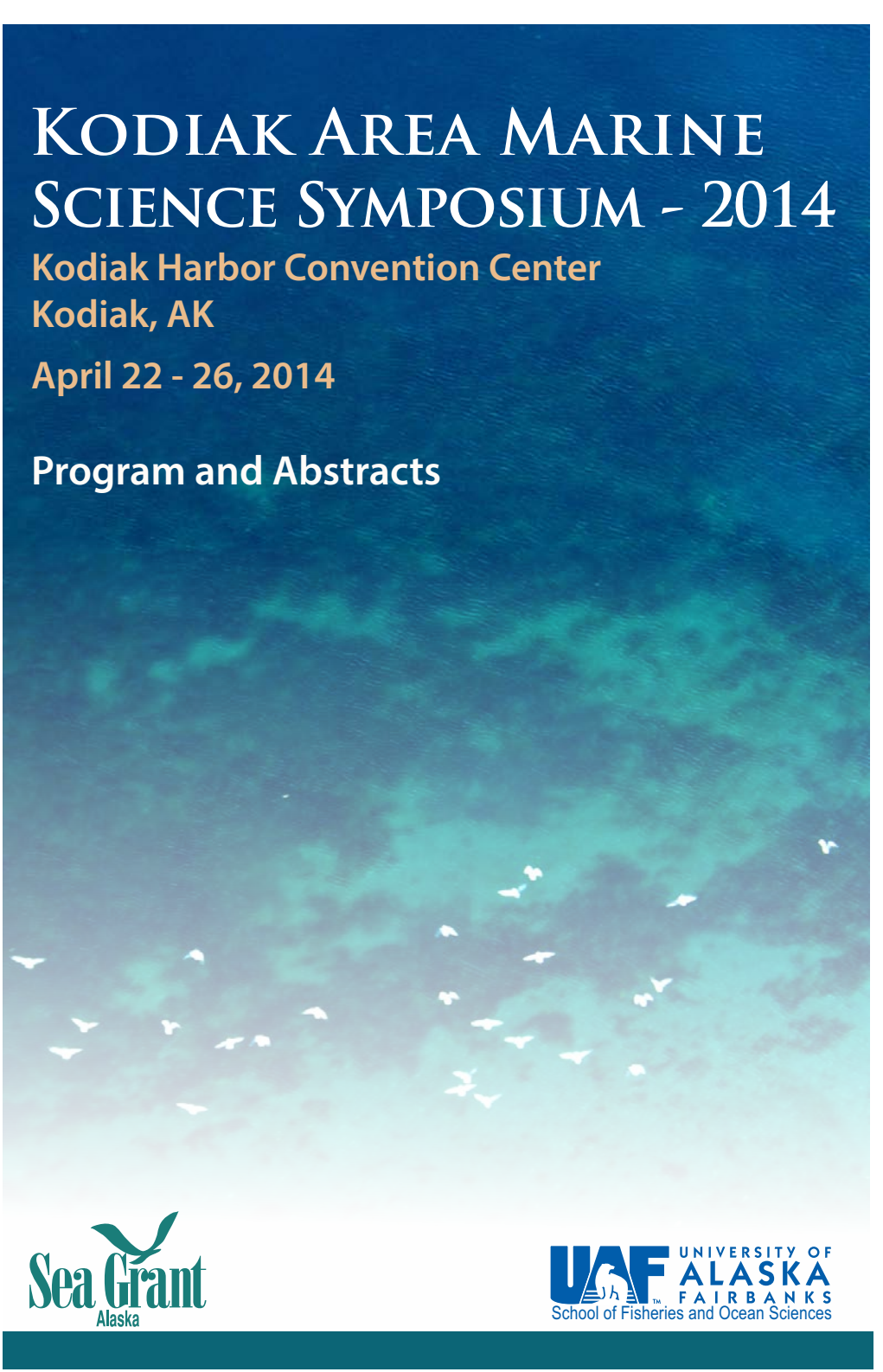
Kodiak Area Marine Science Symposium - 2014

Kodiak Harbor Convention Center
Kodiak, AK

April 22 - 26, 2014

Program and Abstracts



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Tuesday, April 22, 2014		
6:30 pm	KAMSS Kickoff and WhaleFest Reception (Kodiak Harbor Convention Center)	
6:30 - 7:30 pm	Registration, refreshments, and music by St. Innocent's Academy	
7:30 - 9:00 pm	**Keynote Address** Blues, Grays, and Humpbacks: New Insights on Whales and Impacts of Human Activities	**John Calambokidis,** Cascadia Research, Olympia, WA
Wednesday, April 23, 2014		
8:00 am	**Registration**	
9:00 - 9:05 am	**Welcome**	
9:05 - 9:45 am	**Introduction to Marine Science in Kodiak**	
9:45 - 10:25 am	**Keynote Address** Oceanographic Mechanisms Providing Nutrients to the Kodiak Island Marine Ecosystem	**Carol Ladd**, NOAA Pacific Marine Environmental Laboratory, Seattle, WA
10:25 - 10:45 am	**Break**	
	Session 1 - Invertebrates *Session Chair - Robert Foy*	
10:45 - 11:05 am	Ocean Acidification Alters Embryo Develoment and Reduces Fecundity and Calcification in Tanner Crab, *Chionoecetes bairdi*	**William Long,** NOAA Fisheries, Kodiak, AK
11:05 - 11:25 am	Variation in Benthic Species Associated with Weathervane Scallop Beds off Kodiak Island	**Jessica Glass,** University of Alaska Fairbanks, Juneau, AK
11:25 - 11:45 am	Mapping Tanner Crab Habitat in the Kodiak Area of the Gulf of Alaska	**Carrie Worton,** Alaska Department of Fish and Game, Kodiak, AK
11:45 - 12:05 pm	The First Release of Hatchery-Cultured King Crabs in Alaska: An Introduction to a Small-Scale Pilot Study	**Benjamin Daly,** NOAA Fisheries, Kodiak, AK
12:05 - 12:25 pm	Crab Divers and the Hatchery Red King Crab - A Short Film	**Pete Cummiskey,** NOAA Fisheries, Kodiak, AK
12:25 - 1:40 pm	**Lunch**	
1:40 - 2:00 pm	Predation of Early Benthic Phase King Crabs	**Benjamin Daly,** NOAA Fisheries, Kodiak, AK

Wednesday, April 23, 2014 - *continued*

	Session 2 - Fishes *Session Chair - Switgard Duesterloh*	
2:00 - 2:20 pm	Tracking the Abundance and Age Composition of a Large Unfished Aggregation of Pacific Herring *Clupea pallasii* in Kukak Bay, Alaska, 2009-2012	**Michelle Moore,** Alaska Department of Fish and Game, Kodiak, AK
2:20 - 2:40 pm	Not All Waters Were Created Equal—Not Even Close: Spatial Variation in Consumption	**Lei Guo,** University of Alaska Fairbanks, Kodiak, AK
2:40 - 3:00 pm	Feeding Ecology of Juvenile Sockeye Salmon and Resource Partitioning with Threespine Stickleback in Afognak Lake, Alaska	**Natura Richardson** University of Alaska Fairbanks, Juneau, AK
3:00 - 3:20 pm	**Break**	
3:20 - 3:40 pm	Lifestyles of the Small and Toothy: Spiny Dogfish Sharks, *Squalus sukleyi*	**Cindy Tribuzio,** NOAA Fisheries, Juneau, AK
3:40 - 4:00 pm	Kiliuda Bay: One Heck of an Interesting Place	**Olav Ormseth,** NOAA Fisheries, Seattle, WA
	Session 3 - Marine Birds and Mammals *Session Chair - Doug DeMaster*	
4:00 - 4:20 pm	Kodiak Archipelago Nearshore Marine Bird Surveys	**Robin Corcoran,** US Fish and Wildlife Service, Kodiak, AK
4:20 - 4:40 pm	Kittlitz's Murrelet Nesting Ecology on Kodiak Island	**Timothy Knudson,** Southern Illinois University, Carbondale, IL (presented by Robin Corcoran)
4:40 - 6:30 pm	**Free Time**	
6:30- 9:00 pm	**Poster/Video Night: Pizza, Popcorn and No-Host Bar** *(Kodiak Harbor Convention Center)*	

Thursday - April 24, 2014

9:00 - 9:05 am	**Welcome and Announcements**	
	Session 3 - Marine Birds and Mammals (continued) *Session Chair - Doug DeMaster*	
9:05 - 9:25 am	Modeling the Diet of Kodiak Humpback Whales, *Megaptera novaeangliae*: Implications for Marine Predators and Commercial Fisheries near Kodiak, AK	**Dana Wright,** University of Alaska Fairbanks, Fairbanks, AK

Thursday, April 24, 2014 - *continued*

9:25 - 9:45 am	Milk Fatty Acid Composition of Perinatal and Foraging Steller Sea Lions: Examination from Pup Stomachs	**Carlene Miller,** University of Alaska Fairbanks, Seward, AK
9:45 - 10:05 am	Whales as Sentinels in a Changing Marine Environment in the Gulf of Alaska	**Bree Witteveen,** University of Alaska Fairbanks, Kodiak, AK
10:05 - 10:25 am	Whale Bycatch Reduction: What's NOT to Love about Pingers?	**Kate Wynne,** University of Alaska Fairbanks, Kodiak, AK
10:25-10:45 am	**Break**	
	Session 4 - Ecosystem Perspectives *Session Chair - Bree Witteveen*	
10:45 - 11:05 am	Habitat: A Better Way to Look at Marine Fisheries Science	**Gregg Rosenkranz,** Alaska Department of Fish and Game, Kodiak, AK
11:05 - 11:25 am	Deep Sea Revelations: Submarine Expeditions in the Western Gulf of Alaska	**Michelle Ridgway,** Alaska Deep Ocean Science Institute, Auke Bay, AK
11:25 - 11:45 am	A Coastal View: The Alaska ShoreZone Program from a Kodiak Perspective	**Susan Saupe**, Cook Inlet Regional Citizens Advisory Council, Anchorage, AK
11:45 - 12:05 pm	GOAIERP: Broad-Scale Investigations of the Gulf of Alaska Ecosystem	**Olav Ormseth,** NOAA Fisheries, Seattle, WA
	Session 5 - Resource Management *Session Chair - Julie Bonney*	
12:05 - 12:25 pm	Mortality Rates of Tanner Crab, *Chionoecetes bairdi*, Bycatch Discarded by Alaska Bottom Trawlers	**Craig Rose,** FishNext Research, Mountlake Terrace, WA
12:25 - 1:40 pm	**Lunch**	
1:40 - 2:00 pm	Delayed Discard Mortality of the Giant Pacific Octopus, *Enteroctopus dofleini*, Captured as Bycatch in the Gulf of Alaska	**Christina Conrath,** NOAA Fisheries, Kodiak, AK
2:00 - 2:20 pm	Developing a Viable Salmon Excluder for the Bering Sea and Gulf of Alaska Pollock Fisheries Through Cooperative Research	**John Gauvin,** North Pacific Fisheries Research Foundation, Seattle, WA
2:20 - 2:40 pm	Using Vessel Monitoring system Data to Estimate Spatial Effort for Unobserved Fishing Trips	**Jordan Watson,** University of Alaska Fairbanks, Juneau, AK

