *Sebastes melanops* and Dark Rockfish *S. ciliatus* off Kodiak Island, Alaska.	**Carrie Worton,** *Alaska Department of Fish and Game, Kodiak, AK*

9:40 - 10:00	Black Rockfish *Sebastes melanops* Abundance in Kodiak and Chignik Area Waters.	**Phillip Tschersich, Alaska Department of Fish and Game, Kodiak, AK**
10:00 - 10:20	Gulf of Alaska Rockfish Maturity Project	**Christina Conrath,** *NOAA Fisheries, Kodiak, AK*
10:20-10:40	**Break**	
10:40 - 11:00	Diet of 19 Mesopelagic Fish in the Vicinity of Kodiak, Gulf of Alaska, in 2007	**Mei-Sun Yang,** *NOAA Fisheries, Seattle, WA*
11:00 - 11:20	The influence of Polychaete Worm Tube Habitat in Kodiak Flatfish Nurseries	**Brian Knoth,** *NOAA Fisheries, Kodiak, AK*
11:20 - 11:40	Describing Prey Fish Availability in Coastal Waters of the Kodiak Archipelago, Alaska	**Lei Guo,** *University of Alaska Fairbanks, SFOS, Kodiak, AK*
11:40 - 12:00	NPRB GOA IERP MTL: The Forage Fish Component of the GOA Integrated Ecosystem Research Project	**Olav Ormseth,** *NOAA Fisheries, Seattle, WA*
12:00 - 1:20	**Lunch Available for purchase**	
	Session 4 - Marine Birds *Loren Buck- Session Chair*	
1:20 - 1:40	Kittlitz's Murrelet Nesting Ecology on Kodiakell size	**James Lawonn,** *Oregon State University, Department of Fisheries and Wildlife, Corvallis, OR (Robin Corcoran, presenter)*
1:40 - 2:00	Using Radar to Study the Breeding Ecology of Brachyramphus murrelets in Alaska	**Jenna Cragg,** *U.S. Fish and Wildlife Service, Kodiak, AK*
2:00 - 2:20	All Seabirds Don't Tell the Same Story: Productivity of Tufted Puffins and Black-legged Kittiwakes from 2001-2005 in Chiniak Bay, Kodiak, AK	**Cory Williams,** *University of Alaska Anchorage, Anchorage, AK*
2:20- 2:40	Seabird Mortality Surveys in Coastal Alaska	**Jane Dolliver,** *University of Washington/ COASST, Seattle, WA*
	Session 5 - Marine Mammals *Dave Kubiak - Session Chair*	
2:40 - 3:00	Evaluation of Diet Composition and Plane of Nutrition of Free-Ranging Pinnipeds	**Gretchen Geiger,** *University of Alaska Fairbanks, SFOS, Juneau, AK*
3:0 0 - 3:20	**Break**	

3:20 - 3:40	Changes in the Survival and Reproduction of Steller Sea Lions in the Central Gulf of Alaska, 1976-2009	**Lowell Fritz,** *NOAA Fisheries, Seattle, WA*
3:40 - 4:00	The Search for the Smoking Gun: Did Killer Whales Really Do It?	**Seth Newsome,** *University of Wyoming, Laramie, WY (Mike Etnier, Presenter)*
4:00 - 4:20	Kodiak Whales: A Synthesis of 10 Years of GAP Research	**Briana Witteveen,** *University of Alaska Fairbanks, SFOS, Kodiak, AK*
4:20 - 4:40	Movement and Diet of Gray Whales (*Eschrichtius robustus*) off Kodiak Island, Alaska, 2002-2005	**Merrill Gosho,** *NOAA National Marine Mammal Lab, Seattle, WA*
4:40 - 5:00	Kodiak Killers: Life at the Top of the Food Web	**Kate Wynne,** *University of Alaska Fairbanks, SFOS, Kodiak, AK*
6:30 - 8:30	Seafood, Snacks, and Science Fishery Industrial Technology Center Open House	
Tuesday - April 11		
	Session 6 - Utilization *Matt Moir- Session Chair*	
8:30 - 8:40	Announcements	
8:40 - 9:00	Increased Utilization of Harvested Biomass	**Matthew Davenport,** *University of Alaska Fairbanks, Fishery Industrial Technology Center, Kodiak, AK*
9:00 - 9:20	Alaska fish processing byproducts: Enhancing utilization	**Peter Bechtel,** *University of Alaska Fairbanks, USDA Agricultural Research Service, Kodiak, AK*
9:20 - 9:40	Increasing the Utilization of Fish Heads	**Jesse Stine,** *University of Alaska Fairbanks, USDA Agricultural Research Service, Kodiak, AK*
	Session 7 - Human Dimensions *Pat Jacobsen- Session Chair*	
9:40 - 10:00	Fisheries Privatization and Shifting Human-Environment Relationships in the Kodiak Archipelago	**Courtney Carothers,** *University of Alaska Fairbanks, SFOS, Fairbanks, AK*
10:00 - 10:20	Break	

10:20 - 10:40	The Kodiak Ocean Science Discovery Program - Connecting Students with the Fisheries and Science Community	**Switgard Duesterich,** *Alaska Educational Resource Services, NOAA Fisheries, Kodiak Island Borough School District, Kodiak, AK*
10:40 - 11:00	Paleoenvironmental Reconstruction in the Kodiak Archipelago	**Catherine West,** *Smithsonian Institution, National Museum of Natural History, Washington,DC*
11:00 - 11:20	7000 Years of Intertidal Shellfish Exploitation in Chiniak Bay	**Molly Odell,** *University of Washington, Dept. of Anthropology, Seattle, WA*
11:20 - 11:40	A look inland – the archaeology of Kodiak's inland lakes and rivers , AD 500 to 1500	**Patrick Saltonsall,** *Alutiiq Museum, Kodiak, AK*
11:40 - 12:00	Using Southwest Alaskan archaeofaunas to gauge the ecological effects of future climate change.	**Mike Etnier,** *Applied Osteology, Western Washington University, Bellingham, WA*
12:00 - 12:10	**Closure and Thank Yous**	
	Workshops in Nearby Locations	
2:00 - 5:00	Cooperative Marine Research Roundtable - *Fishermen's Hall*	
2:00 - 5:00	Monitoring Marine Invasive Species - *KNWR Interpretive Center*	
	Posters **Downstairs Kodiak Harbor Convention Center**	
1	Afognak Island *Macrocystis pyrifera*	**Susan Saupe,** *Cook Inlet Regional Advisory Council, Anchorage, AK*
2	A Miniature Acoustic Transponder for Simlutaneous Underwater Animal Tracking and Habitat Mapping	**Christian de Moustier,** *Heat, Light and Sound Research, La Jolla, CA (Robert Foy - presenter)*
3	Crab Mass Molting Events, Kodiak Island	**Laura Slater,** *Alaska Department of Fish and Game, Kodiak, AK*
4	Changes in Northern Shrimp (*Pandalus borealis*) Sizes in the Gulf of Alaska	**Joseph O'Gorman,** *NOAA Fisheries, Kodiak, AK*
5	Evaluation of Observer Sampling Methods within the Kodiak Trawl Catcher Vessel Fleet	**Craig Faunce,** *NOAA Fisheries, Seattle, WA*

6	The Gulf of Alaska Project: An Inter-Regional Comparison of Marine Fish Recruitment Dynamics	**Jamal Moss,** *NOAA Fisheries, Juneau, AK*
7	Use of Remote Cameras to Collect Long-Term Seabird Monitoring Data on the Alaska Maritime National Wildlife Refuge	**Arthur Kettle,** *Alaska Maritime National Wildlife Refuge, Homer, AK*
8	Monitoring the Alaska Subsistence Harvest of Northern Sea Otters, Pacific Walruses, and Polar Bears in changing time	**John Trent,** *U.S. Fish and Wildlife Service, Anchorage, AK (Suzann Speckman, presenter)*
9	The U.S. Fish and Wildlife Service and Sea Otter Management in Kodiak	**Suzann Speckman,** *U.S. Fish and Wildlife Service, Anchorage, AK*
10	Oral History of Fisheries in Alutiiq Communities	**Catherine Chambers,** *University of Alaska Fairbanks, SFOS, Fairbanks, AK*
11	Research Projects at Nuniaq Marine Science Camp, 2006	**Tamara Swenson,** *Old Harbor, AK*
12	Offshore Drilling in Bristol Bay, Alaska	**Kodiak High School Students Team B,** *Kodiak, AK*
13	Systematics of Common Marine Mollusks Found in Kodiak, AK	**Kodiak High School Students Team C,** *Kodiak, AK*
14	The Effects of Fish Processing Biowaste on the Ocean's Organisms and Nutrients	**Kodiak High School Students Team A,** *Kodiak, AK*
15	Quality Assessment of Commercially Harvested Weathervane Scallops (*Patinopecten caurinus*) from Alaska	**Kathryn Brenner,** *University of Alaska Fairbanks, SFOS, Kodiak, AK*
16	Development of Flavored Freeze-Dried Cubes from Wild-Caught Pacific Pink Salmon (*Oncorhynchus gorbuscha*)	**Lale Gurer,** *University of Alaska Fairbanks, SFOS, Kodiak, AK*
17	Chemical Characteristics and Antilisterial Testing of Low Color and Flavor Liquid Smokes	**Naim Montazeri,** *University of Alaska Fairbanks, SFOS, Kodiak, AK*
18	Development and Nutritional Quality of Wood-Smoked Fish Sausage Prepared from Pink Salmon (*Oncorhynchus gorbuscha*)	**Naim Montazeri,** *University of Alaska Fairbanks, SFOS, Kodiak, AK*
19	Post-Harvest Quality of Selected Pacific Oysters (*Crassostrea gigas*) Cultured in Kachemak Bay, Alaska, and Puget Sound, Washington	**Stuart Thomas,** *University of Alaska Fairbanks, SFOS, Kodiak, AK*

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Keynote Speaker

The Physical Setting of the Gulf of Alaska Continental Shelf

Thomas Weingartner

Institute of Marine Science, University of Alaska, Fairbanks, AK

Winds, coastal freshwater runoff, and a complex coastal geometry and bathymetry combine to establish a vigorous shelf circulation and numerous physical habitats that structure the marine ecosystems of the Gulf of Alaska. While winds and freshwater runoff establish a seasonally varying flow field that, in the mean, tends to transfer water, heat, and organisms around the gulf from east to west, the bathymetry enhances vertical mixing and exchanges between the basin and the shelf that are likely important for nutrient renewal. There are considerable asymmetries in the shelf environment between the eastern and western gulf, however, which likely leads to different ecological habitats and patterns of biological productivity. Indeed, there may be enhanced cross-shelf transport in the Kodiak region that enhances production here relative to other regions. I will also examine some of the mechanisms that give rise to both interannual and longer-term variations in the shelf environment.

Island in the Stream: Upwelling and Marine Hotspots around the Kodiak Archipelago

John F. Piatt

U.S. Geological Survey, Alaska Science Center, Anchorage, AK

More seabirds breed and forage around the Kodiak archipelago than along the entire coast of the northeast Gulf of Alaska from Sitka to Gore Point. Why? Coastal waters are mostly downwelled in the northeastern gulf, effectively capping much of the continental shelf in this region with a warm surface layer of water that lacks a renewable source of nutrients to sustain primary production. In contrast, as currents on the shelf strike the Kodiak archipelago, upwelling of cold, nutrient-rich waters stimulates primary production and creates a productive hotspot in the northern gulf. This local productivition is carried downstream, enhancing biological productivity on the Alaska Peninsula shelf as well. Currents, bottom topography, temperature, and turbulence all play a role in structuring marine communities upstream and downstream of the Kodiak archipelago. I will examine some patterns of plankton, fish, bird, and mammal communities in the region, and suggest some avenues for future marine research around Kodiak.

