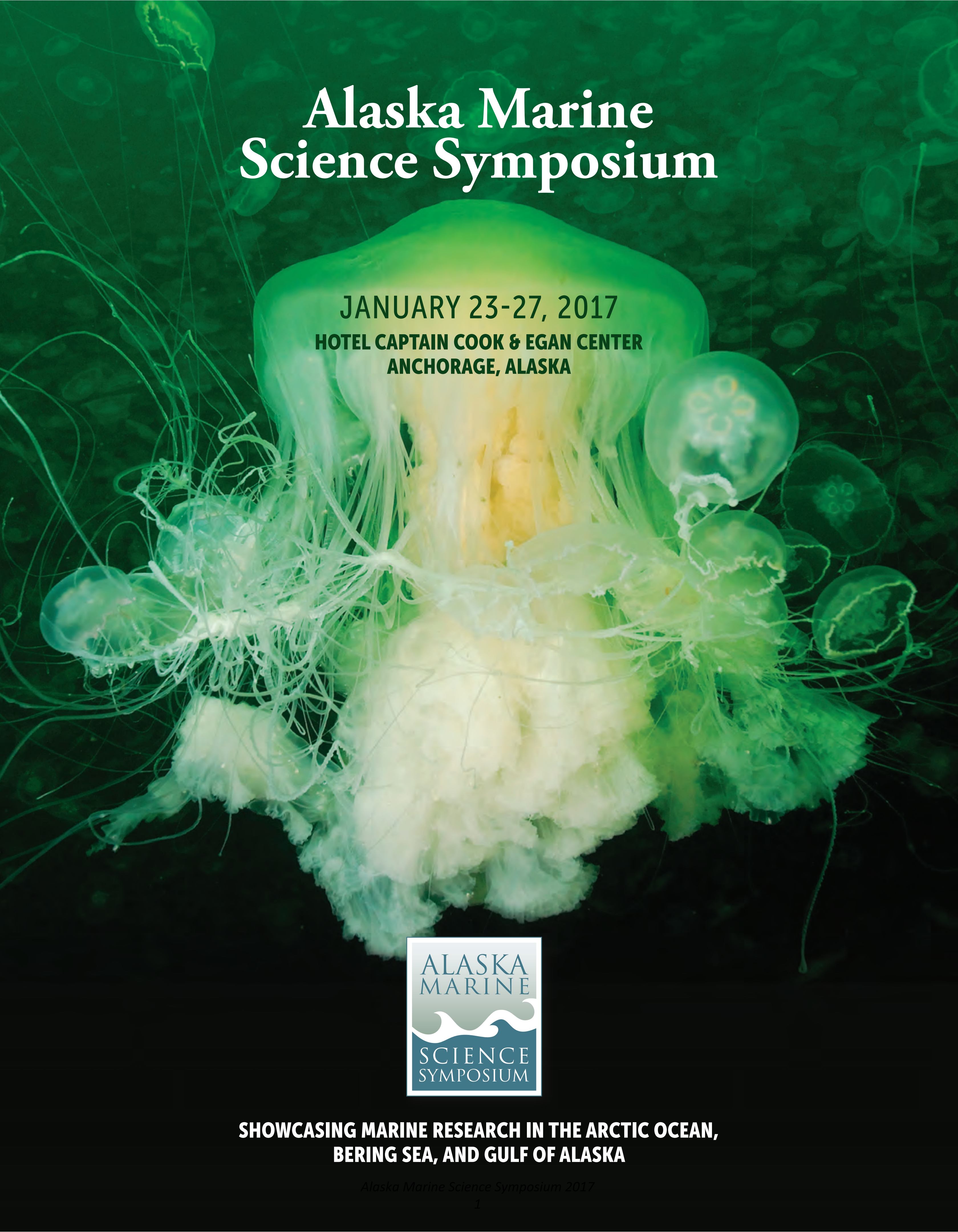
Alaska Marine Science Symposium



JANUARY 23-27, 2017

HOTEL CAPTAIN COOK & EGAN CENTER
ANCHORAGE, ALASKA

ALASKA MARINE SCIENCE SYMPOSIUM

SHOWCASING MARINE RESEARCH IN THE ARCTIC OCEAN, BERING SEA, AND GULF OF ALASKA

2017 Alaska Marine Science Symposium
Book of Abstracts

Editor: James Lee and Ellen Yasumiishi
Organization: Crystal Benson
Abstract Review Committee: Matt Baker, Douglas Burn, Michael Carey, Danielle Dickson, Robin Dublin, Carrie Eischens, George Hart, Warren Horowitz, Rosa Meehan, Aaron Poe, Andrew Seitz, Marilyn Sigman, Ellen Tyler, Tom Van Pelt, Vanessa von Biela, and Christian Zimmerman
Cover Design: Eric Cline
Produced by: NOAA, Alaska Fisheries Science Center and North Pacific Research Board
Printed by: NOAA, Alaska Fisheries Science Center, Seattle, Washington

amss.nprb.org
www.afsc.noaa.gov

The 2017 AMSS Keynote and Plenary speaker abstracts
are presented in chronological order