Thursday, April 24, 2014 - *continued*

2:40 - 3:00 pm	Industry Organized Management Plans: Lessons Learned Using These Creative Management Options in High Effort Fisheries	**Josh Keaton,** NOAA Fisheries, Seattle, WA
3:00 - 3:20 pm	**Break**	
3:20 - 3:40 pm	An Overview of the Fish Resource Permit (FRP) Process	**Michelle Morris,** Alaska Department of Fish and Game, Juneau, AK
	Session 6 - Utilization *Session Chair - Robin Corcoran*	
3:40 - 4:00 pm	Nutritional and Contaminant Analysis of Skates in the Gulf of Alaska: Shaping Future Skate Demand	**Thomas Farrugia,** University of Alaska Fairbanks, Fairbanks, AK
4:00 - 4:20 pm	Freeze-Dried Salmon: Omega-3 Rich Space Food from Alaska Waters	**Alexandra Oliveira,** University of Alaska Fairbanks, Kodiak, AK
4:20 - 4:40 pm	96-Well Biotechnology: Paralytic Shellfish Toxin Quantification without Testing Mice	**Brian Himelbloom,** University of Alaska Fairbanks, Kodiak, AK
4:40 - 5:00 pm	Testing for Paralytic Shellfish Toxins: Comparison between Abraxis Saxitoxin (PSP) ELISA and HPLC Analysis	**Julie Matweyou,** University of Alaska Fairbanks, Kodiak, AK
5:00 - 6:30 pm	**Free time**	
6:30 - 8:30 pm	**Seafood, Snacks, and Science** *UAF - KSMSC (aka Fish Tech - 118 Trident Way)*	

Friday - April 25, 2014

	Session 7 - Human Dimensions *Session Chair - Theresa Peterson*	
9:00 - 9:05 am	**Welcome**	
9:05 - 9:25 am	The Economics of Killer Whale Depredation	**Megan Peterson,** University of Alaska Fairbanks, Juneau, AK
9:25 - 9:45 am	A Comparison of Four Marine Debris Cleanup Programs on Kodiak Island in 2013	**Tom Pogson,** Island Trails Network, Kodiak, AK
9:45 - 10:05 am	Archaeological Data for Marine Scientists	**Patrick Saltonstall,** Alutiiq Museum, Kodiak, AK

Friday, April 26, 2014 - *continued*

10:05 - 10:25 am	Ash Fall and Halibut Feasts: Kodiak Halibut Prospecting in 1911 and 1912	**Anjuli Grantham,** Baranov Museum and Kodiak Historical Society, Kodiak, AK
10:25 - 10:45 am	**Break**	
10:45 - 11:05 am	Piloting a Recreational PSP Monitoring Project	**Julie Matweyou,** University of Alaska Fairbanks, Kodiak, AK
11:05 - 11:25 am	Expanding the Toolbox: Integrating and Visualizing Gulf of Alaska Data	**Molly McCammon,** Alaska Ocean Observing System, Anchorage, AK (Presented by Darcy Dugan)
11:25 - 11:45 am	**Wrap-up**	
11:45 - 1:00 pm	**Lunch**	
	Workshops	
1:00 - 3:00 pm	Alutiiq Museum Tour - Alutiiq Museum Lobby (215 Mission Rd.)	**Patrick Saltonstall,** Alutiiq Museum, Kodiak, AK
1:00 - 3:00 pm	ShoreZone User Workshop UAF - KSMSC - Room 219 (118 Trident way)	**Darren Stewart,** The Nature Conservancy/ ShoreZone Partnership, Anchorage, AK
3:00 - 3:20 pm	**Break**	
3:20 - 5:20 pm	Communicating Science: Bridging Scientists and Communities UAF - KSMSC - Room 219 (118 Trident way)	**Marilyn Sigman,** Alaska Sea Grant Marine Advisory Program and COSEE AK **Marie Acemah,** Digital Storytelling Educational Consultant

Saturday - April 26, 2014

9:00 - 2:00 pm	COASST Training - UAF - KSMSC Room 219 (118 Trident Way)	**Jane Dolliver,** Coastal Observation and Seabird Survey Team, Seattle, WA
3:00 - 5:00 pm	Shark Biology and Dissection - KFRC/ NOAA Building (301 Research Court)	**Robert Foy,** NOAA Fisheries, Alaska Fisheries Science Center, Kodiak, AK

Posters

How Old Are Alaska Crab and Shrimp? Application of a Novel Technique to This Age-Old Question	**Raouf Kilada,** University of New Brunswick, Saint John, NB, Canada (Presented by Laura Stichert)
Taxonomic Composition Affects Phytodetritus Nutritional Value, with Consequences for Egg Production in a Deposit-Feeding Sea Cucumber	**Charlotte Regula-Whitefield,** University of Alaska Fairbanks, Fairbanks, AK
Delivering a Drab Message with a Fun Activity: At-Sea Oil Spill	**Joong Hyun Lee,** Kodiak High School, Kodiak, AK
Dredging up Strengths, Weaknesses, Opportunities and Threats to the Alaska Weathervane Scallop Fishery	**Jessica Glass,** University of Alaska Fairbanks, Juneau, AK
Fatty Acid Extraction of Arctic Crab Tissue Using Two Solvent Systems in Accelerated Solvent Extraction	**Tanja Schollmeier,** University of Alaska Fairbanks, Fairbanks, AK
Will Spatiotemporal Variation in Fatty Acid Signatures of Prey Affect Diet Studies of Top Predators?	**Julia Dissen,** University of Alaska Fairbanks, Fairbanks, AK
ShoreZone Mapping in Alaska and the Pacific Northwest	**Darren Stewart,** The Nature Conservancy/ShoreZone Partnership, Anchorage, AK

Workshops

Alutiiq Museum Tour, Alutiiq Museum Lobby (215 Mission Rd)
Patrick Saltonstall will lead a tour of archeological collections at the Alutiiq Museum and discuss their availability to marine scientists.

ShoreZone User Workshop, KSMSC (118 Trident Way)
This workshop will focus on describing the ShoreZone coastal habitat mapping project in Alaska and its many applications. Discussion will cover oil spill response planning and response, search and rescue capabilities, essential fish habitat identification, and recent updates to the ShoreZone protocol and new data layers such as coastal vulnerability, Shore Stations, and Fish Atlas.

Communicating Science: Bridging Scientists and Communities, KSMSC (118 Trident Way)
This workshop will provide skills and tips to researchers, educators, and community members about partnering to collect scientific information, to clarify the "so what" of research, and to apply it. The workshop will also focus on the "how tos" of using two outreach strategies: community-based film-making and citizen science projects. Learn about what is already happening in Kodiak and participate in discussion of new projects.

COASST training, KSMSC (118 Trident Way)
COASST volunteers collect data on beach-cast carcasses of marine birds to establish the baseline pattern of bird deposition on North Pacific beaches. Data collected helps address important marine conservation issues and protect marine resources.

Shark Biology and Dissection, KFRC/NOAA Building (301 Research Court)

Blues, Grays, and Humpbacks: New Insights on Whales and Impacts of Human Activities

John Calambokidis, *Cascadia Research, Olympia, WA*

Whales can be challenging to study—they inhabit offshore waters and spend most of their time underwater, and their density is often low and patchy. A combination of new approaches highlights how despite these challenges we can gain new insights into their status and the impacts of human activities. Long-term studies have been essential in looking at trends in these long-lived species. Photographic identification of individual animals, pioneered in the 1970s, has been an essential tool in long-term studies, although the major challenge is maintaining support for these studies over the long term. New technology for sensing marine mammals, especially instrumentation that can be attached to animals, provides new ways to look in more detail at their underwater behavior. Increased collaborations among researchers have also proven valuable to facilitate multidisciplinary research efforts and research across broad geographic regions.

In the talk I will examine some examples of how some of these approaches have yielded new insights into the status of some large whales and human impacts. Long-term photo-ID and collaborative broad regional studies like SPLASH have provided key insights into the complicated population structure of humpback whales in the North Pacific and long-term trends in abundance. Use of suction cup–attached tags has provided unique insights into the underwater behavior of whales and now is increasingly allowing better assessments of their reaction to human activities. The SOCAL-Behavioral Response Study is providing new information on how a variety of whales tagged with digital acoustic recording tags respond to both playback of simulated navy sonar and more recently actual navy sonar. Ship strikes have become a growing concern for a number of large whale species and data from tags are providing new insights on why some species are more vulnerable than others and the potential effectiveness of different mitigation strategies.

Oceanographic Mechanisms Providing Nutrients to the Kodiak Island Marine Ecosystem

Carol Ladd, NOAA, Pacific Marine Environmental Laboratory, Seattle, WA ,
carol.ladd@noaa.gov

The continental shelf surrounding Kodiak Island is highly productive, supporting many species of fishes, marine mammals, and seabirds. Phytoplankton are the plants at the base of the oceanic food chain that feed the ecosystem. Satellite images show high levels of phytoplankton during summer around Kodiak Island, and lower levels are observed farther northeast off the Kenai Peninsula. The bathymetry to the south and east of Kodiak Island is characterized by multiple banks and troughs. The highest phytoplankton concentrations appear to be centered over the shallow banks with lower concentrations in the troughs that separate the banks.

Deep oceanic water off the shelf has high nutrient concentrations and can provide the nutrients required by phytoplankton for growth. Many physical mechanisms can result in fluxes of nutrients onto the shelf surrounding Kodiak Island. The important currents in the region, including the Alaskan Stream and Alaska Coastal Current, will be described. The role of wind forcing, eddies, flow in the troughs, and mixing over the banks will be discussed.

Ocean Acidification Alters Embryo Development and Reduces Fecundity and Calcification in Tanner Crab, *Chionoecetes bairdi*

William C. Long, Katherine M. Swiney, and Robert J. Foy
NOAA Fisheries, Kodiak Laboratory, Kodiak, AK, chris.long@noaa.gov, Katherine.Swiney@noaa.gov, robert.foy@noaa.gov

Anthropogenic burning of fossil fuels is causing an increase in the carbon dioxide concentration and drop in pH in the oceans. This change in pH, or ocean acidification, is expected to affect marine animals and communities with calcifying species expected to be particularly vulnerable. We tested the effects of decreasing pH on embryogenesis and fecundity in Tanner crab *(Chionoecetes bairdi)*. Ovigerous Tanner crabs with newly extruded embryos were captured in the Gulf of Alaska and held in waters at pH 8.0 (ambient), 7.8, and 7.5 throughout embryo development. Embryos were sampled monthly and measured using digital micrographs. Fecundity was determined by quantifying larval output throughout larval release. After hatching, females were allowed to mate and extrude a second clutch of embryos and the experiment was repeated for a second year. Embryo size at the end of the first year was slightly higher with decreasing pH. At the end of the second year, most of the embryos that developed in pH 7.5 waters failed to hatch, resulting in a 73% decrease in fecundity. Hatching failure was also observed in the other treatments to a lesser degree. Females in pH 7.5 water had 30% lower calcium content in their carapaces, which may result in decreased hardness and increased vulnerability to predation. Overall project results suggest that ocean acidification may have a negative impact on the Tanner crab population.

Variation in Benthic Species Associated with Weathervane Scallop Beds of Kodiak Island

Jessica R. Glass and Gordon H. Kruse, *University of Alaska Fairbanks, Juneau, AK, jrglass@alaska.edu, gordon.kruse@alaska.edu*
Gregg E. Rosenkranz, *Alaska Department of Fish and Game, Kodiak, AK, gregg.rosenkranz@alaska.gov*

We conducted an analysis of benthic communities in areas targeted by Alaska's weathervane scallop *(Patinopecten caurinus)* commercial fishery. We will report findings for scallop beds east of Kodiak Island and in Shelikof Strait. Fish and invertebrates are incidentally caught in the commercial scallop fishery and subsequently sampled by onboard observers. Some bycatch species are commercially valuable, including Tanner crab *(Chionoecetes bairdi)* and walleye pollock *(Gadus chalcogrammus)*. Using observer bycatch data collected during 1996-2012, we analyzed spatial patterns in community composition on weathervane scallop beds, as well as changes in community composition over time. Another objective was to determine whether spatiotemporal differences in benthic communities could be related to environmental variables (e.g., sediment type, depth, and bottom water temperature).

Using nonparametric tests, including analysis of similarity, we observed spatial and temporal differences in community structure at the scale of individual beds in Shelikof Strait and east of Kodiak Island. Spatial differences in benthic communities east of Kodiak Island appear to be largely attributable to sediment type, although depth and bottom temperature have not yet been analyzed. Changes over time also occurred in both areas, with significant differences during 1996-1999, which could be due to changes in the observer program or altered fishing behavior. Changes during 2000-2012 were also present, but subtle. Results from this study provide a quantitative baseline of benthic community composition on weathervane scallop beds against which future changes can be assessed, and contribute to our understanding of essential fish habitat for weathervane scallops and associated species.