Measuring the Pulse of the Gulf of Alaska: Oceanographic Observations along the Seward Line, 1997-2010

Russell R. Hopcroft, Kenneth O. Coyle, Jeremy T. Mathis, Thomas J. Weingartner, and Terry E. Whitledge

University of Alaska Fairbanks, School of Fisheries and Ocean Sciences, Fairbanks, AK, hopcroft@ims.uaf.edu

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The Seward Line in the northern Gulf of Alaska, just "upstream" of the Kodiak region, has been the focus of multidisciplinary sampling for the past 13 years. Here we report on the observations of physical oceanography, nutrients, phytoplankton, and zooplankton over that period, with emphasis on the last year. In 2010, May temperatures returned to slightly above their long-term means, breaking the recent string of 3 cold years. Late summer surface temperatures were well above the September long-term mean. Consistent with water temperature, the spring bloom was of typical timing as were spring zooplankton communities. In contrast, the warm summer temperatures yielded low zooplankton biomass, with the communities within the Alaska Coastal Current and Prince William Sound flooded by warmwater species originating from southern waters. Implications to higher trophic levels in the Gulf of Alaska (e.g., salmon) will be discussed, as will broader scale modeling efforts and the expanded sampling domain in the Kodiak region for 2011 and 2013.

Preliminary Maps of Seafloor Geomorphology of Kodiak Island and Environs

Jane A. Reid1, Mark Zimmermann2, and Nadine E. Golden3

[1]U.S. Geological Survey, Santa Cruz, CA, jareid@usgs.gov

[2]NOAA FIsheries, Seattle, WA

[3]U.S. Geological Survey, Santa Cruz, CA

Knowledge of the seabed affects many aspects of human usage of the oceans. Where are the areas of rocks, boulders, or large cobbles that provide refuge for groundfish? Where are the soft sediments? Where might it be safe to trawl? Where might currents be strongest as suggested by the nature of the local seabed? What depositional trends can be inferred from seabed composition? While focused seafloor mapping (combined bathymetry, backscatter, and groundtruthing) is the preferred method of gathering the data to support this information, it is also time-consuming, expensive, and at best, covers relatively small areas of the seafloor. Existing Gulf of Alaska seafloor maps are analog, and while useful, do not lend themselves to modern GIS methodology of multilayered analysis and interpretation. We present draft versions of digital three-dimensional seafloor geomorphic maps for the area around Kodiak and Afognak islands. Surficial seafloor characteristics are determined from existing lab analyses and other numerical data derived from written seabed descriptions of grabs, cores, seafloor imagery, and NOS chart data, all part of the usSEABED database. Bathymetric data from NOS charts are digitized, edited, and datum-shifted, then combined into seamless views of seafloor depth, slope, and rugosity. These two data sets, after being individually gridded in ArcGIS®, are combined and visualized using Fledermaus® software, which provides oblique data views from any angle. These images show the predominantly muddy character of the Shelikof Strait, Kiliuda and portions of Stevenson troughs, the coarser Albatross banks and nearshore areas of the islands, and possible relict glacial moraines and fault lines.

Seaweeds of Alaska: Statewide Data Sets and Knowing What's on Your Coastline

Mandy Lindeberg

NOAA Fisheries, Juneau, AK, mandy.lindeberg@noaa.gov

In the past seaweeds in Alaska have been largely overlooked and yet they provide essential habitat and food to many marine species in the shallow nearshore. There are now many new tools available online to managers, researchers, educators, and the public focusing on coastal resources and Alaska's seaweeds. An overview of these tools will be given from statewide data sets such as ShoreZone, Shore Stations (see companion abstract by S. Saupe), and seaweedsofAlaska.com. Seaweeds from the Kodiak archipelago will be highlighted along with how to identify seaweeds near your coastline using the newly published Field Guide to Seaweeds of Alaska.

Coastal Habitat Tools: I Can See Kodiak from My House

Susan Saupe[1], Mandy Lindeberg[2], Mary Morris[3], and John Harper[4]

[1]*Cook Inlet Regional Citizens Advisory Council, Anchorage, AK, saupe@circac.org*

[2]*NOAA Fisheries, Juneau, AK*

[3]*Archipelago Marine Research LTD*

[4]*Coastal and Ocean Resources Inc.*

A robust collection of data and digital imagery collected from the Kodiak region has led to the development of several demonstration projects that are companions to the Alaska ShoreZone Program. A web-based portal to algal and invertebrate species-level information from over 130 intertidal sites around the perimeter of the Kodiak Island archipelago will be described and a "stand-alone" video application tool will show users how to fly along Kodiak's coast by accessing high resolution flash video of the entire Kodiak region's shoreline. The Kodiak Shore Station Database is an interactive spatial data tool that provides invertebrate and algae species data collected from on-the-ground surveys throughout the Kodiak region at a level of detail not possible during aerial surveys. These data augment the region-wide biophysical habitat data provided by ShoreZone Alaska and link to other area shoreline resources such as the "Seaweeds of Alaska" website (see companion abstract by Lindeberg). The ground station data portal guides the viewer through spatial searches by region, locale, station, bioband, or species of flora and/or fauna and allows for downloading query results. The separate flash video tool will be available for distribution, allowing users to "fly" Kodiak's coast from their home computers without requiring Internet access. Recent demonstrations for oil spill drills and response planning have proven that easy access to remote coastal imagery is invaluable for educating nonlocal responders to areas that are not otherwise easily accessible.

Alaska CamSled: Benthic Habitat Research in the Kodiak Vicinity

Gregg Rosenkranz and Ric Shepard

Alaska Department of Fish and Game, Kodiak, AK, gregg.rosenkranz@alaska.gov

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Alaska CamSled is a towed, benthic optical imaging system developed by the Alaska Department of Fish and Game primarily for scallop research. Using machine vision and computer networking technology, the system creates and records a continuous stream of megapixel digital images of the seafloor while towing at speeds to 7.5 km per hr (4.1 knots). We present an overview of the system, describe ongoing research in the Kodiak vicinity, and display images from 2009 and 2010 surveys that show "what's out there" on the bottom around Kodiak.

Field Studies in Support of the Stock Assessment of the Giant Pacific Octopus, *Enteroctopus dofleini*

Christina Conrath[1] and Liz Conners[2]

[1]*NOAA Fisheries, Kodiak, AK, Christina.Conrath@noaa.gov*

[2]*NOAA Fisheries, Seattle, WA*

Research is currently under way in the Gulf of Alaska to examine the life history of *Enteroctopus dofleini* and to develop field collection techniques to support stock assessment of the octopus species assemblage. *E. dofleini* specimens for this study were obtained during various dates throughout 2010 from commercial Pacific cod pot fishers and charter operations operating out of Kodiak, Alaska. A total of 94 samples (44 female, 50 male) were obtained ranging in size from 1.2 to 22.3 kg. A gonadosomatic index (GSI) was calculated, the condition of the reproductive tract was examined, and a gonad maturity coding system was developed for male and female *E. dofleini*. Visual inspection, GSI, and histological results indicate both male and female *E. dofleini* mature around 10-12 kg. The initial study also included a vessel charter for testing and developing "habitat pots"—a specialized gear designed for scientific studies and possible future index surveys of octopus abundance. A variety of pot designs and materials are being tested for use in Alaska. The initial results indicate that plywood box pots fixed along a longline are an economical and feasible method for capturing octopus. In the spring trials, plywood box pots and scrap ATV tires had a capture rate of about 30%, but pots made from a variety of plastic materials had a much lower catch rate (<5%). The results of this study will be utilized in future stock assessments and to assess the feasibility of developing an index survey for octopus in Alaska waters.

The Effects of Prey Density, Habitat Type, and Predator Density on Cannibalism in Red King Crab, *Paralithodes camtschaticus*

W. Christopher Long, Jessica Popp, Katherine M. Swiney, and Scott B. Van Santr

NOAA Fisheries, Resource Assessment and Conservation Engineering Division, Kodiak, AK, chris.long@noaa.gov

Red king crab, *Paralithodes camtschaticus*, exhibits cannibalism in laboratory and hatchery settings and such interactions may limit wild or enhanced populations of juveniles. Cannibalism in crab species can be an important determinant of recruitment success, and this might be especially important in king crab because year-0 and year-1 crab occupy the same habitat types in the wild. In this study we determined the effect of prey density on predation rate by year-1 crab preying on year-0 crab in three different habitat types: sand (unstructured soft sediment), shell (whole clam valves), and shell hash (smaller pieces of crushed shell). We also examined how predator density (1 or 2 predators) interacts with prey density to determine predation rate in a laboratory. Our results showed a proportional predation rate decreased with prey density in all habitat types and at all predator densities, and was lower at all prey densities in shell habitat than in shell hash and sand habitats. The presence of a second predator decreased predation rates at low prey densities, and slightly increased them at high prey densities, indicating a low level of predator interference. This work highlights the importance of structured habitat as a refuge from predation for juvenile crab. It also has implications for potential stock enhancement activities as year-1 crab could inhibit enhancement success though cannibalism of introduced year-0 crab. A potential solution would be to enhance a given area only every other year to give previous cohorts a chance to start podding in less complex habitats.

Ghost Fishing on King Crab in Womens Bay

Peter A. Cummiskey, Eric Munk, and W. Christopher Long

NOAA Fisheries, Kodiak, AK, peter.a.cummiskey@noaa.gov

Womens Bay near Kodiak, Alaska, has supported commercial, subsistence, and personal use fisheries for king, Tanner, and Dungeness crab for many years, with numerous crab pots lost in that time. Since these derelict pots have the potential to "ghost fish" (i.e., capture crab in unattended pots) and cause a substantial mortality to juveniles and adult crab of both sexes, including ovigerous females, they may affect the reproductive potential of the stock, which has been depressed since the early 1980s. Biologists at the National Marine Fisheries Service Kodiak Lab use acoustic tags and scuba to document crab movement, habitat use, and behavior of red king crab in Womens Bay. Tags allow long-term monitoring of pods of up to thousands of crab. Between 1990 and 2008, on nearly 10% of 614 dive observations, the tagged crab were on or in derelict pots. Sixty derelict pots were observed, including 31 Dungeness, 21 other commercial types, 4 homemade, and 8 unknown. Sixty-five percent of these pots were intact and capable of ghost fishing. Twenty-six tagged crab, and hundreds of non-tagged crab were trapped in intact ghost fishing pots, with 12 tagged crab, including 4 mature females, found dead. Divers routinely disable ghost pots and have released hundreds of crab, many mature. We estimate that ghost fishing likely kills between 6 and 12% of king crab per year in Womens Bay and may reduce the ability of the local crab population's ability to rebuild.

Increased Variance as a Leading Indicator of Reorganization in Gulf of Alaska Marine Ecosystems

Michael A. Litzow[1], Daniel Urban[2], and Franz J. Mueter[3]

[1]University of Tasmania, Institute for Marine and Antarctic Studies, Hobart, TAS, Australia, mike_litzow@yahoo.com

[2]NOAA Fisheries, Kodiak, AK

[3]University of Alaska Fairbanks, School of Fisheries and Ocean Sciences, Juneau, AK

It is well known that in the late 1970s, the Gulf of Alaska marine ecosystem abruptly changed from a system dominated by crab and shrimp to one where fish were dominant. This "regime shift" resulted in dramatic changes to the economies of many coastal communities including Kodiak. There was little warning that this major transition was going to occur. However, recent developments in ecosystem modeling suggest a novel approach to this problem: using the variance of key parameters to monitor ecosystem status to predict impending ecosystem shifts. This "variance tracking" approach has been validated by empirical observations in the Gulf of Alaska, suggesting that it may have real world management utility. For this study we used a retrospective analysis of 22 different catch records and stock surveys for crustacean species across Alaska's marine waters. Kodiak Tanner and king crab were included in the analysis using data from Alaska Department of Fish and Game surveys and catch history databases. The annual coefficient of variation of catch and survey density within bays or by management units are our basic measures of variability. For many shellfish stocks, increased variance within bays and on a broader gulf-wide scale preceded the shift of the late 1970s. More recent shifts documented in 1989 and 1999/2000 were not as clearly marked by increased variance. Tracking variance may prove an important tool for early warning of impending large scale changes to the marine ecosystem, which could help minimize the effects of those changes on the community of Kodiak.

Pacific Cod Predation on Tanner Crab in Marmot Bay, Alaska

Dan Urban

NOAA Fisheries, Kodiak, AK, dan.urban@noaa.gov

Pacific cod (*Gadus macrocephalus*) have long been recognized as an important predator of Tanner crab (*Chionoecetes bairdi*). To investigate the predation relationship of these two commercially important species, I conducted a seasonal study of Pacific cod predation on Tanner crab as determined from the stomach contents in Marmot Bay off Kodiak Island, Alaska. A total of 974 stomachs were sampled during six sampling periods from June 1998 to June 1999.By weight, Tanner crab was the most consumed prey item, followed by walleye pollock (*Theragra chalcogramma*), northern shrimp (*Pandalus eous*), and arrowtooth flounder (*Atheresthes stomias*). Numerically, euphausiids were the most consumed prey item, followed by Tanner crab, northern shrimp, mysidacea, and unidentified Eualus shrimp. During this study, cod consumed over 365 million immature Tanner crab, mostly 10-45 mm carapace width, from four different cohorts. The cod per capita predation rate suggests moderate density-dependence on prey numbers, but cod were also confirmed to be opportunistic predators that rapidly switched from Tanner crab consumption to alternative prey species. Without more extensive temporal and spatial data, the role cod predation plays in regulating crab populations on a broader scale is difficult to determine. Further work could help elucidate this important predator/prey relationship and also provide the information needed for the implementation of ecosystem-based fishery management

Assessing Rockfish Abundance in Complex Habitats Using Acoustics and Cameras

Darin T. Jones[1], Thomas C. Weber[2], Christopher N. Rooper[3], John L. Butler[4], and Christopher D. Wilson[5] and Alex De Robertis[5]

[1]NOAA Fisheries, Alaska Fisheries Science Center, Seattle, WA, darin.jones@noaa.gov

[2]CCOM/University of New Hampshire, Durham, NH

[3]NOAA Fisheries, Alaska Fisheries Science Center, Seattle, WA

[4]NOAA Fisheries, Southwest Fisheries Science Center, San Diego, CA

[5]NOAA Fisheries, Alaska Fisheries Science Center, Seattle, WA

Many species of rockfishes (*Sebastes spp*.) are difficult to assess using trawl surveys due to their propensity to aggregate near the seafloor in rocky high relief areas. A feasibility study was conducted during October 2009 in such an area south of Kodiak Island, Alaska, to evaluate the use of standard fisheries acoustic survey methods in conjunction with stereo-video cameras for estimating the distribution and abundance of dusky and northern rockfishes. Uniformly spaced parallel transects were repeatedly surveyed using single beam echosounders over several days. A multibeam echosounder was used to characterize the seafloor as trawlable or untrawlable and these designations were corroborated by camera. Rockfish abundance was estimated using a combination of acoustic and camera measurements. At least 80% of the rockfish detections were observed in untrawlable habitat areas, and within 2.0 m of the seafloor. Over half of the rockfish seen by the camera were within the acoustic dead zone. Repeat passes exhibited high precision and there was no significant difference in fish abundance or height off bottom between night and day. Future work is planned during summer 2011 to evaluate the feasibility of using these methods in broader areas and for other rockfishes in the Gulf of Alaska.

Movement Patterns of Acoustically Tagged Black Rockfish *Sebastes melanops* and Dark Rockfish *S. ciliatus* off Kodiak Island, Alaska

Carrie Worton

Alaska Department of Fish and Game, Kodiak, AK, carrie.worton@alaska.gov

Black rockfish *Sebastes melanops* and dark rockfish *S. ciliatus* inhabit similar nearshore waters in Alaska and are often harvested together in commercial jig fisheries. The site-specific nature of black rockfish and dark rockfish aggregations make them vulnerable to localized depletion, which is a concern for fishery managers. In an effort to understand daily and annual movements of these species, 18 underwater acoustic receivers were deployed in an area of 10 km2 northeast of Kodiak Island, and 85 black rockfish and 55 dark rockfish were implanted with coded acoustic tags and released back to the area. Over 8 million detections were recorded during October 2006 to August 2009. The average duration of absences (>1 day) for each black rockfish ranged from 1.5 to 122.8 days. Multiple absences from the study area were common, with fish returning to the same area even after extended absences. Both female and male black rockfish had the greatest average number of days absent in June, July, October, and November, with mature females absent for longer periods in January, February, and April. Dark rockfish absences were less frequent and shorter in duration (1.1-9.6 days) than black rockfish with no significant seasonal movement patterns. While black rockfish home ranges were significantly larger than dark rockfish, they often overlapped. This study indicates the strong site fidelity of these two nearshore species to similar habitats, with possible differences in life history influencing longer seasonal movements.

Black Rockfish *Sebastes melanops* Abundance in Kodiak and Chignik Area Waters

Philip Tschersich and Carrie Worton

Alaska Department of Fish and Game, Kodiak, AK, philip.tschersich@alaska.gov

The economic importance of black rockfish *Sebastes melanops* in Kodiak archipelago and south Alaska Peninsula waters has provided the impetus to develop a population-based management plan for the commercial jig fishery. Hydroacoustic surveys conducted from 2007 to 2010 were used to generate rockfish abundance estimates in five of the six commercial fishing districts of the Kodiak Management Area and in the three districts of the Chignik Management Area. Live-capture and underwater video sampling were used at most survey locations to apportion the rockfish abundance estimates by rockfish species, and generate a coastal rockfish species distribution profile. The abundance of adult black rockfish was estimated at over 1 million fish in both the Kodiak and Chignik management areas.

Gulf of Alaska Rockfish Maturity Project

Christina Conrath, Brian Knoth, and Elizabeth Chilton

NOAA Fisheries, Kodiak, AK, christina.conrath@noaa.gov

Despite the ecological and economic importance of rockfish fisheries in Alaska waters, little information is available concerning the reproductive biology of the majority of federally managed rockfish species in the Gulf of Alaska (GOA). Many rockfish species or species assemblage assessments currently rely on age at maturity estimates that are drawn from small sample sizes or are based exclusively on macroscopic (visual) staging. For the past several years research biologists working for the Alaska Fisheries Science Center (AFSC) Kodiak Laboratory have studied the reproductive biology of several rockfish species within the GOA. Rockfish samples have been obtained from AFSC surveys, Alaska Department of Fish and Game surveys, North Pacific groundfish observers, and bottom trawl charter operations. To date, over 2,500 rockfish of 11 species have been sampled with past studies focused on northern and dusky rockfishes. Current research is primarily focused on Pacific ocean perch, rougheye, blackspotted, and shortraker rockfish. The ultimate goal of this research is to provide more accurate reproductive parameter estimates, which will improve stock assessment models and result in the most appropriate acceptable biological catch (ABC) levels and overfishing limits (OFL) for rockfish within the GOA.

Diet of 19 Mesopelagic Fish in the Vicinity of Kodiak, Gulf of Alaska, in 2007

Mei-Sun Yang

NOAA Fisheries, Alaska Fisheries Science Center, Seattle, WA, mei-sun.yang@noaa.gov

A total of 1,607 stomachs from 19 species were analyzed to describe the food habits of the mesopelagic species around Kodiak area in the Gulf of Alaska in 2007: brokenline lanternfish (*Lampanyctus jordani*), Alaska dreamer (*Oneirodes thompsoni*), blue lanternfish (*Tarletonbeania crenularis*), longfin dragonfish (*Tactostoma macropus*), *Scopelosaurus adleri*, barreleye (*Macropinna microstoma*), shining tubeshoulder (*Sagamichthys abei*), garnet lampfish (*Stenobrachius nannochir*), northern lampfish (*Stenobrachius leucopsarus*), unknown bathylagid, bigeye lanternfish (*Protomyctophum thompsoni*), *Poromitra curilensis*, highsnout bigscale (*Melamphaes lugubris*), bluethroat argentine (*Nansenia candida*), pinpoint lampfish (*Nannobrachium regale*), northern smoothtongue (*Leuroglossus schmidti*), California headlightfish (*Diaphus theta*), Pacific viperfish (*Chauliodus macouni*), and northern pearleye (*Benthalbella dentata*). Longfin dragonfish, Pacific viperfish, *Scopelosaurus adleri*, Alaska dreamer, and northern pearleye were the main piscivores. Myctophids were the dominant prey fish. Garnet lampfish, bigeye lanternfish, brokenline lanternfish, highsnout bigscale, shining tubeshoulder, and northern lampfish fed mainly on calanoid copepods. Blue lanternfish and bluethroat argentine fed mainly on larvaceans. California headlightfish, northern smoothtongue, the unknown bathylagid, and *Poromitra curilensis* ate different combinations of larvaceans, euphausiids, calanoids, ostracods, gastropods, and chaetognaths. Pinpoint lampfish consumed high percentages of shrimp and cephalopods. Diet comparisons by depth, time, and species will be discussed.

The Influence of Polychaete Worm Tube Habitat in Kodiak flatfish Nurseries

Brian Knoth[1], Clifford Ryer[2] and Benjamin Laurel[2]

[1]*NOAA Fisheries, Kodiak, AK, brian.knoth@noaa.gov*

[2]*NOAA Fisheries, Fisheries Behavioral Ecology Program, Newport, OR*

Many juvenile flatfish species utilize bays around Kodiak Island, Alaska, as nursery areas. Yet not all nursery areas are created equal, with habitat features influencing nursery quality for juvenile flatfish. In Kodiak flatfish nurseries, tube-building ampharetid polychaete worms provide habitat for juvenile flatfish, and in some years form a dense turf covering large sections of the seafloor. Juvenile flatfish, most notably northern rock sole *Lepidopsetta polyxystra*, aggregate along the shallow (inner) edge of this habitat, where tube density is sparse to moderate, avoiding areas where tube density is the highest. We conducted a series of laboratory and field studies to examine the mechanisms controlling this association. Lab and field manipulations showed that dense worm tubes interfere with the ability of juvenile rock sole to bury (a main defense mechanism), potentially explaining their avoidance of this habitat. Field tethering experiments indicated that predation on juvenile flatfish, while generally increasing with depth, was reduced in areas where tube density was sparse to moderate, i.e., along the turf edges. Benthic grab sampling revealed a greater diversity and abundance of benthic invertebrates along the worm edge, yet stomach content analyses of rock sole from along the worm turf edge revealed that fish were primarily consuming ampharetid polychaete worms. These results suggest that polychaete worm tubes are a key habitat feature influencing the distribution, predation risk, and foraging opportunities of juvenile flatfish within shallow water Kodiak nurseries.

Describing Prey Fish Availability in Coastal Waters of the Kodiak Archipelago, Alaska

Lei Guo[1], Robert Foy[2], and Kate Wynne[3]

[1]University of Alaska Fairbanks, School of Fisheries and Ocean Sciences, Kodiak, AK, guo@sfos.uaf.edu

[2]NOAA Fisheries, Kodiak, AK

[3]University of Alaska Fairbanks, School of Fisheries and Ocean Sciences, Kodiak, AK

Assessing the availability of prey fishes is key to understanding fluctuations in populations of apex predators that prey upon them. In this study, lipid and energy content, mesoscale horizontal distribution, and energy density of prey fishes were measured to assess the availability of prey fields to local apex predators over critical periods of their life history in coastal waters of the Kodiak archipelago, Alaska. We focused on four pelagic species that consistently dominate local midwater trawl catches and are important prey for upper trophic level predators: walleye pollock (*Theragra chalcogramma*), Pacific herring (*Clupea pallasii*), capelin (*Mallotus villosus*), and eulachon (*Thaleichthys pacificus*). Lipid and energy content were highly variable within and among species. Dense post-spawning aggregations of prey fishes formed seasonal energetic "hotspots," exemplified by herring schools on the northwest side of the archipelago in May and capelin schools on the northeast side in August. Although the average energy content of individuals in these aggregations was not higher than that in more dispersed schools, local apex predators prefer highly aggregated prey. Therefore, central-place foragers, such as many species of seabirds and pinnipeds, will be more affected by changes in prey aggregative patterns than predators that feed over relatively larger distances, such as cetaceans. Major ecosystem-level perturbations that affect aggregative patterns of prey fishes may have diverse effects on different species of apex predators.

NPRB GOA IERP MTL: The Forage Fish Component of the GOA Integrated Ecosystem Research Project

Olav A. Ormseth

NOAA Fisheries, Alaska Fisheries Science Center, Seattle, WA, olav.ormseth@noaa.gov

The North Pacific Research Board has initiated a multiyear Integrated Ecosystem Research Project (IERP) in the Gulf of Alaska (GOA). The project consists of four components: upper, middle, and lower trophic levels and a modeling group. The goal of IERP is to provide a comprehensive examination of GOA ecosystem dynamics through a combination of retrospective analyses, diverse field activities, and modeling. The project duration is 2011-2014, with field years occurring in 2011 and 2013. The goal of the middle trophic level (MTL) component is to provide a comprehensive examination of the ecology of GOA forage fishes (e.g., capelin, herring, juvenile walleye pollock) from the shoreline out to the shelf break. The primary basis for this work is a comparison of the eastern GOA (i.e., the outer coast of southeast Alaska) to the central GOA (the eastern side of Kodiak Island and the southern Kenai Peninsula). Six nearshore sites in each of the two main regions will be surveyed on a seasonal basis (spring, summer, fall) using a variety of gears designed to assess all habitats within the selected areas. A study of diets will be used to infer trophic relationships. I will provide an overview of the project and present some interesting preliminary results from pilot studies conducted during fall 2010 in the central GOA.