Mapping Tanner Crab Habitat in the Kodiak Area of the Gulf of Alaska

Carrie Worton, David Barnard, and Gregg Rosenkranz, *Alaska Department of Fish and Game, Kodiak, AK, carrie.worton@alaska.gov, david.barnard@alaska.gov, gregg.rosenkranz@alaska.gov*
Christian de Moustier, *Heat, Light, and Sound Research, Inc., La Jolla, CA, cpm@ieee.org*
Philip Tschersich, *Alaska Department of Fish and Game, Kodiak, AK, philip.tschersich@alaska.gov*

The Alaska Department of Fish and Game manages commercial fisheries for Tanner crabs *(Chionoecetes bairdi)* in the Gulf of Alaska (GOA) and conducts annual bottom trawl surveys to assess the populations and provide data to set harvest limits. Bottom trawling is limited to trawlable habitat that comprises only a proportion of the total survey area. The current practice of expanding Tanner crab densities from trawlable habitat to large areas of unknown habitat can potentially create bias in overall population estimates. This is critical because state regulations require that population estimates exceed a lower threshold before opening Tanner crab fisheries. For a benthic species like Tanner crab, understanding the relationships between habitat and abundance is essential for extrapolating population density estimates to larger scales. The goal of this project is to map and describe important Tanner crab habitat northeast of Kodiak Island in the GOA. For the first time, we used WASSP multibeam sonar and a towed benthic imaging system (Alaska CamSled) to deliver full-coverage maps of bathymetry and seafloor acoustic backscatter and to provide both classified substrates and biological observations for Tanner crab habitat. Tanner crabs have preferred habitats and are associated with specific bottom characteristics that can be recognized in data collected by a multibeam sonar system: substrate, biota, and geomorphologic characteristics (depth, hardness, slope, rugosity). This information will be used to increase understanding of the spatial distribution of Tanner crab and their habitat and will aid in interpretation of stock assessment data.

The First Release of Hatchery-Cultured King Crabs in Alaska: An Introduction to a Small-Scale Pilot Study

Benjamin Daly, *NOAA Fisheries, Kodiak Laboratory, Kodiak, AK, ben.daly@noaa.gov*

The ecologically and commercially important red and blue king crab are depleted throughout much of the North Pacific, yet traditional management techniques have not helped many Alaska populations recover, causing fisherman, scientists, managers, and coastal communities to seek alternative solutions. Stock enhancement has been suggested as a possible recovery tool because some populations, such as around Kodiak, are thought to be recruitment limited. The Alaska King Crab Research, Rehabilitation and Biology (AKCRRAB) Program was formed in 2006 with the ultimate goal of enhancing depressed king crab populations in several Alaska locations. AKCRRAB has developed king crab hatchery-culture technology, but large-scale production does not guarantee stock enhancement success. Factors such as predation, size-at-release, release densities, seasonal timing, and habitat likely impact post-release survival, and must be evaluated before the initiation of a large-scale enhancement effort. NOAA researchers conducted a field experiment in fall 2013 near Old Harbor to address some of these issues and develop release strategies. This small-scale experimental release was the first attempt to place hatchery-cultured red king crabs in Alaska waters. I will present some of the science behind developing release strategies, which will be followed by a short video produced by Marina Cummiskey that documents the Old harbor field release.

Crab Divers and the Hatchery Red King Crab—A Short Film

Pete Cummiskey, Chris Long, Ben Daly, and Eric Munk, *NOAA Fisheries, Kodiak Lab, Kodiak, AK, peter.a.cummiskey@noaa.gov, chris.long@noaa.gov, ben.daly@noaa.gov, j.eric.munk@noaa.gov*
Marina Cummiskey, *Kodiak, AK, kayakampers@gmail.com*

When the Kodiak fishery for red king crab collapsed in the early 1980s and failed to recover, local fisherman, researchers, Native leaders, industry officials, and others met to evaluate the feasibility of enhancing local stocks through the release of hatchery-cultured juveniles. The Alaska King Crab Research, Rehabilitation and Biology (AKCRRAB) program was formed to conduct research on cultivation techniques and crab ecology, and to develop release and monitoring strategies. NOAA divers at the Kodiak Lab conducted a series of field studies, which are documented in this short film produced by Marina Cummiskey, an 8th grade home-school student.

The film explores the two field studies conducted by the dive team: the preliminary habitat surveys in the spring and fall of 2011, and the first experimental release of red king crab near Old Harbor, Alaska, in fall 2013. With underwater video and photographs the viewer is guided through the field techniques used to conduct both field experiments. Local crab researchers provide commentary on the project and discuss implications for the future of rehabilitation of local crab stocks in Alaska waters.

Predation of Early Benthic Phase King Crabs

Benjamin Daly, *NOAA Fisheries, Kodiak Laboratory, Kodiak, AK, ben.daly@noaa.gov*

Predation of early benthic phase king crabs could create a population bottleneck, yet we know very little about population-level effects. Increases in groundfish abundances coincided with declines in Alaska red king crab populations and gut content analyses show that groundfish prey on large, softshell juvenile red king crabs. However, correlations do not represent empirical evidence for predation mortality and documentation of early benthic phase king crabs in stomach analyses are virtually nonexistent because samples are taken outside shallow nursery areas. Nearshore tethering studies demonstrate a diverse group of predators including juvenile flatfish, ronquils, sculpins, kelp greenling, hermit crabs, and sea stars, and laboratory studies show early benthic phase king crabs are highly cannibalistic, yet the relative importance of these predators is unknown. I will provide an overview of the current state of knowledge with respect to predation of early benthic phase king crabs, identify major questions that remain unanswered, discuss potential implications for assessment, and suggest areas of needed research including nearshore gut content analyses, size-specific predation susceptibility, the role of Pacific cod predation, cannibalism in the wild, and mechanisms for recruitment limitation.

Tracking the Abundance and Age Composition of a Large Unfished Aggregation of Pacific Herring, *Clupea pallasii*, in Kukak Bay, Alaska, 2009–2012

Michelle Moore, *Alaska Department of Fish and Game, Kodiak, AK, michelle.moore@alaska.gov*

The Alaska Department of Fish and Game has monitored the abundance of a winter aggregation of Pacific herring *(Clupea pallasii)* over a period of several years in the waters of Kukak Bay. Biomass estimates from hydroacoustic surveys were calculated, along with age composition estimates and documentation of observed predator assemblages. Pacific herring are both biologically and economically important, which provides great impetus for study. Results demonstrate a relatively small remote embayment within the Kodiak Management Area that is of tremendous ecological importance.

Not All Waters Were Created Equal—Not Even Close: Spatial Variation in Consumption by Groundfishes in the Kodiak Area

Lei Guo, Bree Witteveen, and Kate Wynne
University of Alaska Fairbanks, Kodiak Seafood and Marine Science Center, Kodiak, AK, lguo2@alaska.edu, bhwitteveen@alaska.edu, kate.wynne@alaska.edu

A large number of predators use waters around the Kodiak archipelago, including numerous species of groundfishes, marine mammals, and seabirds. Many of these predators have experienced large-magnitude population fluctuations over the past decades. These changes prompt the question: how does the population fluctuation of one predator affect others? In order to elucidate such interactions, we estimated consumption by key predators in the Kodiak area. We focused on spatial variations during summer months, when biomass of migratory predators is the highest. For each fish species, length-specific consumption was estimated through bioenergetic simulation, and biomass, length-frequency, and diet data from bottom trawl surveys were employed to assess spatial variation. Results showed profound differences in consumption (t/km^2) among areas with values ranging across several orders of magnitude. These differences are primarily attributed to variations in groundfish biomass, which is in turn related to bathymetric features such as submarine banks and troughs. These results, combined with consumption estimates of other predators, will help us better understand the tropho-dynamics in waters around the Kodiak archipelago. As a comparison, local balaenopterid whales were estimated to consume similar amounts of forage fishes to those by groundfishes in certain areas, significantly increasing predation pressure on local forage fish populations and potential competition pressure on other predators, especially central-place foragers such as Steller sea lions.

Feeding Ecology of Juvenile Sockeye Salmon and Resource Partitioning with Threespine Stickleback in Afognak Lake, Alaska

Natura Richardson and Anne Beaudreau, *University of Alaska Fairbanks, Juneau, AK, nrichardson2@alaska.edu, abeaudreau@alaska.edu*
Mark Wipfli, *University of Alaska Fairbanks, Fairbanks, AK, mwipfli@alaska.edu*
Heather Finkle, *Alaska Department of Fish and Game, Kodiak, AK, heather.finkle@alaska.gov*

Juvenile sockeye salmon *(Oncorhynchus nerka)* and threespine stickleback *(Gasterosteus aculeatus)* use similar lacustrine habitats during productive summer months. Considerable spatial and temporal overlap has been observed in both habitat and prey of these two fishes. Many northern latitude lakes are oligotrophic, which may limit plankton production and food resources. If shared resources are limited, the two species should not coexist indefinitely, yet stickleback and juvenile sockeye comprise the majority of fish assemblages in numerous northern lakes. For this study, diets of Afognak Lake juvenile sockeye salmon and threespine stickleback were examined for temporal and ontogenetic foraging patterns and predator-prey, size-based relationships. We also quantified niche breadth and niche overlap to understand coexistence through resource partitioning. Results from this study help contribute to a better understanding of interspecies interactions, community structure, and food web dynamics within sockeye nursery lakes.

Lifestyles of the Small and Toothy: Spiny Dogfish Sharks, *Squalus suckleyi*

Cindy A. Tribuzio, *NOAA Fisheries, Juneau, AK, cindy.tribuzio@noaa.gov*
Gordon H. Kruse, *University of Alaska Fairbanks, Juneau, AK, ghkruse@alaska.edu*
William R. Bechtol, *Bechtol Research, Homer, AK, bechtolresearch@hughes.net*

The spiny dogfish *(Squalus suckleyi)* is a small shark that inhabits coastal waters of the eastern North Pacific Ocean and is often bycaught in fisheries targeting more valuable species. Thus, it is generally considered a "nuisance species" or other less flattering names. While commercial landings of dogfish have been somewhat limited, there is continued interest in a potential for increased harvesting. Research has been under way for the last 10 years to better understand the biology and to improve stock assessments for spiny dogfish. The purpose of this talk is to profile the biology of this species and highlight new and ongoing research. As is typical of sharks, this species is long-lived and slow growing with low rates of reproduction, characteristics consistent with species that are sensitive to overfishing. However, due to limited abundance information, it is difficult to estimate current harvest rates, which are thought to be low, for spiny dogfish in the Gulf of Alaska (GOA). Ongoing research in the GOA, including the Kodiak area, is focused on improved age estimates so that a quantitative stock assessment model may be developed. Early results are showing that new methods are improving the precision in the age estimates and thus may be more suitable for stock assessments. Preliminary results from new tagging research are shedding light on the distribution of this species. While it appears that spiny dogfish can be highly migratory, a substantial number of fish seems to remain within certain habitats in the GOA.

Kiliuda Bay: One Heck of an Interesting Place

Olav Ormseth and Kim Rand, *NOAA Fisheries, Seattle, WA, olav.ormseth@noaa.gov*

As part of the Gulf of Alaska Integrated Ecosystem Research Program (GOAIERP), we conducted seven fish and oceanography surveys in Kiliuda Bay on the eastern side of Kodiak Island. GOAIERP is a multidisciplinary project aiming to better understand the dynamics of the GOA ecosystem. The visits to Kiliuda Bay were part of extensive inshore fieldwork on both sides of the GOA and were conducted seasonally (spring, summer, fall) in 2011 and 2013. We also conducted a preliminary survey there in fall 2010. Fishes were sampled using nearshore seines, trawling, and acoustic transects. Oceanography stations were conducted that involved a CTD cast, plankton tow, and water sampling for nutrients and other compounds. The oceanography of the inner and outer regions of Kiliuda Bay are quite different, likely due to the presence of a shallow sill halfway up the bay. A similar contrast was observed in fish species composition and diets. Fishes appear to be generally abundant in Kiliuda Bay, in particular gadids of various ages. This talk will provide an overview of the inshore survey results.