Kittlitz's Murrelet Nesting Ecology on Kodiak

M. James Lawonn[1], Robin M. Corcoran[2], John F. Piatt[3], and William H. Pyle[4]

[1]*Oregon State University, Department of Fisheries and Wildlife, Corvallis, OR, mjlawonn@gmail.com*

[2]*Kodiak National Wildlife Refuge, Kodiak, AK*

[3]*U.S. Geological Survey, Anchorage, AK*

[4]*Kodiak National Wildlife Refuge, Kodiak, AK*

The Kittlitz's murrelet (*Brachyramphus brevirostris*) is a rare and little-studied seabird that nests primarily in Alaska, where long-term monitoring indicates declines of up to 80%. This species is of high conservation concern, and is a highly ranked "candidate" for protection in the United States under the Endangered Species Act. We studied breeding Kittlitz's murrelets from 2008 to 2010 on western Kodiak Island. We located nests by systematically searching nesting habitat, placed motion sensitive cameras on a subset of nests, and collected morphometric and genetic data on chicks following hatch. We located a total of 34 active nests representing about 30% of all nests ever found for this species. Of those 34 nests, five fledged young, giving a total apparent nest success rate of 0.147 over three years. Foxes accounted for four of five camera-documented depredations of nests. Other potential limiting factors to nest success included unviable eggs and chick death. Five eggs thought to be unviable were observed from 2008 to 2010, representing nearly 15% of total eggs laid. Chick death, secondary to malnourishment or exposure to inclement weather, accounted for about 12% of total nest failures. Camera images from six nests suggest that sand lance are an important forage fish for Kittlitz's murrelets on Kodiak Island. Measurements from three chicks indicate that growth rates on Kodiak may be high compared with a cooperative murrelet nesting ecology study on Agattu Island. This study is ongoing with fieldwork scheduled to begin again in May 2011, and preliminary results will be presented.

Using Radar to Study the Breeding Ecology of Brachyramphus Murrelets in Alaska

Jenna L. Cragg and Alan E. Burger

University of Victoria, Biology Department, Victoria, BC, Canada, jenna.cragg@gmail.com

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Kittlitz's murrelet (*Brachyramphus brevirostris*) is a rare and poorly understood seabird found in Alaska and eastern Russia. On Kodiak Island, Alaska, it is sympatric with the well-studied and more widespread marbled murrelet (*B. marmoratus*). Although these species share behavioral traits including non-colonial, highly cryptic nesting behavior and nearshore piscivorous foraging, they exhibit some subtle behavioral differences that are not well understood. Both species commute to and from the nest in dark twilight, making visual studies of this behaviour impossible. Marine radar has become a standard tool to study the inland flight behavior of marbled murrelets in forested watersheds throughout British Columbia and in the United States, and has shown high statistical power to detect population trends; however, radar has not been used for monitoring populations of either murrelet species in Alaska. In 2010 I conducted a pilot study using marine radar to investigate diurnal, seasonal, and spatial patterns of inland flight behavior of Brachyramphus murrelets on Kodiak Island. This study confirmed the suitability of radar for tracking murrelets in Alaska, and identified challenges in radar monitoring that are unique to the Alaska landscape. These included prolonged murrelet activity patterns due to the lengthened twilight period of high latitude summer, frequent high winds that affected the reliability of species identification, and the presence of two murrelet species that are indistinguishable on radar. We will continue radar surveys on Kodiak Island in 2011 to develop radar protocols that can be used for monitoring populations of Brachyramphus murrelets throughout Alaska.

All Seabirds Don't Tell the Same Story: Productivity of Tufted Puffins and Black-Legged Kittiwakes from 2001-2005 in Chiniak Bay, Kodiak, Alaska

Cory T. Williams[1], S. Dean Kildaw[2], André R. Breton[3], and C. Loren Buck[4]

[1]*University of Alaska Anchorage, Department of Biological Sciences, Anchorage, AK, afctw@uaa.alaska.edu*

[2]*University of Alaska Fairbanks, Institute of Arctic Biology, Fairbanks, AK*

[3]*Colorado State University, Colorado Cooperative Fish and Wildlife Research Unit, Fort Collins, CO*

[4]*University of Alaska Anchorage, Department of Biological Sciences, Anchorage, AK*

Seabirds are useful indicators of relative abundance and demographics of intermediate trophic levels because they eat small, young-of-year fishes that are ecologically important links in the food web but difficult to quantify in trawl and hydroacoustic surveys. We monitored dietary, reproductive, physiological, and behavioral parameters of a surface-feeding larid (black-legged kittiwake) and a diving alcid (tufted puffin) across their breeding season in Chiniak Bay, Kodiak, Alaska, from 2001 to 2005. Productivity of black-legged kittiwakes during our study decreased across years with relatively high levels in 2001 and 2002 and very low levels in 2004 and 2005. Cooler, more saline oceanographic conditions were associated with earlier breeding, increased reproductive success, and lower levels of physiological stress in kittiwakes. In contrast, tufted puffins exhibited high levels of reproductive success and nestling growth rates throughout the study, with the exception of one small colony where nestling mortality due to predation by small mammals was observed. Diets of both species consisted primarily of Pacific sandlance and capelin throughout the study, although stable isotope data indicated puffins were consuming substantial amounts of lower–trophic level invertebrates prior to incubation. Overall, our results indicate that ocean conditions that are warmer and less saline negatively impact reproduction by black-legged kittiwakes but had neither positive nor negative effects on reproductive performance of tufted puffins. The disparity between species likely reflects differences in the spatial extent of foraging, the timing of peak energy demands, or the threshold biomass of forage fishes required for successful reproduction.

Seabird Mortality Surveys in Coastal Alaska

J.E. Dolliver[1], J.K. Parrish[2], A.E. Woods[3] and C.W. Wright[3]

[1]University of Washington, Coastal Observation and Seabird Survey Team (COASST), Seattle, WA, dolliver@uw.edu

[2]University of Washington, COASST/ Program on the Environment, Seattle, WA

[3]University of Washington, COASST, Seattle, WA

The Coastal Observation and Seabird Survey Team (COASST) is a unique citizen science program that trains participants to survey beaches monthly and collect data in a standardized, rigorous manner. This highly accurate and independently verifiable data set creates the baseline against which a variety of factors, including anthropogenic factors, can be assessed. Since its inception in 1999, COASST has grown to over 600 people surveying 300 beaches, including over 60 in Alaska. In Alaska, the breeding season is a consistent peak; whereas in the Lower 48, peaks occur post-breeding, during the winter, and in the very early spring at the onset of migration back to breeding colonies. Highest encounter rates occur in the Bering Sea and Aleutian Islands, at sites with or near large breeding colonies, at rates much lower than those on the outer coast of the Lower 48. Large-scale die-offs of seabirds, known as wrecks, occasionally occur throughout the Pacific Northwest and Alaska, littering the beaches with hundreds to thousands of carcasses. In Alaska, wrecks are infrequent but catastrophic, and account for the highest densities ever recorded in the world.

Evaluation of Diet Composition and Plane of Nutrition of Free-Ranging Pinnipeds

Gretchen L. Geiger[1] and Shannon Atkinson[1], Gail M. Blundell[2], James R. Carpenter[3], Kate Wynne[4]

[1]*University of Alaska Fairbanks, School of Fisheries and Ocean Sciences, Juneau, AK*

glgeiger@alaska.edu

[2]*Alaska Department of Fish and Game, Juneau, AK*

[3]*University of Hawaii at Manoa, Department of Human Nutrition, Honolulu, HI*

[4]*University of Alaska Fairbanks, School of Fisheries and Ocean Sciences, Kodiak, AK*

The harbor seal *(Phoca vitulina)* population of Tugidak Island, Alaska, declined significantly starting in the late 1970s and, since the early 1990s, has begun to slowly recover. The "nutritional stress hypothesis" proposes that a change in the availability or quality of prey items in the pinniped diet may be a contributing factor to the decline or slow recovery of a population. Scat samples were collected from Tugidak Island during the summer and early fall from 2001 to 2009. Hard-part remains from harbor seal scats were isolated, identified to the lowest possible taxon, and approximate prey composition of the diet determined from the frequency of occurrence. The nutritional profile of the estimated diets is being determined using a prey nutritional database developed from proximate analyses of various prey found in Alaska waters. Using prey proportions of pinniped diets from the scats, the nutritional value of the diet can be evaluated. Hard-parts analysis identified Irish lord species *(Hemilepidotus)* as the dominant prey item throughout collection years, with rock sole species *(Lepidopsetta)*, greenling species *(Hexagrammos)*, halibut *(Hippoglossus stenolepis)*, and Pacific cod *(Gadus macrocephalus)* also occurring frequently. Fecal corticosterone profiles are being used to assess what sex the scats came from. Combining the prey database and the plane of nutrition with the ability to determine the sex that the scat came from, researchers will have a tool that enables the analysis of nutritional data from free-ranging pinnipeds, facilitating our ability to compare data across years and from both sexes, providing insights regarding the role of nutrition in evaluating changes in pinniped populations. Identification of the components of harbor seal diets may also allow for the detection of competition between pinnipeds and fishermen in the areas surrounding Tugidak Island. By identifying the potential for competition, resource managers may be better able to balance the needs and desires of fishermen in the waters around Tugidak Island.

Changes in the Survival and Reproduction of Steller Sea Lions in the Central Gulf of Alaska, 1976-2009

Lowell Fritz[1], Rod Towell[1] , Elizabeth Holmes[2], Kathryn Chumbley[3], Tom Gelatt[3], and Grey Pendleton[4]

[1]NOAA Fisheries, National Marine Mammal Laboratory, Seattle, WA, lowell.fritz@noaa.gov

[2]NOAA Fisheries, Northwest Fisheries Science Center

3NOAA Fisheries, National Marine Mammal Laboratory, Seattle, WA

4Alaska Department of Fish and Game, Juneau, AK

The population of western Steller sea lions (*Eumetopias jubatus*) in the central Gulf of Alaska declined almost 90% between the late 1970s and 2000, and has since been relatively stable. NMML conducts aerial surveys to count adult and juvenile (non-pup) and recently born (pup) sea lions at haul-out and rookery locations during the breeding season. In addition, NMML brands pups born on rookeries with unique, permanent marks to enable estimation of age- and cohort-survival and reproductive rates. Demographic modeling using counts of non-pups and pups during the breeding season, as well as an index of juvenile recruitment, indicated that the steep rate of population decline in the 1980s was associated with a large drop in the survival rate of juveniles, but only small changes in adult survival and reproduction. The slower rate of population decline observed in the 1990s and the relative stability of the 2000s were associated with improvements in both adult and juvenile survival but continued erosion in reproductive rates. Rates of juvenile survival estimated for the late 1980s and the 2000s from brand-sighting studies are in close agreement with survival estimates from the demographic model, yet these results are based on completely different data. This similarity lends support to the conclusion that survival rates of Steller sea lions in the central Gulf of Alaska are currently as high as or higher than they have been in the last 30+ years, suggesting that recovery of the population is not being limited by low survival but by reduced or delayed reproductive output.

The Search for the Smoking Gun: Did Killer Whales Really Do It?

Seth Newsome[1], Michael A. Etnier[2],and Daniel H. Monson[3]

[1]University of Wyoming, Department of Zoology and Physiology, Laramie, WY, snewsome@uwyo.edu

[2]Applied Osteology/Western Washington University, Bellingham, WA

[3]U.S. Geological Survey, Alaska Science Center, Anchorage, AK

Alan Springer, Jim Estes, and others published a provocative article in 2003 hypothesizing that killer whale predation alone can explain the apparently sequential collapse of several marine mammal populations in the North Pacific. That paper has been criticized for inadequately or unfairly presenting the available data. Regardless of the choice of and manner in which specific data relevant to this hypothesis are analyzed, all that have been presented thus far are imperfect proxies for a phenomenon that was neither observed nor recorded. We propose that stable isotope analysis of annual growth increments of killer whale teeth sourced from the North Pacific provides the most direct means of testing the "killer whale hypothesis." If the diet of transient killer whales changed in the manner hypothesized by Springer et al., this change should be reflected in the isotopic signatures within the teeth of long-lived animals and across teeth from individuals that lived at different times.

To date, we have secured tooth samples from 13 transients. Of these, 10 have been analyzed. All 10 show clear chronological patterning in their isotopic signatures. However, the isotopic shifts are more indicative of the reduced input of milk in the diet than they are of a shift from whales to pinnipeds and sea otters. Transient killer whales routinely hunt around, and occasionally strand on Kodiak Island. If the diet of transients has shifted from very large prey species like whales to relatively small species like harbor seals and sea otters, these prey populations may be in jeopardy of localized declines from the increased predation pressure. If, however, the hypothesis is disproved, that would suggest that Kodiak harbor seals and sea otters are not experiencing higher-than-normal predation from killer whales.Our sampling coverage is still inadequate to test the "killer whale hypothesis," either for the North Pacific in general or specifically for Kodiak. As more samples become available, we hope to increase the geographic and temporal coverage of our sampling to better address this issue.

Kodiak Whales: A Synthesis of 10 Years of GAP Research

Briana Witteveen and Kate Wynne

University of Alaska Fairbanks, School of Fisheries and Ocean Sciences, Kodiak, AK, bree.witteveen@alaska.edu

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Since its inception in 1999, a major component of the Gulf Apex Predator Prey (GAP) project has focused on researching the abundance, distribution, and foraging ecology of large whales, primarily fin, humpback, and gray whales, of the Kodiak archipelago. Aerial surveys are used to monitor broad trends in seasonal distribution, while vessel-based surveys collect identification photographs and biopsy samples from individuals. To date, nearly 1,500 individual fin, humpback, and gray whales have been identified and cataloged and over 400 biopsy samples have been collected. Analysis of the stable carbon and nitrogen isotope ratios from biopsy samples suggests that the diet of humpback whales varies annually and regionally and indicates that animals near shore have a more fish-based diet, while their offshore counterparts likely rely more on zooplankton. Results also imply potential differences in prey choice between fin and humpback whales despite often sharing habitats. Additional insights into diets have come through tagged whales, eight humpbacks and four fins, transmitting real-time dive depths. The combined analyses of whale dives and prey availability, in the form of pelagic backscatter, have provided some evidence of whale prey preferences, including an apparent selection for capelin over juvenile pollock by humpback whales. Gray whale prey habits have been studied through 24 samples of mud and fecal plumes collected in areas of high gray whale density. Analysis of samples showed high densities of cumaceans, a nontraditional prey species.

Movement and Diet of Gray Whales *(Eschrichtius robustus)* off Kodiak Island, Alaska, 2002-2005

Merrill Gosho[1] and Patrick Gearin[1], Ryan Jenkinson[2], Jeff Laake[3], Lori Mazzuca[4], David Kubiak[5], John Calambokidis[6], Will Megill[7], Brian Gisborne[8], Dawn Goley[9], Christina Tombach[10], James Darling[11], Volker Deecke[12]

[1]NOAA Fisheries, National Marine Mammal Laboratory, Seattle, WA, Merrill.Gosho@noaa.gov

[2]San Diego State University, Department of Biology, San Diego, CA

[3]NOAA Fisheries, National Marine Mammal Laboratory, Seattle, WA

[4]SPAWAR Systems Center Pacific, San Diego, CA

[5]Mythos Expeditions, Kodiak, AK

[6]Cascadia Research, Olympia, WA

[7]Coastal Ecosystems Research Foundation, Seattle, WA

[8]Juan de Fuca Express, Victoria, BC, Canada

[9]Humboldt State University, Department of Biological Sciences, Arcata, CA

[10]Wildlife Consulting, Goleta, CA

[11]Tonquin Research Inc., Tofino, BC, Canada

[12]University of St. Andrews, Scottish Oceans Institute, St. Andrews, Fife, Scotland, UK

Large feeding aggregations of gray whales, *Eschrichtius robustus*, numbering 200-400 individuals, have been documented near Ugak Bay off the northeast coast of Kodiak Island, Alaska, since at least 1999 (Moore et al. 2007). In 2002, 2003, and 2005, surveys were conducted off Ugak Bay to photo-identify individual gray whales and to determine their foraging habits and prey consumption. Surveys were conducted in August or early September for a total of 15 days of survey effort. Eighty-four unique gray whales were identified from photographs taken near Ugak Bay from 2002 to 2005. Seventeen of these whales were matched to gray whales photographed in the Pacific Northwest from northern California to southeast Alaska, an area that is utilized by a portion of the eastern Pacific gray whale population often referred to as the Pacific Coast feeding group (PCFG). The timing of these sightings indicated that some of the gray whales seen at Kodiak Island spend time in the summer months foraging south of Alaska and that the home range of gray whales in the PCFG can extend from northern California all the way to Kodiak Island.

*continued...*Movement and Diet of Gray Whales

Seven gray whales sighted around Kodiak Island in 2002-2003 returned and were identified there in 2005, which may indicate some level of site fidelity. It is believed that these movements are driven by food availability. During 2002 and 2005, 36 samples were collected from fecal plumes near surfacing gray whales. Ninety-two percent of the samples collected in 2005 contained exoskeletons of cumaceans, a swarming epibenthic crustacean that is present in the area in high densities. The gray whales off Ugak Bay were foraging in waters averaging 95 m deep (range 85-104 m). These depths are thought to be the deepest benthic foraging locations known for gray whales south of the Bering Sea.

Kodiak Killers: Life at the Top of the Food Web

Kate M. Wynne

University of Alaska Fairbanks, Alaska Sea Grant Marine Advisory Program, Kodiak, AK, kate.wynne@alaska.edu

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Transient, or mammal-eating, killer whales are difficult to study: they travel broadly in small quiet pods and kill a variety of marine mammals. So observing their kills—and understanding their dietary needs—requires incredible patience by dedicated researchers or incredibly good luck and voluntary reporting by the public. In Kodiak we have the latter. A pod of transient killer whales, nicknamed the "Kodiak Killers," has been observed in Kodiak Harbor periodically but repeatedly since the early 1990s. With their distinctive dorsal fins, members of this pod are easily recognized as they hunt and occasionally kill Steller sea lions, and the pod's composition and reproductive success have been monitored over the years. Although most frequently reported in Kodiak Harbor, members of the pod have also been observed killing sea lions near Resurrection Bay and killing sea otters in Uganik Bay. Other transient killer whales pass through Kodiak waters as well, some of which have attacked and killed humpback and gray whales. Reports by volunteers among the public, USCG, guides, pilots, and fishermen have been invaluable in identifying killer whale pods and locating carcasses of whales killed by orcas in Kodiak. I will present a 10-year summary of documented marine mammal kills by the Kodiak Killers and other transient killer whales and discuss their role as apex predators in Kodiak waters. I will highlight the value of opportunistic reports to transient killer whale research and request further reporting and documentation of orca predation on marine mammals by Kodiak residents.

Increased Utilization of Harvested Biomass

Matthew P. Davenport[1], Leo D. Pedersen[1], Peter J. Bechtel[2] and Scott Smiley[2]

[1]University of Alaska Fairbanks, Fishery Industrial Technology Center, Kodiak AK, mpdavenport@alaska.edu

[2]University of Alaska Fairbanks, USDA Agricultural Research Service, Kodiak, AK

One goal of the Alaska byproduct utilization program is reducing volumes of seafood processing waste. Different seafood products create different amounts of processing waste. When processed for fillets, up to 70% of the landed weight is discarded in Alaska pollock. When salmon is canned, only 35% of the landed weight becomes processing waste. Newer large processors were required to have wet reduction plants as part of their operation. However, small, remote operations such as those found in southeast Alaska or Bristol Bay do not generate sufficient waste to make investment in wet reduction plants cost effective. A less expensive alternative involves the enzymatic hydrolysis of proteinaceous materials like flesh. Once the waste is hydrolyzed, salmon oil and proteinaceous products can be recovered. The hydrolytic reactions must be controlled to maintain product quality and consistency. We have developed an inexpensive, rapid test for the progress of the reaction allowing greater control over it. This test can be used to adjust the reaction to achieve the buyer's specifications. Another focus of our research involves drying undersized pollock. These fish comingle with larger conspecifics and landed as bycatch. The undersized fish are discarded because they cannot be effectively processed using standard filleting equipment. The Asian seafood industry includes a large dried fish products sector. We are investigating drying small pollock at lowered temperatures, reducing the oxidation of lipids that tend to produce off flavors. Our results indicate that undersized pollock, dried under lower temperature conditions, have appropriate characteristics for sale to Asian markets.

Alaska Fish Processing Byproducts: Enhancing Utilization

P.J. Bechtel

University of Alaska Fairbanks, USDA Agricultural Research Service, Kodiak, AK, peter.bechtel@ars.usda.gov

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Fish harvested from Alaska waters provide over half of the total wild fish harvested and processed for human consumption in the United States. Large amounts of pollock, salmon, cod, and flatfish are harvested and processed annually, resulting in over 1 million metric tons of byproducts. Alaska fish byproducts have several advantages because they are derived from sustainable fisheries where all fish are initially processed for human consumption. Major byproducts from the fish processing industry are heads, viscera, frames, and skin. These byproduct components are often combined and used as the raw material to make fish meals and oils. However, other products can be made from the individual parts. Viscera is the generic term used to describe the organs and tissue removed after the belly cavity and usually includes the reproductive tissues, stomach, liver, and digestive track. A variety of different products can be made from livers, stomachs, and other tissues. Another abundant byproduct from most processing plants is fish heads, which are good sources of high quality protein, oils rich in omega-3 fatty acids, and other components. Fish skins are used to make gelatin products and leather products. Working together research is being conducted by the USDA Agricultural Research Service and the University of Alaska Fairbanks at the Fishery Industrial Technology Center in Kodiak, Alaska, with the goal of increasing the utilization of fish processing byproducts.

Increasing the Utilization of Fish Heads

J.J. Stine and P.J. Bechtel

University of Alaska Fairbanks, USDA Agricultural Research Service, Kodiak, AK, jesse.stine@ars.usda.gov

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The Alaska fisheries industries bring in large amounts of fish each year, and much of the fish mass is lost during processing as byproduct. The goal of our research is to understand the physical and chemical properties of these byproducts in order to better utilize this limited resource. Recent projects examined pollock and salmon fish heads in order to potentially add value to these underutilized byproducts. We dissected fish heads and analyzed each part for its chemical composition and also examined the amount of chondroitin sulfate that could be extracted from head tissues. Whole heads were dissected into four distinct parts (gills, braincase, cheeks, and others) and were analyzed for protein, minerals, and fat content, and also the amino acid, mineral, and fatty acid profiles were determined. Dried whole salmon heads had 51.0% fat and 35.4% protein. Gills had the highest mineral content. The fatty acid profile showed that all parts had an omega-3/omega-6 ratio >7.5. The brain and braincase contain the highest fat percentage; however, the fatty acid profile was not markedly different from the other head parts and all head parts contained high percentages of omega-3s. Two separate analytical techniques were employed to determine the chondroitin sulfate content in fish byproducts. Analysis by HPLC provided a profile of the major forms of the different chondroitin sulfates, which vary with species and tissue origin. This study indicates that certain fisheries byproducts contain levels of chondroitin sulfate that may warrant commercial extraction.

Fisheries Privatization and Shifting Human-Environment Relationships in the Kodiak Archipelago

Courtney Carothers

University of Alaska Fairbanks, School of Fisheries and Ocean Sciences, Fairbanks, AK, clcarothers@alaska.edu

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Drawing on ethnographic research with indigenous Alutiiq fishing villages in the Kodiak archipelago, this paper explores the displacements generated by the privatization of commercial fisheries access. Social and economic relationships between Alutiiq villages and canneries in the twentieth century facilitated flexible commercial-subsistence fishing engagements. More recent property rights forms of fisheries harvest have brought about a dramatic alienation of local fishing rights and place-based livelihoods in these communities. Findings from this research suggest that the commodification of fishing rights is based on conceptualizations of human-environment relationships fundamentally opposed to the cultural logics of social dependence and informal economy of village communities. Privatization discourses and policies represent fishing participants as efficient, fully engaged in commercial economies, and geographically and occupationally mobile; fishing motivations as profit-driven; and fishing rights as alienable commodities. These conceptualizations have excluded and marginalized certain kinds of fishing operations, lifestyles, communities, and rights. After summarizing research conducted between 2005 and 2010, primarily in the communities of Larsen Bay, Old Harbor, and Ouzinkie, on the social impacts of limited entry and individual fishing quota policies, this paper will also introduce a new research project designed to explore similar issues in the community of Kodiak.