Kodiak Archipelago Nearshore Marine Bird Surveys

Robin Corcoran, *U.S. Fish and Wildlife Service, Kodiak, AK, robin_corcoran@fws.gov*
Jenna L. Cragg, *University of Victoria, Victoria, BC, Canada, jenna.cragg@gmail.com*

Marine birds are conspicuous, abundant, high trophic-level consumers that are sensitive to change in the nearshore environment. Because of these characteristics, seabirds are frequently identified as indicators of the health of marine ecosystems and have proven particularly useful in recent years for the study of climate change and regime shifts in the marine environment. Marine birds have been systematically monitored during the breeding season on the Kodiak archipelago since 2011 by Kodiak National Wildlife Refuge biologists and volunteers. Survey design is based on protocols used regionally to monitor marine birds in Prince William Sound, Kachemak Bay, and Cook Inlet. Transect selection and survey protocols are directly comparable to the National Park Service Nearshore Marine Bird and Mammal Surveys conducted at Katmai and Kenai Fjords National Parks. We will present data from the Kodiak archipelago on population estimates for a suite of nearshore marine birds. Several of the species are of conservation concern (Kittlitz's and marbled murrelet, black oystercatcher, and Aleutian tern), and the Kodiak area may support significant percentages of the region's populations of these birds. Our goals for this program are to determine long-term trends and habitat associations for key marine bird species relevant to refuge management objectives and to contribute data to a regional monitoring program for birds throughout the Gulf of Alaska.

Kittlitz's Murrelet Nesting Ecology on Kodiak

Timothy W. Knudson, *Southern Illinois University, Carbondale, IL, knud0194@crk.umn.edu*
M. James Lawonn, *Oregon State University, Corvallis, OR, matthew.lawonn@oregonstate.edu*
Robin M. Corcoran (presenter), *U.S. Fish and Wildlife Service, Kodiak, AK, robin_corcoran@fws.gov*
James R. Lovvorn, *Southern Illinois University, Carbondale, IL, lovvorn@siu.edu*
John F. Piatt, *U.S. Geological Survey, Anchorage, AK, jpiatt@usgs.gov*
William H. Pyle, *U.S. Fish and Wildlife Service, Kodiak, AK, bill_pyle@fws.gov*

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 priority for monitoring and research in southwestern Alaska. The Kodiak Refuge, in partnership with other federal agencies and universities, has conducted the longest continuous nesting ecology study of this species. We studied breeding Kittlitz's murrelets from 2008 to 2013 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 91 active nests representing over 50% of all nests ever found for this species. Of those 91 nests, 26 fledged young, giving a total apparent nest success rate of 29% over six years. Foxes accounted for 16 of 18 camera-documented depredations of nests. Other potential limiting factors to nest success included unviable eggs and chick death due to parasites and disease, including seven chick deaths due to saxitoxin, one of the neurotoxins responsible for paralytic shellfish poisoning. Camera images of food deliveries to chicks indicated that sand lance are an important forage fish for Kittlitz's murrelets on Kodiak Island. This study is ongoing with fieldwork scheduled to begin again in May 2014, and preliminary results will be presented.

Modeling the Diet of Kodiak Humpback Whales, *Megaptera novaeangliae*: Implications for Marine Predators and Commercial Fisheries Near Kodiak, Alaska

Dana L. Wright and Briana Witteveen, *University of Alaska Fairbanks, Kodiak, AK, dlwright2@alaska.edu, bree.witteveen@alaska.edu*
Terrance Quinn II, *University of Alaska Fairbanks, Juneau, AK, terry.quinn@alaska.edu*
Kate Wynne, *University of Alaska Fairbanks, Kodiak AK, kate.wynne@alaska.edu*
Lara Horstmann-Dehn, *University of Alaska Fairbanks, Fairbanks, AK, lara.horstmann@alaska.edu*

Humpback whales *(Megaptera novaeangliae)* are multiple apex predators that forage in the waters of the Kodiak Archipelago. The diets of many of these predators are often directly or indirectly linked to ecologically, culturally, and commercially important fish species, including Pacific salmon *(Oncorhynchus spp.)*, Pacific herring *(Clupea pallasii)*, and walleye pollock *(Gadus chalcogrammus)*. Therefore, overlap in diet compositions between humpback whales and other consumers of marine resources likely occurs in this region. The use of stable isotope mass-balance equations (mixing models) to estimate diet compositions of consumers has become increasingly popular following the inclusion of Bayesian statistics. This study used a mixing model to estimate the diet composition of humpback whales in the Kodiak archipelago using ratios of stable car- bon (13C/12C) and nitrogen (15N/14N) from skin samples collected between 2004 and 2012. Here we present results from humpback whale diet models and briefly discuss implications of these results to other consumers in the Kodiak archipelago, including Steller sea lions *(Eumetopias jubatus)* and commercial fisheries.

Milk Fatty Acid Composition of Perinatal and Foraging Steller Sea Lions: Examination from Pup Stomachs

Carlene Miller, *University of Alaska Fairbanks, Seward, AK, cnmiller@alaska.edu*
Lori Polasek, *University of Alaska Fairbanks and Alaska SeaLife Center, Seward, AK, lorip@alaskasealife.org*

Understanding influences of maternal resources on pup provisioning is necessary when examining recovery potential of the western distinct population segment of Steller sea lions (SSL, *Eumetopias jubatus*). A means to identify maternal state (i.e., perinatal or foraging) of individuals, beyond direct observation, would aid in investigating maternal physiology. Understanding the influence of maternal foraging on milk fatty acid (FA) composition is crucial as milk FAs are important for offspring growth and development.

To investigate the relationship of milk FA composition between perinatal and foraging lactating SSLs, milk samples were collected in 2010 and 2011 via gastric intubation from SSL pups on a small rookery in central Gulf of Alaska. Maternal states of lactating females of sampled pups were determined via remotely operated video cameras on the rookery. All lab processing was conducted at the UAF Kodiak Seafood and Marine Science Center. Milk FA composition between maternal states was compared using univariate and multivariate statistical analyses.

Milk FA composition between perinatal and foraging lactating SSLs was significantly different and thus can be utilized to distinguish between perinatal and foraging lactating SSLs of the same region. Milk secreted by lactating foraging SSLs was enriched, on a relative percentage basis, in all n-3 FAs compared to milk of lactating perinatal SSLs, indicating foraging post-parturition is important as it increases relative percentages of milk FAs needed by young pups for proper development.

Whales as Sentinels in a Changing Marine Environment in the Gulf of Alaska

Briana H. Witteveen, Lei Guo, and Kate M. Wynne, *University of Alaska Fairbanks, Kodiak, AK, bree.witteveen@alaska.edu, lguo2@alaska.edu, kate.wynne@alaska.edu*

With long-term and interrelated studies, the University of Alaska's Gulf Apex Predator-prey (GAP) study has collected environmental, predator, and prey data needed to assess the degree of temporal variability and dietary overlap among sympatric apex predators in the Gulf of Alaska since 1999. Combined, GAP studies have provided both multiyear snapshots and long time-series data demonstrating that Kodiak's apex predators are responding to highly variable marine prey resources. Such multiyear studies are key to monitoring temporal variability and assessing the direction, magnitude, and consequences of long-term trends. Because of the removal and subsequent recovery of balaenopterid whales in the Gulf of Alaska across the past several decades, GAP studies have focused heavily on the foraging ecology and population dynamics of baleen whales. Using empirical data from GAP and other regional studies as input into consumption models, we explored the tropho-dynamic impacts of changes in whale populations and their response to environmental change. With this, the secondary and tertiary effects of those changes on prey populations and subsequent changes in the carrying capacity for Steller sea lions and other upper trophic level consumers were explored. We will present preliminary results from the modeling effort that takes a top-down approach at exploring the impact of balaenopterid whales on the nearshore marine ecosystem that includes waters of the Kodiak area and the Gulf of Alaska.

Whale Bycatch Reduction: What's NOT to Love about Pingers?

Kate Wynne and Briana Witteveen, *University of Alaska Fairbanks, Kodiak, AK, kwynne@alaska.edu, bwitteveene@alaska.edu*

Fin and humpback whales are massive marine consumers that feed intensively on zooplankton and forage fish in Kodiak bays and nearshore waters. Although present year-round, peak numbers of foraging whales in Kodiak waters overlap local herring and salmon fisheries both temporally and spatially.

While foraging, baleen whales may encounter coastal fishing nets accidentally and become entangled if unaware of the gear in time to avoid it. Entanglements can prove dangerous for both the fishermen and whales involved and costly in terms of gear damage, lost fishing time, and serious whale injury. Although currently infrequent, the rate at which fin and humpback whales encounter active seine and gillnet gear in Alaska is expected to increase as these endangered whale populations recover from decades of exploitation. Results of local field trials suggest low frequency acoustic alarms, or whale pingers, can reduce the potential for baleen whale bycatch in fishing gear by making nets more "acoustically visible" to approaching whales.

So what's not to love about this relatively cheap, safe, and apparently effective tool for reducing whale entanglement? Growing global concern that increasing levels of marine noise are degrading whale habitat has raised questions regarding biological trade-offs of using acoustic devices to reduce whale bycatch. We will summarize past and future efforts by UAF to monitor the effects and effectiveness of whale pingers in the context of this conservation conundrum.

Habitat: A Better Way to Look at Marine Fisheries Science

Gregg Rosenkranz and Ric Shepard, *Alaska Department of Fish and Game, Kodiak, AK, gregg.rosenkranz@alaska.gov, ric.shepard@alaska.gov*

Marine fisheries fieldwork in Alaska has been dominated since inception by stock assessment surveys designed to estimate abundance of exploited species for use in setting commercial fishery harvest levels. These studies are typically conducted with modified commercial fishing gear followed by application of stock assessment models that were developed with unit stock and dynamic pool assumptions. Many researchers have noted that populations of benthic species that exhibit strong spatial structure are poorly suited for assessment and modeling with these classical techniques. In this presentation, we review literature on research and management of spatially structured stocks and provide examples from Alaska's weathervane scallop *(Patinopecten caurinus)* and Tanner crab *(Chionoecetes* sp.*)* fisheries. Images and results from Alaska CamSled research in the Kodiak area will be used to illustrate aspects of these populations that make their assessment difficult. We argue that given our current state of knowledge regarding these species, spatial management plans that incorporate closed areas and/or rotational harvest strategies are more likely to produce sustainable fisheries than further application of classical survey and assessment techniques. Tools such as Alaska CamSled can aid in development of spatial management plans through nonintrusive sampling in closed waters, collection of detailed habitat and ecological information for use in mapping, collection of spatially explicit multispecies density information, and monitoring of ecosystem changes over time.

Deep Sea Revelations: Submarine Expeditions in the Western Gulf of Alaska

L. Michelle Ridgway, *Alaska Deep Ocean Science Institute, Auke Bay, AK, mridgway@alaskadeepocean.org*

The deepest ocean habitats in US possession lie in the western Gulf of Alaska. Deeper than Denali is high, waters of the Aleutian Trench plunge to over 8,800 meters. At nearly twice the average depth of the world's oceans (4,400 m), no traditional sampling efforts have adequately characterized this vast ecosystem. Indeed, data on waters beyond fishing depths (about 1,000 m) are extremely limited in the WGOA.