The Kodiak Ocean Science Discovery Program: Connecting Students with the Fisheries and Science Community

Switgard Duesterloh

Alaska Educational Radio System/NOAA Fisheries/Kodiak Island Borough School District, Kodiak, AK, switgard@gci.net

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The Kodiak Island Borough School District and the Kodiak Laboratory of the Alaska Fisheries Science Center developed the Ocean Science Discovery Laboratory (OSDL) at the Kodiak Fisheries Research Center to improve ocean literacy in grades K-12. Starting in 2010, over 80% of 3rd, 4th, and 5th grade students, and all Kodiak middle school 6th grade students, have participated in OSDL for a 2.5-hour marine science program. These programs were developed collaboratively between scientists and teachers to address grade-level requirements of the Alaska educational standards in science. In a combination of lecture and active student participation in a laboratory setting, students learn and apply skills and contents of scientific observation, experimentation, and analysis. An important cornerstone of the OSDL concept is the integration of Kodiak's rich and diverse community of scientists in the education and outreach to students and the community at large. By connecting students with scientists and knowledgeable volunteers, they gain insight in the diversity of ocean life and the people working to protect and harvest its resources. The Kodiak Ocean Science Discovery Program continues to grow in 2011 and invites interested community members to become involved.

Paleoenvironmental Reconstruction in the Kodiak Archipelago

Catherine F. West

Smithsonian Institution, National Museum of Natural History, Washington, DC, foster.west@gmail.com

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Marine resources recovered from Kodiak's archaeological sites are used here to reconstruct the prehistoric environment. More specifically, carbonate structures (such as shellfish and fish otoliths) are sampled for stable oxygen isotopes, which can be used to estimate the environmental conditions where these animals were living for thousands of years. The data produced by this project are useful for understanding the effects of climate change on human activities, and these long-term records have the potential to inform our understanding of contemporary environmental changes.

7000 Years of Intertidal Shellfish Exploitation in Chiniak Bay

Molly Odell

University of Washington, Department of Anthropology, Seattle, WA, meodell@uw.edu

Large shell middens are a hallmark of archaeological sites along the Pacific coast of North America, including Kodiak Island. While these refuse piles demonstrate that people consumed large quantities of intertidal shellfish for thousands of years, very little anthropological research has examined the role that shellfish played in the prehistoric economies of this area. A growing body of literature elsewhere on the northwest coast is painting a much more complex picture of shellfish exploitation than had previously been recognized, including evidence for purposeful management and conservation of clam harvests. This paper explores the cultural and ecological factors that explain the historic anthropological lack of interest in this type of prey. In addition, new data from an archaeological site in Chiniak Bay, Mitksqaaq Angayuk, will be presented. Mitksqaaq Angayuk is a unique site because it contains preserved shellfish remains and bone from 3,400 years ago to the historic Russian period in the 19th century, allowing archaeologists to look at changing diets through time. The ancient shellfish assemblages are also compared to modern intertidal communities.

A Look Inland: The Archaeology of Kodiak's Inland Lakes and Rivers, AD 500 to 1500

Patrick Saltonstall

Alutiiq Museum, Kodiak, AK Patrick@alutiiqmuseum.org

Over the last decade, the Alutiiq Museum has conducted extensive archaeological surveys and excavations along the shores of Kodiak's major lakes and rivers. The results of this research indicate that Alutiiq use of interior environments changed dramatically from occasional seasonal use mostly at the lakes to massive winter settlements alongside the largest rivers. There was a surge of settlement on the area lakes around AD 500 when lake core data suggest that the salmon runs were at a low point. Meanwhile many of the areas surrounding the Gulf of Alaska were abandoned in the later half of the first millennium because of an apparent crash in marine productivity of the Gulf of Alaska. Does the increased emphasis of interior resources reflect an adaptive strategy to mitigate the loss of marine resources?

Using Southwest Alaska Archaeofaunas to Gauge the Ecological Effects of Future Climate Change

Michael A. Etnier[1] and Jeanne M. Schaaf[2]

[1]Applied Osteology/Western Washington University, Bellingham, WA, michael.etnier@wwu.edu

[2]Lake Clark National Park and Preserve/Katmai National Park and Preserve/Aniakchak National Monument and Preserve, Anchorage, AK

Archeofaunal assemblages—preserved bones and shells from archaeological and paleontological sites—are important repositories of unique natural and cultural resource scientific data spanning several millennia. These assemblages have the potential to add significantly to our understanding of past climate change and, by extension, can provide a measure of the degree of ecological changes likely to be experienced in the future. We have compiled archaeofaunal data for sites from the greater Kodiak archipelago and the Alaska Peninsula to determine the extent to which past climate changes have affected the marine ecology of southwest Alaska over the last 7,000 years. Our data include presence/absence and relative abundance of key marine taxa, as well as isotopic chemical signatures and population genetics patterns. Preliminary results suggest that some taxa, like harbor seals and cormorants, are extremely resilient to all but the most dramatic changes in climate while other taxa, like ringed seal and eiders, are much more sensitive. For Kodiak, most marine species fall into the "resilient" category. This is not to say that the island's marine communities will remain unchanged in the face of local and global climate changes. For instance, species that today have more southerly distributions, such as California sea lions and Guadalupe fur seals, might become more common visitors, or even residents of Kodiak. The incidence of both of these species in Alaska has increased over the past decade, but it is not clear if these increases are related to changing climate.

Afognak Island Macrocystis pyrifera

Susan Saupe

Cook Inlet Regional Citizens Advisory Council, Anchorage, AK, saupe@circac.org

In 2002, during aerial surveys in the northern Kodiak Island archipelago, Macrocystis kelp beds were documented on the west side of Afognak Island, just north of the mouth of Foul Bay, and in May 2005 the presence of Macrosystis kelp was confirmed and voucher samples were collected. Additional shoreline surveys during that same summer in June documented a few smaller Macrocystis beds in the Kodiak Island archipelago: two small beds on the southwest corner of Shuyak Island and a small bed in Kiliuda Bay. Dive surveys in 2006 and 2009 documented the spatial extent of the individual beds, the distribution of individual kelp plants along the coast, and kelp plant densities and species associations. Plant tissues were collected in 2009 and are being coordinated with international researchers to conduct DNA analyses to extend a recent study that reclassified five species of Macrocystis kelp, worldwide, into one species, *M. pyrifera*. Macrocystis is well documented in the more oceanic, outer coast and areas of southeast Alaska, and is not described north of Icy Bay in the eastern Gulf. In the western Gulf of Alaska, the range has been reported to include Kodiak Island but specific locations or beds have not been described until now. Future surveys will take place in areas where either individual plants or beds have been observed in the western Gulf of Alaska, including several plants sighted on the outer Kenai Peninsula coast and a bed that has become established near the outer coast of Prince William Sound.

A Miniature Acoustic Transponder for Simultaneous Underwater Animal Tracking and Habitat Mapping

C. de Moustier[1], A. Franzheim[2], R. Foy[3], J.M. Burns[4], J.W. Testa[5]

[1]*HLS Research, Inc., La Jolla, CA, cpm@hlsresearch.com*

[2]*Consultant, Portsmouth, NH*

[3]*NOAA Fisheries, Kodiak, AK*

[4]*University of Alaska Anchorage, Department of Biological Science, Anchorage, AK*

[5]*University of Alaska Anchorage, Department of Biological Science/NOAA Fisheries, Anchorage, AK*

We developed a prototype miniature underwater acoustic transponder that operates with a standard 160 kHz WASSP WBM-160F multibeam echo-sounder (ENL, Auckland, New Zealand). Each transponder has a unique coded reply that is clearly detectable in the receive sequence for a single sonar ping. In addition, the transponder has two as-yet unused channels available for optional sensors whose data could be encoded in the replies. Range and bearing of the replies from multiple transponders can be obtained in a single sonar ping cycle. This allows for the integration of acoustic mapping, animal tracking, and environmental sensing, thus providing real-time environmental context to movement data. In a field test of this system, transponders were attached to the carapace of three red king crabs (*Paralithodes camtschaticus*) that were subsequently released in a small 35 m deep basin in Womens Bay, Kodiak Island, Alaska. On three successive days post-deployment, the WASSP sonar was used to locate the crabs as they moved a few hundreds of meters within the basin. These results demonstrate the feasibility of real-time active acoustic tracking of mobile benthic animals whose acoustic target strength normally would not rise above the surrounding bottom echoes. While the crab experiment was done in 25-35 m water depth, the system was also successfully tested without animals in deeper waters (to 190 m). Future developments are needed to optimize the system for more mobile, midwater predators.

Systematics of Common Marine Mollusks Found in Kodiak, Alaska

Jeffery Pennington[1], Will Vogt[1], Anastasia Painter[1], Autumn Kimmel[1], Kayla McCarthy[1], Switgard Duesterloh[2] and Jane Eisemann[2]

[1]*Kodiak High School Oceanography Class, Kodiak, AK*

[2]*Kodiak, AK, switgard@gci.net*

This poster is the work of a group of Kodiak High School oceanography class students. The authors researched the systematic relationships of several mollusks, focusing on common species in the Kodiak area, several of which are collected for subsistence by locals around Kodiak Island. Systematics is the study of the diversification of life on planet earth and the relationships between living organisms. By classifying commonly found marine organisms, we compare common and diverse characteristics, their origins and function, ecology, and life history. Highlighting chosen representatives of cephalopods, bivalves, gastropods, nudibranchs, chitons, and limpets, we demonstrate some of the fascinating features of local marine species.

Crab Mass Molting Events, Kodiak Island

Laura M. Slater[1], Daniel Urban[2], J. Eric Munk[3], Kally Spalinger[3], Robert J. Foy[3], and Douglas Pengilly[4]

1Alaska Department of Fish and Game, Kodiak, AK, laura.slater@alaska.gov

2NOAA Fisheries, Kodiak, AK

3NOAA Fisheries, Kodiak, AK

4Alaska Department of Fish and Game, Kodiak, AK

Growth in crabs is achieved through ecdysis, or the molting of the exoskeleton that allows for an incremental increase in size. Once Tanner (*Chionoecetes bairdi*) and Dungeness (*Metacarcinus magister*) crabs reach a certain size, molting usually occurs annually. Tanner crab have determinate growth and cease molting after their terminal molt to maturity, in contrast to Dungeness crab, which have indeterminate growth and will continue to molt throughout their life. Mass molting events are clearly visible and offer an opportunity to collect exuviae (cast shells) when crabs congregate near shore prior to molting (as Tanner crab are known to), a strong cohort molts relatively synchronously, and local conditions concentrate exuviae on the shoreline. Here we provide a summary of mass molting events reported for Tanner and Dungeness crabs in Monashka Bay, Ugak Bay, and Pasagshak Bay since 2003. Opportunistic sampling of Tanner crab exuviae showed that events consisted mostly of males ranging in size from 47 to 150 mm carapace width (CW). The size frequency of Tanner crab exuviae measured during a spring molt event in Ugak Bay was similar to the dominant size class measured during the stock assessment survey the previous summer. Documentation of mass molting events can assist in predicting recruitment and may be useful in detecting changes in molt timing relative to oceanographic conditions. Additional information is welcome from anyone who has witnessed a mass molting event.

Changes in Northern Shrimp *(Pandalus borealis)* Sizes in the Gulf of Alaska

Joseph B. O'Gorman and J. Daniel Urban

NOAA Fisheries, Kodiak, AK, brian.o'gorman@noaa.gov

Starting in 1962, morphometrics of the major protandric hermaphrodite forms of northern shrimp (*Pandalus borealis*) have been collected from fisheries surveys conducted in the Gulf of Alaska. From the mid 1980s through the 1990s, the mean carapace length of the male, transitional, and female forms, as well as the overall maximum sizes, decreased in the Gulf of Alaska. During this same time period, density and abundance estimates based on surveys also decreased. Although decreased length statistics may have initially been attributed to fishing pressure, sizes have not rebounded in the 25 years since the fishery closed. The density, abundance, and associated length statistics of these forms were negatively correlated with increased water temperatures. Warmer water temperatures are known to decrease intermolt periods and lead to smaller sizes of maturity of both male and female shrimp. An overall decrease in shrimp sizes has major implications for the fishery. The yield per animal is smaller so more shrimp must be harvested per pound. Smaller shrimp are less desirable to the consumer and therefore the ex-vessel value is lower. Perhaps most important, smaller females carry fewer eggs than larger individuals, which may result in lower recruitment to the fishery. Warmer water may also increase predation pressure due to increased abundance of predators such as Pacific cod. Although the Gulf of Alaska has reverted to cooler temperatures in recent years, carapace length statistics and stock abundance have not significantly increased. The environmental threshold needed for those increases to occur remains poorly understood.