Since the 1930s, submarine technology has been used in the WGOA to investigate unique habitats, exploit resources, explore archeological sites, spy on enemy ships and subs, and to conduct *in situ* research on fish, coral, and invertebrates. In every case, submariners have contributed to our understanding of the WGOA physical and biological undersea world. Original video imagery and data on deep-sea life revealed through extensive efforts to recover military submarines such as the USS *Grunion* off of Kiska, Japanese subs sunk in the Aleutian Theater, and shipwrecks off of Kodiak, indicate that submersible technology augments our limited understanding of species distributions and interactions in deep waters. Highlights from expeditions of the DSV *Alvin* discovery of chemosynthetic life near Kodiak, Delta submarine dives on coral gardens in the Aleutians, as well as discoveries by private and military submariners in the WGOA will be presented.

A Coastal View: The Alaska ShoreZone Program from a Kodiak Perspective

Susan M. Saupe, *Cook Inlet Regional Citizens Advisory Council, Anchorage, AK, saupe@circac.org*

When the drilling rig *Kulluk* grounded on the outer coast of Sitkalidak Island just over a year ago, incident commanders had immediate virtual access to the beach. High resolution video and photographs and shoreline information were provided to the decision-makers by two online tools during the earliest hours of the incident, hours before real-time imagery of the coast was obtained from overflights.

Prior to the *Kulluk* incident, the partnering organizations and agencies of the Alaska ShoreZone program recognized that knowledge of shoreline features and habitats can be critical for making good coastal resource management decisions, such as those necessary for oil spill planning and response. The imagery and data collected during a series of coastal aerial surveys can be accessed through a web-site developed and administered by NOAA Fisheries. High resolution video and photographs, as well as geomorphic and biological habitat data, from more than 70% of Alaska's coast are now available by the partners to any user online.

In addition to flying the coast online, users can query geospatial data on shore-line features such as morphology, sediment substrate, beach exposure, and "bio-bands" of eelgrass, canopy kelps, salt marshes, and numerous other biotic habitat descriptors. Data and imagery from the *Kulluk* incident area will be used to dem-onstrate two web-accessible tools—NOAA's ShoreZone flex site and an online data portal and visualization tool developed by the Alaska Ocean Observing System to integrate ShoreZone data and imagery with other information that can be critical in oil spill planning and response.

GOAIERP: Broad-Scale Investigations of the Gulf of Alaska Ecosystem

Olav Ormseth, *NOAA Fisheries, Seattle, WA, olav.ormseth@noaa.gov*
Russell Hopcroft, *University of Alaska Fairbanks, Fairbanks, AK*
Carol Ladd, *NOAA Fisheries, Seattle, WA*
Kalei Shotwell, *NOAA Fisheries, Juneau, AK*
Franz Mueter, *University of Alaska Fairbanks, Juneau, AK*

More than 40 scientists are currently working on the large-scale ecosystem study known as the Gulf of Alaska Integrated Ecosystem Research Program (GOAIERP). The goal of the study is to use coordinated investigations in different disciplines and at multiple levels (field work, laboratory analyses, modeling) to better understand the dynamics of the GOA ecosystem and the survival of juvenile fishes. The project duration is 2010-2015, with the major field activities occurring in 2011 and 2013, and is structured around a comparison of the eastern GOA (outer coast of southeast Alaska) with the central GOA (eastern side of Kodiak Island and southern Kenai Peninsula). The field activities included seasonal fish and oceanography surveys in these two regions. Oceanographic moorings were deployed in each region. In addition to field studies, we conducted retrospective analyses of physical and biological time series that will be used to provide context for the field efforts. Habitat modeling, which included the production of enhanced bathymetry information at different spatial scales, is being used to predict groundfish habitats. Fish diets are being studied using a variety of techniques to understand interactions among species, and are related to laboratory studies of nutritional condition, energy content, and growth rates. Seabird diets and reproductive biology are being studied at sites in each of the study regions. All efforts are paralleled by a modeling component that links oceanographic and lower trophic level models to individual models of young fish. I will present an overview of this effort as well as some preliminary results.

Mortality Rates of Tanner Crab, *Chionoecetes bairdi*, Bycatch Discarded by Alaska Bottom Trawlers

Craig S. Rose, *FishNext Research, Mountlake Terrace, WA, fishnextresearch@gmail.com*
Kathleen McGauley and Julie Bonney, *Alaska Groundfish DataBank, Kodiak, AK, agdb@gci.net*
Carwyn Hammond, *NOAA Fisheries, Seattle, WA, carwyn.hammond@noaa.gov*
Noelle Yochum, *Oregon State University, Corvallis, OR, noelle.yochum@oregonstate.edu*

Crab bycatch by bottom trawlers has been a significant issue in the management of Alaska's marine fisheries, creating conflict between two of the largest fisheries of their kind in the world (Alaska crab and flatfish fisheries). Mortality rates for discarded crabs are poorly understood, even though bycatch numbers have been well tracked by an onboard observer program. The one study providing initial mortality estimates (Stevens 1990) involved catch handling practices differing significantly from current Alaska trawl fisheries practices, including longer handling times than presently experienced by crab bycatch. The reflex action mortality predictor (RAMP) has proven effective for accurately and efficiently estimating mortality rates, including their application to Alaska crab species (Stoner et al. 2008, Hammond et al. 2013). We conducted reflex assessments of Tanner crab *(Chionoecetes bairdi)* discarded during fishing aboard Alaska bottom trawlers and applied a RAMP to estimate discard mortality rates. Estimated mortality rates for Gulf of Alaska trawling averaged nearly 40% lower than those observed by Stevens (1990). This reduction was consistent with a significant relationship between handling time and mortality rates, indicated in both current and previous studies.

Note: This presentation is a preview of a paper for the Lowell Wakefield Fisheries Bycatch symposium, May 13-16, 2014.

Delayed Discard Mortality of the Pacific Giant Octopus, *Enteroctopus dofleini*, Captured as Bycatch in the Gulf of Alaska

Christina L. Conrath, *NOAA Fisheries, Kodiak Laboratory, Kodiak, AK, Christina.Conrath@noaa.gov*

The octopus assemblage in the Gulf of Alaska is composed of at least seven species, and commercial catches in this region are dominated by the Pacific giant octopus *(Enteroctopus dofleini)*. Octopus have recently been removed from the "other species" group of groundfish by the North Pacific Fishery Management Council and annual catch limits are now established for this assemblage. Biological and fishery data are limited for octopus in this region. Octopus catch limits based on historical incidental catch rates are very conservative, and octopus catch accounting assumes 100% mortality for octopus bycatch whether octopus are retained or discarded. The majority of octopus bycatch occurs in Pacific cod *(Gadus macrocephalus)* pot fisheries. Recent data collected by North Pacific groundfish observers indicate that immediate mortality of octopus caught in these fisheries is very small (<5%). A long-term delayed discard mortality study was initiated in January 2014 with octopus collected from both fall and winter commercial cod pot fisheries. The long-term mortality of these specimens will be assessed by maintaining them at the Kodiak Laboratory seawater facility for at least 21 days. Data on delayed or long-term mortality of this species will enable scientists to develop a gear-specific discard mortality factor and will aid in the management of octopus in the Gulf of Alaska.

Developing a Viable Salmon Excluder for the Bering Sea and Gulf of Alaska Pollock Fisheries Through Cooperative Research

John Gauvin, *North Pacific Fisheries Research Foundation, Seattle, WA, gauvin@seanet.com*
John Gruver, *United Catcher Boats Association, Seattle, WA, jgruver@ucba.org*
Craig Rose, *NOAA Fisheries, Seattle, WA, craig.rose@noaa.gov*

Modifying trawl nets to allow salmon escapement was a desirable goal given the mounting concern over salmon bycatch in pollock fishing. Unfortunately, no one knew how to do it. Sorting grids commonly used to reduce halibut bycatch were not viable. An effective "excluder" needed to be based 100% on differences in swimming behavior between pollock and salmon. Armed with little more than a video clip of salmon swimming in a pollock net and a blank whiteboard, industry managers, fishermen, net designers, and NMFS scientists sat down to brainstorm in 2002. The results of that session and all the work since are salmon excluder concepts that we have field trialed in controlled ex periments. This cooperative research between the pollock industry and NOAA's RACE Division was begun in 2003. From the outset, the North Pacific Fishery Research Foundation has served as a coordinator for the pollock industry's work on excluders. The first viable excluder was developed in 2012 and it came into wide use by pollock fishermen that year. Unfortunately, it proved to have limitations—its performance varied greatly with vessel horsepower and it required a lot of vessel-specific turning to work correctly. Fortunately, we have a new excluder under development. Preliminary results show it can achieve 40% or greater Chinook escapement with manageable pollock loss and few negative effects on fishing efficiency. Our talk will describe highlights and challenges in salmon excluder development and present testing results from the Bering Sea (2012) and Gulf of Alaska (2013 and spring 2014 if available).

Using Vessel Monitoring System Data to Estimate Spatial Effort for Unobserved Fishing Trips

Jordan T. Watson, *University of Alaska Fairbanks and Pacific States Marine Fisheries Commission, Juneau, AK, jordan.watson@noaa.gov*
Alan C. Haynie, *NOAA Fisheries, Seattle, WA, alan.haynie@noaa.gov*
Patrick J. Sullivan, *Cornell University, Ithaca, NY, pjs31@cornell.edu*

The primary characteristics of fishing effort—how much, how often, when, and where—are critical components for estimating the impacts of commercial fishing on target and nontarget species, as well as on their habitats. For vessels that target a number of North Pacific species including pollock and Pacific cod, vessel monitoring systems (VMS) transmit fishing vessel locations and times at regular intervals, capturing vessel movement behaviors (e.g., speed and turn angles). Thus, they offer an opportunity to resolve many of the uncertainties surrounding fishing effort in the absence of fishery observers. We used the North Pacific pollock catcher vessel fleet as a test case for utilizing VMS data to predict when fishing occurred. We combined VMS and 100% fishery observer coverage data from 2011 and 2012 to build generalized additive models of fishing effort. Out-of-sample model predictions of fishing and non-fishing behaviors yielded a high degree of accuracy both within and across years. Models were extended to data from 2003-2010 for which fishery observer coverage was 100% for a portion of the fleet and 30% for the remainder. Out-of-sample predictions for the 100% coverage vessels and for the observed portion of the 30% coverage vessels yielded similar prediction accuracies to those from 2011-2012. Models were then extended to the remainder of the fleet to predict fishing effort for the unobserved fishing trips. We also compared these models to speed filters that have been employed in some cases to estimate fishing effort from VMS data, finding that speed filters commonly overestimate the likelihood that fishing occurred. We are using similar methods to estimate unobserved fishing effort for the Pacific cod fishery in the Bering Sea and the pollock and cod fisheries in the Gulf of Alaska. Our approach demonstrates an underutilized opportunity for VMS data, providing probabilistic estimates of fishing behavior through a framework that is applicable across multiple gear types, target species, years, and management areas.

Industry Organized Management Plans: Lessons Learned Using These Creative Management Options in High Effort Fisheries.

Josh Keaton, *NOAA Fisheries, Juneau, AK, josh.keaton@noaa.gov*

Managing a fishery "inseason" (i.e., determining closures while fishery is in progress) requires a minimum amount of time to collect data and close a fishery. If harvests are expected to exceed the amount of quota available in that time, NMFS cannot manage the fishery inseason and will establish a closure date in advance of the fishery opening. In the case of certain high-effort fisheries, where NMFS projects harvest in a single day will exceed the quota available, NMFS will not allow the fishery to open. Some of these actions do not meet the objectives of the agency and most have direct impacts on fishing industry participants.

Regulations of sufficient flexibility that allow managers to meet both agency and industry needs are difficult to implement. However, there is an increasing need for more flexible management options. In 2007 the first industry-organized inseason management plan was proposed to NMFS managers. This plan provided the flexibility needed for the industry to harvest remaining amounts of total allowable catch and allowed NMFS to manage the fishery inseason.

Since 2007, several industry groups have submitted plans with creative management methods and they have been tested with varying degrees of success. Lessons learned are applied to subsequent plans and these plans have evolved into effective management tools. The use of these plans provides flexibility to try new management methods that meet the objectives of both managers and the fishing industry. When implemented, these industry management plans have greatly improved management of non-catch share groundfish fisheries.

An Overview of the Fish Resource Permit (FRP) Process

Michelle Morris, *Alaska Department of Fish and Game, Juneau, AK, Michelle.Morris2@alaska.gov*

The Alaska Department of Fish and Game (ADFG) is the steward of the fish resources of the state. A Fish Resource Permit (FRP) is required for all collections of fish, invertebrates, and aquatic plants not covered by existing regulations for scientific and educational use. The application process involves a thorough investigation by various department staff to ensure the study plan is sound and the resource can withstand collections with no significant adverse effects. Permits indicate species and numbers allowed to be collected, acceptable methods, and stipulations that are to be followed. Any results from projects are submitted in a required report to ADFG and are provided to reviewers of the original application and are made available to the public.

FRPs also cover propagative research by accredited institutions of higher learning and cooperative government projects to test feasibility of various incubation, marking, rearing, and release techniques involving fish and invertebrates. Propagative research is highly regulated to ensure that the resource can withstand any collections and that genetic, pathological, and management concerns are addressed. Any releases from propagative research are considered common property.

FRPs expire annually and the applicant must be in good standing with compliance of their permit conditions before any subsequent permits can be issued. Twenty permits were issued in the Kodiak area in 2013 for projects ranging from research on PSP testing, sea otter prey, various king crab studies, coho salmon propagation, and aquarium collections.

Nutritional and Contaminant Analysis of Skates in the Gulf of Alaska: Shaping Future Skate Demand

Thomas J. Farrugia, *University of Alaska Fairbanks, Fairbanks, AK, tjfarrugia@alaska.edu*
Alexandra C.M. Oliveira, *University of Alaska Fairbanks, Kodiak, AK, acoliveira@alaska.edu*
Howard Teas, *Alaska Department of Environmental Conservation, Anchorage, AK, howard.teas@alaska.gov*
Andrew C. Seitz, *University of Alaska Fairbanks, Fairbanks, AK, acseitz@alaska.edu*

Skates are in growing demand worldwide, especially in European and Asian markets, and there is increasing economic pressure to develop directed fisheries for them in Alaska. Big skates *(Beringraja binoculata)* and longnose skates (Raja rhina) are the largest and most frequently landed skates in the Gulf of Alaska (GOA), yet there have been no studies done on their nutritional value and contaminant load. Currently only the wings are retained from GOA skates; the livers are being discarded but could be an important source of high quality fish oil. Seafood is recognized as an important source of proteins, amino acids, and long chain omega-3 fatty acids. However, one of the primary concerns is the level of heavy metals, particularly mercury, present in fish tissues, which may influence the demand of certain fishery products.

Knowledge of the protein, lipid, moisture, and omega-3 content of skate products, as well as concentrations of contaminants, could be critical information to determine a long-term demand for skate products from the GOA. To address this lack of knowledge, I collected 10 big and 10 longnose skates from near Kodiak and Cordova, Alaska, sampled muscle and liver tissue from each individual, and analyzed nutritional content (protein, moisture, and lipid content and fatty acid profiles) and heavy metal load (mercury, arsenic, selenium, cadmium). Muscle samples had high moisture content and liver samples had very high lipid content. Mercury levels were below the World Health Organization safety limits. These data will be shared with the fishing industry and will be integrated into a bioeconomic model developed to determine the most profitable and sustainable harvest strategy for skates in the GOA.

Freeze-Dried Salmon: Omega-3 Rich Space Food from Alaska Waters

Alexandra C.M. de Oliveira and Brian H. Himelbloom, *University of Alaska Fairbanks, Kodiak, AK, acoliveira@alaska.edu*

Although products from the ocean are considered highly nutritious, seafood is one of the least likely products provided in extraterrestrial missions because of the difficulties in meeting shelf-life requirements. The goal of this study was to develop flavored freeze-dried sockeye (FDS) salmon cubes made from high-quality boneless deep-skinned fresh fillets. The product guidelines were set as: (i) FDS should have water activity (Aw) below 0.5; (ii) FDS should maintain nutritional benefits of fresh sockeye muscle; (iii) FDS should not undergo chemical or microbial deterioration for up to 6 months of storage at 35 degrees C; (iv) FDS should receive high acceptance by consumers evaluating its sensorial properties.

FDS (Aw about 0.4) underwent a 6-month storage trial (T = 35C) and samples were analyzed for microbial load and chemical stability at 30 day intervals. Development of lipid oxidation Fproducts was not observed, and total bacterial counts were very low and did not change over 180 days of storage (3.5 Log CFU/g). FDS nutritional value did not change over storage and 1 oz of product contained 838 mg of long-chain omega-3 fatty acids, of which 186 and 536 mg were eicosapentaenoic acid (EPA) and docosa hexaenoic acid (DHA), respectively. The American Heart Association (AHA) recommends a daily consumption of 1 g of EPA+DHA for healthy individuals, and a 1.5 oz serving size of FDS exceeds AHA recommendation. Consumer taste tests were held at the UAF campus and participants (n = 198) tasted randomized comparisons of three FDS flavor recipes. Products differed in salt content and degree of spiciness (“salt,” “cayenne,” and “red pepper”), and statistical analysis of data showed preference for one of the formulation (cayenne) over the two others.

Overall, flavored FDS salmon cubes are a shelf-stable, nutrient-rich, and energy-dense food that may be suitable for inclusion in astronaut meals and meals ready-to-eat.

96-Well Biotechnology: Paralytic Shellfish Toxin Quantification without Testing Mice

Brian Himelbloom, Julie Matweyou, and Tia Leber, *University of Alaska Fairbanks, Kodiak, AK, bhhimelbloom@alaska.edu, jamatweyou@alaska.edu, tleber@alaska.edu*
Ray RaLonde, *University of Alaska Fairbanks, Anchorage, AK, ray.ralonde@alaska.edu*

The history of saxitoxin (paralytic shellfish toxin) analytical testing has spanned over seventy-five years with the gold standard being testing extracts through intraperitoneal (body cavity) injections into live mice. This animal-testing procedure has achieved the standard for overall toxicity and is the regulatory testing procedure. However, other methods of toxin testing have been developed with the advantages of no animals needed for testing, lower detection of toxicity, and quantification of the multitude of analogs of the saxitoxin molecule. This review will present the various types of laboratory-based methods for conducting saxitoxin analysis with a special emphasis on microplate assays. Our current research project is evaluating one of the commer-cially available saxitoxin kits. It employs a 96-well microplate, proprietary reagents for conducting an enzyme-linked immunosorbent assay (ELISA), microplate reader of absorbance values, and software for calculating saxitoxin concentrations in shellfish extracts.

Testing for Paralytic Shellfish Toxins: Comparison between Abraxis Saxitoxin (PSP) ELISA and HPLC Analysis

Julie Matweyou, Brian Himelbloom and Tia Leber, *University of Alaska Fairbanks, Kodiak, AK, julie.matweyou@alaska.edu, bhhimelbloom@alaska.edu, tleber@alaska.edu*
Ray RaLonde, *University of Alaska Fairbanks, Anchorage AK, ray.ralonde@alaska.edu*

Alaska has a serious public health problem caused by paralytic shellfish toxin in shellfish consumed from personal and subsistence harvest. Testing personally harvested shellfish at the Alaska Department of Environmental Conservation (ADEC) Environmental Health Laboratory is logistically difficult and cost prohibitive. Alternate testing methods that can be remotely located, require minimal training, and are less expensive can help protect human health. The Abraxis saxitoxin enzyme linked immunosorbent assay (ELISA) is a promising test that could dramatically reduce the cost of testing and enable an effective toxin-screening program. However, because the suite of neurotoxins collectively known as saxitoxin is complex, the test needs to be evaluated for regional and species-specific differences in toxin analog composition. This study evaluates the Abraxis ELISA on four subsistence and two commercially harvested Alaska bivalves. High performance liquid chromatography (HPLC) was used to validate the Abraxis test results and to provide assessment of paralytic shellfish toxin analog composition. Results from this study will be presented and the usefulness of the assay discussed.

The Economics of Killer Whale Depredation

Megan Peterson, Franz Mueter, and Keith Criddle, *University of Alaska Fairbanks, Juneau, AK, mjpeterson6@alaska.edu, fmueter@alaska.edu, kcriddle@alaska.edu*
Alan Haynie, *NOAA Fisheries, Seattle, WA, alan.haynie@noaa.gov*

Killer whale *(Orcinus orca)* depredation (whales stealing or damaging fish caught on fishing gear) adversely impacts demersal longline fisheries for sablefish *(Anoplopoma fimbria)*, Pacific halibut *(Hippoglossus stenolepis)*, and Greenland turbot *(Reinhardtius hippoglossoides)* in the Bering Sea, Aleutian Islands, and western Gulf of Alaska. These interactions increase direct costs and opportunity costs associated with catching fish and reduce the profitability of longline fishing in western Alaska. This study synthesizes commercial observer data, longline survey, and fisherman-collected depredation data to: (1) estimate the frequency of killer whale depredation on longline fisheries in Alaska; (2) estimate depredation-related catch per unit effort reductions; and (3) assess direct costs and opportunity costs incurred by longliners in western Alaska as a result of killer whale interactions. The percentage of commercial fishery sets affected by killer whales was highest in the Bering Sea fisheries for sablefish (21.4%) and Greenland turbot (9.9%). Average catch per unit effort reductions on depredated sets ranged from 35.1 to 69.3% for the observed longline fleet in all three management areas from 1998 to 2012 ($P < 0.001$). To compensate for depredation, fishermen set additional gear to catch the same amount of fish, and this increased fuel costs by an additional 82% per depredated set (average $433 additional fuel per depredated set). In a separate analysis with six longline vessels in 2011 and 2012, killer whale depredation avoidance measures resulted in an average additional cost of $494 per vessel-day for fuel and crew food. Opportunity costs of time lost by fishermen averaged $522 per additional vessel-day on the grounds.

A Comparison of Four Marine Debris Cleanup Programs in the Kodiak Area in 2013

Tom Pogson and Andy Schroeder, *Island Trails Network, Kodiak, AK, tom@islandtrails.org, andy@islandtrails.org*

In this presentation I will compare four marine debris programs in the Kodiak area in 2013: coast walk volunteer marine debris removal from beaches off the Kodiak road system, the incentive marine debris removal program, the Tugidak NOAA community marine debris removal, and the much larger Japanese tsunami debris removal program. The following factors will be used to make the comparison: logistics, costs, benefits, efficiency, and overall results. Which is best? Or are they part the fabric of a series of techniques that will make up a long-term strategy for marine debris removal in the Kodiak archipelago?

Archaeological Data for Marine Scientists

Patrick Saltonstall, *Alutiiq Museum, Kodiak, AK, Patrick@alutiiqmuseum.org*

The Kodiak archipelago is blessed with a rich archaeological record that documents Alutiiq reliance on marine resources for well over 7,000 years. The data available from archaeological contexts have incredible time depth, and can be exceptionally informative to marine scientists studying the Gulf of Alaska today. Archaeological data can be used to determine such things as the species available at various moments in time, past water temperatures, and the structures of past food webs and their evolution over time. However, archaeological data lack a fine-grained temporal scale, and tend to be patchy in time and space.

Ash Fall and Halibut Feasts: Kodiak Halibut Prospecting in 1911 and 1912

Anjuli Grantham, *Baranov Museum and Kodiak Historical Society, Kodiak, AK, anjuli@baranovmuseum.org*

The history of Kodiak's fisheries sciences, commercial fishing, and natural disasters come together in W.J. Erskine's halibut fishing experiments conducted in 1911 and 1912. This Kodiak businessman commissioned a two-year study of Kodiak's halibut to determine if Kodiak could support a halibut industry. During the second season of this prospecting operation, Novarupta at Katmai erupted. At the study's end, Erskine determined that the Albatross Banks had the halibut resources to support one of the largest halibut fisheries in the Territory. This presentation will include a synopsis of one of the earliest halibut surveys in the region and the historical context in which it was created.