Evaluation of Observer Sampling Methods within the Kodiak Trawl Catcher Vessel Fleet

Craig H. Faunce[1], Jennifer A. Cahalan[2], and Julie Bonney[3]

[1]NOAA Fisheries, Alaska Fisheries Science Center, Seattle, WA, Craig.Faunce@noaa.gov

[2]Pacific States Marine Fisheries Commission, Alaska Fisheries Science Center, Seattle, WA

[3]Alaska Groundfish Data Bank, Kodiak, AK

Managing Alaska groundfish requires that the amount of total removals is known. Often this information comes from industry sources that may not contain information on discarded catch. The accurate accounting of both retained and discarded portions of catch is enabled through the effective use of Alaska fishery observers. Since observers are fully tasked with a broad suite of duties at sea, the efficient use of their time is important. We have embarked on a project that aims to explore two possible improvements to how observer data are generated and utilized within the sector of catcher vessels that deliver to shoreside processors. The first component of the project will compare the logistical feasibility and resulting catch metrics (mean and variance) from current at-sea observer sampling methods to those resulting from an alternative method that focuses on sampling the at-sea discard portion of the catch. The second component will examine the effectiveness of using observer data to verify the accuracy of species identification on industry reports of retained catch (fish tickets). This project will take place in Kodiak, Alaska, which is consistently ranked among the top U.S. ports in terms of landed weight and value. Field activities will occur during spring 2011.

The Gulf of Alaska Project: an Inter-Regional Comparison of Marine Fish Recruitment Dynamics

Jamal Moss[1], Kalei Shotwell[1], Franz Mueter[2] and Shannon Atkinson[2]

[1]NOAA Fisheries, Auke Bay Laboratories, Juneau, AK, jamal.moss@noaa.gov

[2]University of Alaska Fairbanks, School of Fisheries and Ocean Sciences, Juneau, AK

The Gulf of Alaska Project is a newly initiated North Pacific Research Board integrated ecosystem research program focused on identifying and quantifying key processes that regulate the recruitment of five commercially and ecologically important groundfish species in the Gulf of Alaska (GOA). The focal species are Pacific ocean perch, sablefish, Pacific cod, walleye pollock, and arrowtooth flounder, all of which demonstrate different life histories but experience the same oceanographic conditions during their first year of life. This comprehensive study will contrast regional differences in oceanographic processes during spring, summer, and fall in the southeastern and central Gulf of Alaska, and relate environmental conditions to species-specific health, condition, and recruitment. A combination of fieldwork, laboratory experiments, and retrospective analyses will be combined to determine the main drivers controlling juvenile transport to favorable nursery habitat and interannual differences in cohort survival.

Use of Remote Cameras to Collect Long-Term Seabird Monitoring Data on the Alaska Maritime National Wildlife Refuge

Arthur B. Kettle, Leslie Slater, and G. Vernon Byrd

U.S. Fish and Wildlife Service, Alaska Maritime National Wildlife Refuge, Homer, AK, Arthur_Kettle@fws.gov

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Biologists at the Alaska Maritime National Wildlife Refuge annually monitor the timing and success of seabird reproductive effort at several sites. These and other variables are used to measure the response of seabird populations to changes in the marine food web. Conventional monitoring methods for cliff-nesting seabirds use periodic observations of plots by field crews throughout the breeding season. At some seabird colonies, however, difficult access makes this method infeasible. Attempts have been made through the years to use time-lapse cameras to automatically record nesting events through the season. Mechanical equipment failure and the insufficient power supply have in the past made this approach unreliable. However, current solid-state digital cameras and intervalometers (which control shutter release) are mechanically more reliable, are more moisture-resistant, and draw much less power.We built and tested several time-lapse photography systems for unattended use of up to four months atop cliffs at East Amatuli and Barwell islands. Here we describe the camera systems used and the results of our tests.

Monitoring the Alaska Subsistence Harvest of Northern Sea Otters, Pacific Walruses, and Polar Bears in Changing Times

John N. Trent and R. Bradley Benter

U.S. Fish and Wildlife Service, Marine Mammals Management Office, Anchorage, AK, John_Trent@fws.gov

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Since 1989 the U.S. Fish and Wildlife Service has quantified subsistence harvests of northern sea otters (*Enhydra lutris kenyoni*), Pacific walruses (*Odobenus rosmarus divergens*), and polar bears (*Ursus maritimus*) with its Marking, Tagging and Reporting Program (MTRP). Under an exemption allowed by the Marine Mammal Protection Act of 1972, Alaska Natives may harvest in a non-wasteful manner for both subsistence purposes and creation of authentic Native handicrafts. We employ a network of 150 coastal community residents who attach numbered tags and record essential harvest information. We summarize annual reported harvests for the three species consisting of five marine mammal stocks. The 20 year MTRP database presently has over 14,320 harvest records for northern sea otter, 31,700 for Pacific walrus, and 1,620 for polar bear. The MTRP is a permanent, extensive, and real-time assessment system that records and "marks" actual reported harvest annually. It also emphasizes collaborative, long-term working relationships between rural subsistence hunters, contract taggers, and the USFWS. The data are used to estimate harvest effects and to prepare documents like stock assessment reports (Angliss and Lodge 2002). The MTRP also assists the USFWS in evaluating and responding to unlawful trade or transport of raw marine mammal parts. MTRP data thus contribute directly to both population management decision-making and enforcement of the Marine Mammal Protection Act. Recently documented climate-driven habitat changes (Serreze 2009) have increased the need for valid harvest data in the North. The southwestern stock of Alaska sea otters was listed as "threatened" in 2005 under the Endangered Species Act (ESA). In May 2008 both polar bear stocks in Alaska were similarly listed under the ESA. Although Section 10(e) of the ESA allows for the subsistence harvest of listed species, careful harvest monitoring by the MTRP is clearly required in these changing times.

The U.S. Fish and Wildlife Service and Sea Otter Management in Kodiak

Suzann G. Speckman[1], Douglas M. Burn[1], Verena A. Gill[1], and Kristin K. Worman[1], Angela M. Doroff[2], Elizabeth Frame[3], McCrea Cobb[4]

[1]U.S. Fish and Wildlife Service, Marine Mammals Management, Anchorage, AK, suzann_speckman@fws.gov

[2]Kachemak Bay Research Reserve, Homer, AK

[3]NOAA Fisheries, Northwest Fisheries Science Center, Seattle, WA

[4]U.S. Fish and Wildlife Service, Kodiak National Wildlife Refuge, Kodiak, AK

Sea otters in Kodiak are part of the southwest Alaska stock, which ranges from central Cook Inlet to the western end of the Aleutian chain. This population is currently listed as threatened under the Endangered Species Act. Although numbers in the Aleutian Islands have declined by more than 90% since the mid 1980s, aerial surveys for sea otters in 1994, 2001, and 2004 indicate that numbers in the Kodiak archipelago have remained stable. However, a current population estimate is needed for this area, and the U.S. Fish and Wildlife Service (USFWS) plans to survey one-third of the Kodiak archipelago each year for the next three years to produce an update.
Under the Marine Mammal Protection Act, only Alaska Natives may legally hunt sea otters. Subsistence harvest of sea otters in the Kodiak archipelago averages about 66 per year, and 10 taggers located in the Kodiak area help USFWS monitor sea otter harvest. Local residents assist USFWS in recovering about five stranded sea otter carcasses from the Kodiak area every year. Two otters killed by boats in Kodiak Harbor in 2009 were intoxicated with paralytic shellfish poisoning (PSP), which presumably limited their swimming abilities. Capture and disease screening of live Kodiak sea otters in 2004-2005 and comparison with live sea otters from the Commander Islands, Russia, a stable population, showed that the general health of otters in both areas was similar. Otters from the Commanders met predictions for a population at carrying capacity, whereas Kodiak otters did not indicate food limitation.

Quality Assessment of Commercially Harvested Weathervane Scallops *(Patinopecten caurinus)* from Alaska

Kathryn Brenner[1], Alexandra Oliveira[1], Charles Crapo[1], Gregg Rosenkranz[2], Ryan Burt[2], and Marsha Spafard[2], Peter J. Bechtel[3], Ray RaLonde[4]

1University of Alaska Fairbanks, School of Fisheries and Ocean Sciences, Kodiak, AK, kabrenner@alaska.edu

2Alaska Department of Fish and Game, Kodiak, AK

3University of Alaska Fairbanks, USDA Agricultural Research Service, Kodiak, AK

4University of Alaska Fairbanks, School of Fisheries and Ocean Sciences, Anchorage, AK

The weathervane scallop (*Patinopecten caurinus*) has been commercially harvested in Alaska since 1967. Kodiak is known for consistently high quality edible muscle. Vessel operators in the eastern Gulf of Alaska, however, have reported poor scallop muscle quality due to "weak meat," characterized by high moisture content and off-white to grayish muscle color. The Alaska scallop industry has difficulty marketing poor quality scallops. The objective of this research was to quantify variability in edible muscle of weathervane scallop to address scallop meat quality issues. Two groups of 40 whole scallops—Weak (WS) and Not Weak (NWS)—from Yakutat; and two batches (17 individuals, 30 individuals) of edible scallop muscle from Kodiak (KOD1 and KOD2) were sampled. Physical measurements and biochemical analyses were conducted to determine quality differences between groups. Biochemical analyses included proximate composition; lipid class distribution; fatty acid (FA), mineral and amino acid profiles and muscle pH. Moisture content was significantly ($P < 0.05$) higher in WS (81.6%) than NWS (78.1%). Glycogen content was similar ($P < 0.05$) for NWS (1.61%), KOD 1 (2.19%), and KOD2 (1.75%) but was not detected in WS. A significantly ($P < 0.05$) lower amount of omega-3 FA was detected in WS (112.2 mg per g lipids) than in NWS (179.9 mg per g lipids) and KOD 2 (171.5 mg per g lipids). Edible meat to body ratios were significantly ($P < 0.05$) lower (23.6) in WS than in NWS (33.7). Results indicate that WS are lower in overall quality than NWS and KOD scallops. Further investigation into the causes of "weak meat" scallops is warranted.

The Effects of Fish Processing Biowaste on the Ocean's Organisms and Nutrients

McKenzie Barnett, Pearson Brodie, Ethan Buchinger, Jordan Fogle, and Samantha Haight

Kodiak High School Oceanography Class, Kodiak, AK

The effect that fish processing biowaste has on surrounding environments, habitats, and organisms is highly controversial. Although it is a natural pollutant, fish biowaste has the ability to affect oxygen levels, salinity, temperature, pH levels, and the overall abundance of organisms in seawater. The infiltration of this waste also affects the food web of surrounding marine environments, especially when present in large amounts. Fish processing facilities, like those in Kodiak, Alaska, dump millions of metric tons of fish waste into the ocean every year. Marine environments surrounding these sites are at risk for anoxia (oxygen depletion), harmful algae blooms, and other harmful effects. Alternatives such as thermal depolymerization process (TDP) could help alleviate the problems associated with biowaste dumping at fish processing facilities.