Piloting a Recreational PSP Monitoring Project

Julie Matweyou, *University of Alaska Fairbanks, Kodiak, AK, julie.matweyou@alaska.edu*
Steve Doerksen, *Kodiak Island Borough School District, Kodiak, AK, sdoerksen01@kibsd.org*
Morgan Eagar, *Ouzinkie School, Ouzinkie, AK, meagar01@kibsd.org*
Dan Clarion, *City of Ouzinkie, Ouzinkie, AK, ouzinkiemayor@ouzinkie.org*
Bobbi Anne Barnowsky, *Native Village of Old Harbor, Old Harbor, AK, bobbi.barnowsky@ohtcmail.org*

Paralytic shellfish poisoning (PSP) is a persistent problem for Alaska shellfish harvesters. The Alaska Department of Environmental Conservation Division of Environmental Health (EH) has launched a three-year pilot study to monitor personally harvested shellfish. Kodiak was selected as one of four communities statewide that are participating in the Recreational Shellfish Beach Monitoring Pilot Program. The Kodiak Island Borough School District (KIBSD) is the administrative body for the program on Kodiak Island and participating communities include Ouzinkie and Old Harbor. The Ouzinkie and Old Harbor schools, supported by community members and local tribal organizations, have been sampling butter clams monthly from selected beaches to determine PSP toxin concentrations throughout the year. The project is not designed to certify a beach as safe, but rather to collect information on toxin trends in the region. Sample testing is performed by the EH lab using high performance liquid chromatography (HPLC). Ouzinkie toxin concentrations hovered near or at the regulatory limit of 80 µg toxin/100 g tissue for most of 2013, with the exception of the June sample concentration of 127 µg toxin/100 g tissue. Old Harbor toxin concentrations were elevated at the onset of sampling in March and increased into June, decreased mid summer, then increased again in August. The maximum toxin concentration in the Old Harbor area was 364 µg toxin/100 g tissue. Interestingly, toxin concentrations from the June samples collected in two locations ap- proximately 0.5 miles apart varied widely, indicating complex oceanographic patterns. Toxin results are being disseminated to the community, with KIBSD students involved in data interpretation and graphing. Project participants will share their results and discuss their experiences with the project.

Expanding the Toolbox: Integrating and Visualizing Gulf of Alaska Data

Molly McCammon, *Alaska Ocean Observing System, Anchorage, AK, mccammon@aoos.org*
Rob Bochenek, *Axiom Consulting and Design, Anchorage, AK, rob@axiomalaska.com*
Darcy Dugan **(presenter)**, *Alaska Ocean Observing System, Anchorage, AK, dugan@aoos.org*

Research and monitoring efforts in the Gulf of Alaska over recent years have led to new discoveries and scientific breakthroughs. The wealth of data resources currently available include real-time conditions, forecast models, satellite imagery, time-series monitoring, and project data ranging from oceanography to breeding birds. Continued collaboration is needed to maintain and expand these efforts. However, there is a simultaneous need to integrate existing information to better understand the environment, promote safe operations, and inform decisions regarding human activities.

Integrating data is a challenge since many data sets are housed in isolated and physically dispersed locations. Technical barriers such as complex data formats, lack of standardization, and inadequate metadata have also made acquiring and using scientific information a daunting task. As a result, existing data are often underused.

To help address these needs, the Alaska Ocean Observing System has partnered with GulfWatch Alaska (the long-term monitoring program funded by the Exxon Valdez Oil Spill Trustee Council) to develop a Gulf of Alaska Portal. This interactive web-based mapping application visualizes oceanographic and atmospheric models, real-time sensor feeds, satellite observations, and GIS layers in a seamless interface. Users choose from several hundred layer options including ocean circulation and temperature grids, habitat maps, environmental sensitivity indices, marine mammal observations, and ShoreZone video and imagery.

The goal of this tool is to improve access to existing information that can benefit a wide spectrum of research and management efforts, including emergency response. This presentation will provide a live view of the portal.

How Old Are Alaska Crab and Shrimp? Application of a Novel Technique to This Age-Old Question

Raouf Kilada, *University of New Brunswick (Saint John), Saint John, NB, Canada, rkilada@yahoocom*
Laura Stichert **(presenter)**, *Alaska Department of Fish and Game, Kodiak, AK, laura.stichert@alaska.gov*
Joel Webb and Kevin McNeel, *Alaska Department of Fish and Game, Juneau, AK, joel.webb@alaska.gov, kevin.mcneel@alaska.gov*
Quinn Smith, *Alaska Department of Fish and Game, Douglas, AK, quinn.smith@alaska.gov*

The age of fish and shellfish species can often be determined by examining growth bands preserved in calcified structures such as scales, otoliths, and shells. This direct aging method has not been used for crustacean species due to the presumed loss of all integumental structures at each molt, thus the recourse to indirect methods for estimating crustacean age. In 2012, Kilada et al. developed a new technique to determine the age in four decapod species including snow crab from eastern Canada. The technique relies on counting growth bands that were found to be deposited in the endocuticle layer of the eyestalk and/or gastric mill. The band counts were corroborated with available age-at-size information for the four species. We are initiating a study to evaluate the application of this technique on three commercially important crab and shrimp species in Alaska, specifically red king crab *(Paralithodes camtschaticus)*, Tanner crab *(Chionoecetes bairdi)*, and spot shrimp *(Pandalus platyceros)*. Our objectives are to assess the presence and location of growth bands for these species and, if present, to compare band counts with available age-at-size estimates. Preliminary efforts have revealed the presence of bands for all three species within the endocuticle of the eyestalk, as well as within the gastric mill of the red king crab. If this age determination technique proves successful for Alaska crustaceans, its further development and application could improve estimates of important fishery parameters, allow for a better understanding of population dynamics, and enable future development of age-structured stock assessment models.

Taxonomic Composition Affects Phytodetritus Nutritional Value, with Consequences for Egg Production in a Deposit-Feeding Sea Cucumber

Charlotte Regula-Whitefield and Sarah Mincks Hardy, *University of Alaska Fairbanks, Fairbanks, AK, cmregulawhitefield@alaska.edu, smhardy@alaska.edu*
Alexandra Oliveira, *University of Alaska Fairbanks, Kodiak, AK, acoliveira@alaska.edu*

Phytoplankton vary in biochemical composition, including the relative amounts and types of fatty acids (FA) they produce. Northeast Pacific waters have recently exhibited shifts in composition of phytoplankton assemblages, with smaller taxa proliferating where diatoms once dominated. Such shifts may cause changes in nutritional value of phytodetritus available to consumers. Many essential FAs cannot be synthesized by animals, and must come from primary producers in the diet. FAs are vital to egg formation, adding membrane structure, and yolk energy. We investigated effects of phytoplankton diets on the sea cucumber *Parastichopus californicus* reproduction and FA provisioning of eggs. For 32 weeks, we maintained adult animals on the diatom *Thalassiosira* or the chlorophyte *Tetraselmis*, both native species to the northeast Pacific. Spawning was then induced, and fecundity, egg sizes, and pre-feeding larval developmental and survival rates were recorded. Females fed *Tetraselmis* showed higher fecundity, while larvae from females fed *Thalassiosira* had higher survival rates; egg sizes and larval development rates did not differ between treatments. Subsamples of eggs were analyzed for lipid and FA composition to determine whether dietary FA differences were reflected in the eggs.

Delivering a Drab Message with a Fun Activity: At-Sea Oil Spill

Joong Hyun Lee, *Kodiak High School, Kodiak, AK, joonghyunlee@hotmail.com*
Switgard Duesterloh, *University of Alaska Anchorage, Kodiak College, Kodiak, AK, switgard@gci.net*

The Prince William Sound Regional Citizens' Advisory Council (PWSRCAC or RCAC) was established after the tragic Exxon Valdez oil spill in 1989. The oil spill affected communities, "from the Sound itself to Kodiak Island to lower Cook Inlet," negatively. Monitoring the environmental impacts of the Valdez Marine Terminal, researching ways to promote safe oil transportation, and informing the public of the detrimental effects of oil spills are some of the Council's responsibilities. The oil industry, government agencies, and the local communities all share responsibilities to preserve the beauty of nature from toxic oil spills. RCAC works arduously to inform the citizens of oil spill responses, preventions, and impacts. Outreach is in part focused on the youth. Teaching the youth, the future pioneers and keepers of the environment, is one of the biggest focal points because RCAC needs them to become concerned, active citizens in the future. As a Kodiak Ocean Science Discovery Program intern, I developed a new at-sea oil spill curriculum for a classroom setting through a grant in the RCAC partners in education program. The purpose of the simulation is to educate students in Kodiak's rural schools about the difficulties of cleaning up an oil spill and the importance of prevention.

Dredging Up Strengths, Weaknesses, Opportunities and Threats to the Alaska Weathervane Scallop Fishery

Jessica R. Glass and Gordon H. Kruse, *University of Alaska Fairbanks, Juneau, AK, jrglass@alaska.edu, gordon.kruse@alaska.edu*
Scott A. Miller, *NOAA Fisheries, Juneau, AK, scott.miller@noaa.gov*

We report findings of a socioeconomic assessment of the commercial weathervane scallop fishery off Alaska. Research was structured within the framework of a SWOT (strengths, weaknesses, opportunities, threats) analysis, a strategy commonly used to analyze the internal (strengths, weaknesses) and external (opportunities, threats) components of an industry. Within the SWOT framework, we focused on five categories: socio-cultural, technological, economic, environmental, and regulatory. Semi-structured interviews were conducted with 26 participants who had detailed knowledge of the fishery, including industry members, fishery managers, biologists, and members of coastal communities affected by the fishery. Participants were interviewed from communities including Juneau, Kodiak, Yakutat, Homer, Cordova, Anchorage, and Seattle. We addressed topics such as attitudes of the Alaska public toward scallop dredging, impacts of the scallop industry on Alaska coastal communities, market influences of East Coast and imported scallops, changes in the management of the fishery, and a number of environmental considerations. Questions also addressed the risks and benefits of scallop industry participation in community supported fisheries (CSFs) in Alaska. Several unifying opinions emerged from this study, including a lack of awareness of the fishery in Alaska communities and fears about rising fuel costs and diminishing harvest levels. The majority of participants consider the fishery to be managed sustainably, although the lack of data available on scallop recruitment and abundance is a large concern. This analysis provides information to both fishery managers and the scallop industry relevant to the environmental, economic, and social sustainability of the scallop fishery abundance is a large concern. This analysis provides information to both fishery managers and the scallop industry relevant to the environmental, economic, and social sustainability of the scallop fishery.

Fatty Acid Extraction of Arctic Crab Tissue Using Two Solvent Systems in Accelerated Solvent Extraction

Tanja Schollmeier and Katrin Iken, *University of Alaska Fairbanks, Fairbanks, AK, tschollmeier@alaska.edu, kbiken@alaska.edu*
Alexandra Oliveira, *University of Alaska Fairbanks, Kodiak, AK, acoliveira@alaska.edu*

Trophic interactions are of great importance for our understanding of ecosystem structure, especially in light of ongoing environmental changes. Lipids are increasingly used in the analysis of trophic interactions in the marine environment, but the results can be influenced by the extraction method being used. One method available, the accelerated solvent extraction (ASE) utilizes high temperatures and pressures for lipid extraction but different solvents may have different extraction efficiencies, depending on the sample type. Building on traditionally used ASE solvent systems developed for various fish tissues, we modified these methods in this study to determine the extraction efficiencies of dichloromethane and of 2:1 chloroform-methanol on freeze dried tissue samples of arctic snow crab *(Chionoecetes opilio)*. Extraction efficiencies were compared against those for Lake Superior fish tissue (obtained from the National Institute of Standards and Technology). Two internal standards were added for accurate calculation of extraction efficiency and quantity of the fatty acid peak areas after gas chromatography. This enabled us to determine the preferable solvent system to use for an arctic benthic invertebrate to achieve high extraction efficiencies.

Will Spatiotemporal Variation in Fatty Acid Signatures of Prey Affect Diet Studies of Top Predators?

Julia N. Dissen, Sarah M. Hardy, and Lara Horstmann-Dehn, *University of Alaska Fairbanks, Fairbanks, AK, jndissen@alaska.edu, smhardy@alaska.edu, lara.horstmann@alaska.edu*
Alexandra Oliveira, *University of Alaska Fairbanks, Kodiak, AK, acoliveira@alaska.edu*

Fatty acid (FA) composition (or "signature") of consumer tissues can be used to identify prey species, because many dietary FAs are conserved and incorporated into predator tissues in predictable patterns. The whole-body FA signature of fishes and invertebrates could provide valuable insight into the ecology of individual prey species, as well as their trophic relationships to other organisms in arctic ecosystems. Measuring the entire FA profile of an organism could reveal differences or similarities in the diet of species across regions and years that are not found by looking at a single FA biomarker alone. Additionally, constructing a library of prey FA signatures is crucial for diet interpretation of predator adipose tissue in upper trophic–level diet studies, such as quantitative fatty acid signature analysis (QFASA). We are analyzing the FA signature of three species of forage fishes, *Boreogadus saida* (arctic cod), *Lycodes polaris* (polar eelpout), and *Lycodes sagittarius* (archer eelpout) across multiple years (2011-2013) and geographic locations (Beaufort Sea, Chukchi Sea, and Norton Sound). Regional differences in FA composition of target species could provide insights on broad scale spatial patterns and how they could be affecting the available food sources for prey in these habitats. Moreover, if FA signatures vary among regions or years more than they vary among individuals, construction of a comprehensive library of prey species FAs will require more intense sampling effort to avoid biasing QFASA models. Quantifying the degree of within-species variability is essential to the accurate interpretation of fatty acid data used in characterizing diets of top predators.

ShoreZone Mapping in Alaska and the Pacific Northwest

Darren Stewart, Cindy A.E. Hartmann Moore, Steve G. Lewis, Mary C. Morris, John R. Harper, Mandy R. Lindeberg, and Susan M. Saupe
The Nature Conservancy/ShoreZone Partnership, Anchorage, Alaska, dstewart@tnc.org

ShoreZone is a coastal marine habitat mapping system, in which spatially referenced aerial imagery is collected specifically for classification. The resulting data set includes imagery with mapped geomorphic and biological attributes in a searchable geospatial data set. The imagery provides a useful baseline and visual reference. The mapped features include shoreline morphology, substrates, and biotic resources such as eelgrass, canopy kelps, salt marshes, and other habitat descriptors. There are many applications for these data including oil spill contingency planning, habitat research, search and rescue, and coastal resource evaluations including community planning.

Approximately 108,095 km of ShoreZone imagery exists for the Pacific Northwest coastline including the entire shoreline of Oregon (1,795 km), Washington (4,933 km), British Columbia (37,619 km), and 63,748 km of the Alaska coastline (about 80%). The Alaska imagery and data can be viewed online at http://alaskafisheries.noaa.gov/shorezone/. Various resources, training, summary reports and current events can be found at www.ShoreZone.org.

The Alaska ShoreZone program is built on a foundation of multiple funding and contributing partners, including state and federal government agencies, nonprofit organizations, and private industry, as well as resource managers, scientists, and spatial data specialists. The multi-organization program provides a framework to build on and supports a contiguous, integrated coastal resource database that extends from Southeast Alaska through the Gulf of Alaska, the Alaska Peninsula, Bristol Bay, and north to Kotzebue Sound and the Chukchi and Beaufort Seas.

The program goal is to have all of the Alaska shoreline imaged and mapped using the ShoreZone protocol and to make these data web accessible. The partnership is actively seeking additional partners to help accomplish this goal.

Contents

Key Note Presentations

Blues, Grays, and Humpbacks: New Insights on Whales and Impacts of Human Activities 9
John Calambokidis, Cascadia Research, Olympia, WA

Oceanographic Mechanisms Providing Nutrients to the Kodiak Island Marine Ecosystem 10
Carol Ladd, NOAA, Pacific Marine Environmental Laboratory, Seattle, WA ,

Session 1 - Invertebrates

Ocean Acidification Alters Embryo Development and Reduces Fecundity and Calcification in Tanner Crab, *Chionoecetes bairdi* 11
William C. Long, Katherine M. Swiney, Robert J. Foy

Variation in Benthic Species Associated with Weathervane Scallop Beds of Kodiak Island 12
Jessica R. Glass, Gordon H. Kruse, Gregg E. Rosnkranz

Mapping Tanner Crab Habitat in the Kodiak Area of the Gulf 13
Carrie Worton, David Barnard, and Gregg Rosenkranz, Christian de Moustier, Philip Tschersich 13

The First Release of Hatchery-Cultured King Crabs in Alaska: An Introduction to a Small-Scale Pilot Study 14
Benjamin Daly

Crab Divers and the Hatchery Red King Crab—A Short Film 15
Pete Cummiskey, Chris Long, Ben Daly, Eric Munk, Marina Cummiskey

Predation of Early Benthic Phase King Crabs 15
Benjamin Daly

Session 2 - Fishes

Tracking the Abundance and Age Composition of a Large Unfished Aggregation of Pacific Herring, *Clupea pallasii*, in Kukak Bay, Alaska, 2009–2012 16
Michelle Moore 16

Not All Waters Were Created Equal—Not Even Close: Spatial Variation in Consumption by Groundfishes in the Kodiak Area 16
Lei Guo, Bree Witteveen, Kate Wynne

Feeding Ecology of Juvenile Sockeye Salmon and Resource Partitioning with Threespine Stickleback in Afognak Lake, Alaska 17
Natura Richardson and Anne Beaudreau, Mark Wipfli, Heather Finkle

Lifestyles of the Small and Toothy: Spiny Dogfish Sharks, Squalus suckleyi 18
Cindy A. Tribuzio, Gordon H. Kruse, William R. Bechtol 18

Kiliuda Bay: One Heck of an Interesting Place 18
Olav Ormseth and Kim Rand

Session 3 - Marine Birds and Mammals

Kodiak Archipelago Nearshore Marine Bird Surveys 19
Robin Corcoran, Jenna L. Cragg,

Kittlitz's Murrelet Nesting Ecology on Kodiak 20
Timothy W. Knudson, M. James Lawonn, Robin M. Corcoran (presenter), James R. Lovvorn, John F. Piatt, William H. Pyle

Modeling the Diet of Kodiak Humpback Whales, *Megaptera novaeangliae*: Implications for Marine Predators and Commercial Fisheries Near Kodiak, Alaska ***21***
Dana L. Wright and Briana Witteveen, Terrance Quinn II, Kate Wynne, Lara Horstmann-Dehn

Milk Fatty Acid Composition of Perinatal and Foraging Steller Sea Lions: Examination from Pup Stomachs 22
Carlene Miller, Lori Polasek

Whales as Sentinels in a Changing Marine Environment in the Gulf of Alaska 23
Briana H. Witteveen, Lei Guo, and Kate M. Wynne

Whale Bycatch Reduction: What's NOT to Love about Pingers? 24
Kate Wynne and Briana Witteveen

Session 4 - Ecosystem Perspectives

Habitat: A Better Way to Look at Marine Fisheries Science 25
Gregg Rosenkranz and Ric Shepard

Deep Sea Revelations: Submarine Expeditions in the Western Gulf of Alaska 26
L. Michelle Ridgway

A Coastal View: The Alaska ShoreZone Program from a Kodiak Perspective 27
Susan M. Saupe

GOAIERP: Broad-Scale Investigations of the Gulf of Alaska Ecosystem 28
Olav Ormseth, Russell Hopcroft, Carol Ladd, Kalei Shotwell, Franz Mueter

Session 5 - Resource Management

Mortality Rates of Tanner Crab, *Chionoecetes bairdi*, Bycatch Discarded by Alaska Bottom Trawlers 29
Craig S. Rose, Kathleen McGauley, Julie Bonney, Carwyn Hammond, Noelle Yochum,
Delayed Discard Mortality of the Pacific Giant Octopus,*Enteroctopus dofleini*, Captured as Bycatch in the Gulf of Alaska 30
Christina L. Conrath
Developing a Viable Salmon Excluder for the Bering Sea and Gulf of Alaska Pollock Fisheries Through Cooperative Research 31
John Gauvin, John Gruver, Craig Rose
Using Vessel Monitoring System Data to Estimate Spatial Effort for Unobserved Fishing Trips 32
Jordan T. Watson, Alan C. Haynie, Patrick J. Sullivan
Industry Organized Management Plans: Lessons Learned Using These Creative Management Options in High Effort Fisheries 33
Josh Keaton
An Overview of the Fish Resource Permit (FRP) Process 34
Michelle Morris

Session 6 - Utilization

Nutritional and Contaminant Analysis of Skates in the Gulf of Alaska: Shaping Future Skate Demand 35
Thomas J. Farrugia, Alexandra C.M. Oliveira, Howard Teas, Andrew C. Seitz
Freeze-Dried Salmon: Omega-3 Rich Space Food from Alaska Waters 36
Alexandra C.M. de Oliveira and Brian H. Himelbloom
96-Well Biotechnology: Paralytic Shellfish Toxin Quantification without Testing Mice 37
Brian Himelbloom, Julie Matweyou, and Tia Leber, Ray RaLonde
Testing for Paralytic Shellfish Toxins: Comparison between Abraxis Saxitoxin (PSP) ELISA and HPLC Analysis ... 37
Julie Matweyou, Brian Himelbloom and Tia Leber, Ray RaLonde

Session 7 - Human Dimensions

The Economics of Killer Whale Depredation 38
Megan Peterson, Franz Mueter, and Keith Criddle, Alan Haynie
A Comparison of Four Marine Debris Cleanup Programs in the Kodiak Area in 2013 39
Tom Pogson and Andy Schroeder
Archaeological Data for Marine Scientists 39
Patrick Saltonstall
Ash Fall and Halibut Feasts: Kodiak Halibut Prospecting in 1911 and 1912 39
Anjuli Grantham
Piloting a Recreational PSP Monitoring Project 40
Julie Matweyou,Steve Doerksen, Morgan Eagar, Dan Clarion, Bobbi Anne Barnowsky
Expanding the Toolbox: Integrating and Visualizing Gulf of Alaska Data 41
*Molly McCammon, Rob Bochenek, Darcy Dugan **(presenter)***

Posters

How Old Are Alaska Crab and Shrimp? Application of a Novel Technique to This Age-Old Question 42
*Raouf Kilada, Laura Stichert **(presenter)**, Joel Webb and Kevin McNeel, Quinn Smith*
Taxonomic Composition Affects Phytodetritus Nutritional Value, with Consequences for Egg Production in a Deposit-Feeding Sea Cucumber 43
Charlotte Regula-Whitefield and Sarah Mincks Hardy, Alexandra Oliveira
Delivering a Drab Message with a Fun Activity: At-Sea Oil Spill 43
Joong Hyun Lee, Switgard Duesterloh
Dredging Up Strengths, Weaknesses, Opportunities and Threats to the Alaska Weathervane Scallop Fishery.. 44
Jessica R. Glass, Gordon H. Kruse, Scott A. Miller
Fatty Acid Extraction of Arctic Crab Tissue Using Two Solvent Systems in Accelerated Solvent Extraction 45
Tanja Schollmeier and Katrin Iken, Alexandra Oliveira
Will Spatiotemporal Variation in Fatty Acid Signatures of Prey Affect Diet Studies of Top Predators? 46
Julia N. Dissen, Sarah M. Hardy, Lara Horstmann-Dehn, Alexandra Oliveira
ShoreZone Mapping in Alaska and the Pacific Northwest 47
Darren Stewart, Cindy A.E. Hartmann Moore, Steve G. Lewis, Mary C. Morris, John R. Harper, Mandy R. Lindeberg, and Susan M. Saupe