Development of Flavored Freeze-Dried Cubes from Wild-Caught Pacific Pink Salmon *(Oncorhynchus gorbuscha)*

Lale Gurer[1], Duy Nguyen[2], Alexandra Oliveira[3], Quentin Fong[3], Brian Himelbloom[3], and Charles Crapo[3]

[1]University of Alaska Fairbanks, School of Fisheries and Ocean Sciences, Kodiak, AK, lgurer@alaska.edu

[2]University of Alaska Fairbanks, School of Fisheries and Ocean Sciences, Kodiak, AK/ University of Nha Trang, Department of Aquatic Product Processing Technology, Nha Trang City, Khanh Hoa, Vietnam

[3]University of Alaska Fairbanks, School of Fisheries and Ocean Sciences, Kodiak, AK

Ready-to-eat seafood products are a growing segment of the food industry worldwide. Among them, freeze dried (FD) seafood products, used as snacks, finger foods, salad toppings, or ingredients in dehydrated soup have increased in popularity in recent years. The objective of this study was to develop FD flavored products from salmon fillets. Deep-skinned and boneless, frozen fillets were diced into small cubes, vacuum packaged, and stored (–30ºC) until usage. Five test batches of salmon cubes (C; F1-F4) were flavored using a two step process of blanching, either at 60ºC for 30 min (C; F1; F2) or at 95ºC for 3 min (F3; F4), followed by a glazing step either at 30ºC for 30 min (C; F1; F2) or at 0ºC for 10 min (F3; F4). Glazed fish cubes were FD, using Virtis Freeze Drier, and four test products (F1-F4) were produced together with a control (C). Products C, F1, and F2 were FD for 27 h, while F3 and F4 were FD for 11.5 h and 11 h, respectively. The chemical composition and microbial load of the products was determined using standard laboratory methods. A Consumer Acceptability Test was also conducted, including 114 participants, to compare preference among products. Overall, the processing yields averaged 27% for low water activity (aw < 0.20) products (C, F1, and F2), while processing yields for F3 (aw = 0.49) and F4 (aw = 0.67) were higher at 32% and 37%, respectively. In conclusion, it was possible to produce shelf-stable FD salmon products either at low or intermediate water activity levels, which will have different applications for the food industry.

Chemical Characteristics and Antilisterial Testing of Low Color and Flavor Liquid Smokes

Naim Montazeri, Brian Himelbloom, Alexandra Oliveira, and Chuck Crapo

University of Alaska Fairbanks, School of Fisheries and Ocean Sciences, Kodiak, AK, n.mont@alaska.edu

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Chemical characteristics and antilisterial tests of low color and flavor liquid smoke fractions were conducted as a potential application for cold-smoked salmon without inducing too much smoky flavor/color to the product. Recent studies showed the effectiveness of these fractions (low in phenol and carbonyl) against Listeria monocytogenes—causative agent of listeriosis. We selected four commercial smokes Code 10-Poly having strong color and flavor, and refined fractions AM-3, AM-10, and 1291 (Kerry Ingredients and Flavors, Monterey, TN). Lowest pH and highest titratable acidity were for Code 10-Poly (2.3 and 10.3%) and reverse for 1291 (5.7 and 0.7%) followed by AM-3 (4.3 and 2.2%) and AM-10 (4.2 and 2.3%). Two spectrophotometric methods to measure total phenolic compounds showed color formation only in Code 10-Poly, which together with results from gas chromatograph–mass spectrometer analysis indicate negligible phenol concentrations in other fractions. Various carbonyl and aldehyde compounds were identified in the fractions. Disc diffusion assay on plate count agar was used to evaluate antilisterial properties of the liquid smokes against *L. innocua* (as a model for *L. monocytogenes*). Significant inhibition ($P < 0.05$) was in all fractions tested except for 1291, which had slight inhibition zones at high concentrations (mean = 8 mm). Code 10-Poly resulted in the largest inhibition zones followed by AM-10 and AM-3 (averaged 36, 30, and 28 mm, respectively). This study forms the basis for assessing of liquid smokes as antilisterial supplements to cold-smoked salmon.

Development and Nutritional Quality of Wood-Smoked Fish Sausage Prepared from Pink Salmon *(Oncorhynchus gorbuscha)*

Naim Montazeri, Chuck Crapo, Huseyin Biceroglu, Katie Brenner, Stuart Thomas, Brian Himelbloom, Matthew Davenport, and Alexandra Oliveira

University of Alaska Fairbanks, School of Fisheries and Ocean Sciences, Kodiak, AK, n.mont@alaska.edu

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Pink salmon (*Oncorhynchus gorbuscha*) is the most abundant yet least economically valued Pacific salmon species harvested in Alaska. It is a low-cost protein-rich muscle food suitable for value-added fish products. The objective was to develop a novel sausage formulation produced from boneless skinless fillets. Edible salmon oil and coconut oil (at the same proportion) were used as emulsifiers and texture enhancers in formulating the salmon sausages. Fresh and smoked sausages were produced using a traditional process (a 5 hour smoking process was carried out until the core temperature reached to 71.1ºC at 40% humidity). Products were analyzed according to various chemical, physical, and microbial quality parameters. Smoking process reduced water content from 69% to 63% and increased protein (to 22%), lipid (to 6%), and carbohydrate (to 5%). Salt content remained low (averaged 1.2%) and fatty acid profile did not significantly changed ($P > 0.05$). Smoked sausages had lower bacterial count (less than detection limit of 100 per gram), less whiteness, and higher hardness than fresh sausages, and contained high levels of unsaturated fatty acids (PUFA 776 mg) with high concentrations of EPA (160 mg) and DHA (322 mg) per serving size (85 g). Analysis of fatty acids of oils showed that most originated from the applied salmon oil (PUFA 164 mg per g, EPA 44 mg per g, and DHA 55 mg per g). Fresh and smoked salmon sausages are protein and omega-3 rich products that show potential for introduction to consumers seeking healthier alternatives to land animal products.

Post-Harvest Quality of Selected Pacific Oysters *(Crassostrea gigas)* Cultured in Kachemak Bay, Alaska, and Puget Sound, Washington

Stuart R. Thomas[1], Ray RaLonde[2], Chris Langdon[3], Alexandra Oliveira[4]

[1]University of Alaska Fairbanks, School of Fisheries and Ocean Sciences, Kodiak,AK, srthomas6@alaska.edu

[2]University of Alaska Fairbanks, School of Fisheries and Ocean Sciences, Anchorage, AK

[3]Oregon State University, Coastal Oregon Marine Experimental Station, Newport, OR

[4]University of Alaska Fairbanks, School of Fisheries and Ocean Sciences, Kodiak, AK

The primary objective of this project was to evaluate the biochemical and fatty acid composition as well as shell characteristics of families of oysters from the USDA-funded Molluscan Broodstock Program (MBP) planted at a subtidal site in Kachemak Bay, Alaska, and at an intertidal site in Thorndyke Bay, Puget Sound, Washington. MBP selects oysters to improve yields, growth, and survival but little is known about the effects of selection on other properties of selected oysters. Shell and meat characteristics of oysters from each of the seven highest-yielding MBP families were compared with those from non-selected control families at each site, sampled in October 2009 and in June 2010. Percent solid, ash, protein, glycogen, and lipid contents, as well as fatty acid compositions were determined. Information from this study will be valuable for marketing Alaska oysters.

Research Projects at Nuniaq Marine Science Camp, 2006

Tamara Swenson, Amelia Reed, Ben Hoyt, Lisa Ann Christiansen, Blake Strain, Tucker Bigley, Gwendolyn Christiansen, Zack Hoyt, Chance Christiansen, Brian Koozaata, Grant Elvehjem, Devin Koozata, Kristen Larionoff, Michael Inga, Chase Shugak, and Marn Elvehjem

Old Harbor, Alaska

A short skiff ride from Old Harbor, Nuniaq Marine Science Camp is situated in a mosaic of rich intertidal reefs, eelgrass meadows, and clam beds. On these shores of Sitkalidak Island, local youth explored marine life and conducted research projects from nearshore waters to the deep sea in August 2006. Working with elders, visiting scientists, and local tribal leaders, students mapped the intertidal habitats of Nuniaq camp vicinity and conducted studies on bivalve population dynamics, halibut diet, morphometrics and aging with otoliths, king crab subtidal habitat surveys using an ROV, and carried out a census of marine life. Biodiversity of marine organisms identified included over 180 species. Twelve halibut analyzed were aged from 6 to 16 years old and diet included sculpin, bivalves, small fish, and octopus. Clam populations of five species indicated that high densities occur at Nuniaq beach, but three species have very low density of younger year classes, suggesting likely low populations and poor harvesting prospects in future years. Nine deep subtidal sites within 7 miles of Nuniaq Marine Science Camp had sand, mud, gravel, and rocky substrata with diverse habitat-forming biota but no king crab were observed.

Offshore Drilling in Bristol Bay, Alaska

Dylan Kavanaugh, Trevor Nelson, Rosevonne Sala, Mark Carlo Portillo, and Jordan Fogle

Kodiak High School Oceanography Class, Kodiak, AK

This poster is the work of a group of Kodiak High School oceanography class students. The authors chose the topic to investigate the threat of oil pollution to Alaska's fisheries. Several of the authors are participants in one or more fisheries and many Kodiak fishing boats participate in Bristol Bay fisheries. Offshore oil drilling in Bristol Bay, Alaska, is a possibility in the near future. This could have either a negative or a positive impact on the state in terms of money revenues and possible oil spills. Major concerns surround the fishing industry there and the diverse marine wildlife. Benefits that would come from drilling for oil in Bristol Bay include a substantial increase in income for Alaska, an economical boost with new available jobs, and even a decrease in dependency on foreign countries for our crude oil and gasoline. On the other hand, potential threats include the risks of major oil spills and in turn devastation to the fisheries that call the area "home base." Commercial fishing has been prominent in the area for over 100 years, and Bristol Bay is home to the largest sockeye salmon run in the world. The salmon runs generate 2 billion dollars annually for the state of Alaska. There has been some controversy in the political realm on this topic, and even the media has given it attention. We propose some ideas for future protection of Bristol Bay, including using suction pumps, booms, and skimmers in the event of a spill, and to be sure that these are on site, ready for use at all times. Creating a third party advisory council would also be beneficial.

Oral History of Fisheries in Alutiiq Communities

Catherine P. Chambers and Courtney Carothers

University of Alaska Fairbanks, School of Fisheries and Ocean Sciences, Fairbanks, AK, cpchambers@alaska.edu

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Several prominent shifts throughout time have affected the ability of Alutiiq fishermen on the Kodiak archipelago to participate in commercial fisheries. Regulatory changes such as the limitation and commodification of fishing rights have occurred in conjunction with other technological, environmental, and economic transitions. Previous research suggests that the transitions experienced during the 1950-1970s were particularly important for evaluating more recent shifts from the 1970s through the present. Therefore, it is important to understand the specific histories of those involved in fishing to obtain a holistic view of the transitions in commercial fishing on Kodiak. Here, we use an oral history framework to document and explore individuals' personal fishing participation histories and the relative importance of the different changes experienced in several important time periods. We focus on all the different aspects encompassing the histories of Alutiiq fishermen, such as commonalities in lived experiences, variations in life paths, and trends in opinions and insights regarding participation in fisheries over time. This research also investigates individuals' perceptions of shifts in their home communities related to commercial and subsistence fisheries during the course of their lifetimes with special reflections on childhood and youth experiences.

Workshops

Saturday April 9		
8:00-5:00	Teaching Alaska Seas and Rivers Curriculum - The workshop is designed to provide one full day of exploration of lessons found in Alaska Sea Grant's Alaska Seas and Rivers K-8 on-line curriculum, a half day of field experience and a half day of science symposium attendance to learn about current scientific research being conducted in the Kodiak area. The workshop is available to teachers and informal educators as a one-credit professional development course at a cost of $40.	KIBSD
10:00 -noon	Tour Alutiiq Museum - view archaeological collections with Patrick Saltonstall and Mike Etnier.	Alutiiq Museum
noon - 5:00	Seabird Mortality Monitoring for COASST - volunteers trained to collect data on beach-cast carcasses of marine birds and establish baseline pattern of bird deposition on North Pacific beaches.	FITC
2:00 - 5:00	Communicating Ocean Science - This workshop will provide scientists, educators, and anyone involved in science communication with strategies for communicating science to diverse audiences, including the media, the general public, K-12 teachers and students, and people in "informal" education settings such as field trips, ecotours, museums, and aquaria. Participants will be actively engaged in the practicing the use of concept mapping and message boxes as effective communication tools.	Fisherman's Hall
Sunday April 10		
8:00-5:00	Teaching Alaska Seas and Rivers Curriculum - *continued*	NOAA Lab and Conference location

Tuesday April 12		
2:00 - 5:00	Cooperative Marine Research Roundtable - join Kodiak residents, fishermen, researchers, and educators in an open discussion about current marine research data gaps and opportunities for future cooperative research in the Kodiak area.	Fisherman's Hall
2:00 - 5:00	Monitoring Marine Invasive Species - learn how to identify current species of concern in Alaska and current techniques for monitoring marine invasive species.	KNWR Interpretive Center

Credits

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