Contents

Welcome and Keynote Speakers- Monday, January 23

Workshops and Keynote Speakers: Monday, January 23

TIME	TITLE	PRESENTER	SECTION
8:00 - NOON	2015 Communicating Ocean Sciences Workshop		Workshop
1:00 - 1:30 PM	Welcome		
1:30 - 2:15 PM	Changes of Oceanographic Conditions in the Pacific Sector of the Arctic Ocean and the Impact to Marine Ecosystems	Takashi Kikuchi	Keynote
2:15 ------->	Research Plans for the Arctic: the US Arctic Research Commission's Goals and Objectives Report 2017-2018 and the Integrated Arctic Research Policy Committee's 5-year Research Plan	Fran Ulmer	Keynote
<----- 3:30 PM	Our Experiences as Arctic Youth Ambassadors and the Future of Alaska's Arctic	Macy Kenworthy and Cade Terada	Keynote
3:30 - 3:45 PM	**BREAK**		
3:45 - 4:30 PM	Tracing the Evolution and Extinction of High Latitude Marine Megafauna	Nicholas Pyenson	Keynote
4:30 - 5:15 PM	The Recent Marine Heat Wave in Alaska: A Dress Rehearsal for Climate Change?	Nick Bond	Keynote

Keynote

Changes of Oceanographic Conditions in the Pacific Sector of the Arctic Ocean and the Impact to Marine Ecosystems

Takashi Kikuchi
Japan Agency for Marine-Earth Science and Technology

The Arctic Ocean has experienced unexpected environmental changes due to global warming and rapid sea-ice reduction. Recent observations revealed significant warming, freshening and ocean acidification, especially in the Pacific sector of the Arctic Ocean. However, there are still significant knowledge gaps on Arctic Ocean environmental changes. Monitoring of oceanographic conditions and better understanding of the impacts on marine ecosystems are necessary to continue. In collaboration with research institutions and universities in the United States and other Arctic countries, Japanese researchers have been investigating environmental changes in the Arctic Ocean since the early 1990s.

The Pacific Arctic Group (PAG) is one of the most important scientific frameworks to conduct observational research with a Pacific perspective on Arctic science. With the strong collaboration among PAG partners, we have been conducting ship-based observations using the RV *Mirai* and long-term monitoring with a mooring observation system in the Chukchi and Beaufort seas. The results of this international collaboration research in the Chukchi and Beaufort seas will be introduced, as well as recent research topics on changes in oceanographic conditions and their impacts on marine ecosystems.

Takashi Kikuchi is the Deputy Director of JAMSTEC's Institute of Arctic Climate and Environment Research and Team Leader of its Arctic Ocean Climate System Research. He has participated as a researcher or lead scientist on research cruises to the Arctic for nearly 20 years. He is currently the chair of the Pacific Arctic Group, and has been an Executive Committee member of the International Arctic Buoy Program since 2008, as well as an International Science Steering Group Member for the Arctic-Subarctic Ocean Flux Program since 2010.

Kikuchi is the author of numerous scientific papers and is a contributing author to the Adaptation Action for a Changing Arctic - Bering/Chukchi/Beaufort regional report for the Arctic Monitoring and Assessment Program.

Keynote

Summary of the 2017-18 USARC Goals Report Highlighting Progress in Arctic Research and the New Interagency Arctic Research Policy Committee's 5-year Plan

Honorable Fran Ulmer
Chair, U.S. Arctic Research Commission

The U.S. Arctic Research Commission (USARC) recently released its "Report on the Goals and Objectives for Arctic Research 2017-2018 for the US Arctic Research Program," (Goals Report). Emphasizing the need for continued scientific research in all of its six major goals, the Commission released new recommendations for these goals. In addition, the Commission also calls attention to progress made on these goals over the past two years.

Building upon the Goals Report, the Interagency Arctic Research Policy Committee in mid-December released the second comprehensive Arctic Research Plan covering the years 2017-2021. The new plan supports U.S. policy across a range of scales, from Arctic people and communities to the global scale. The research described in Arctic Research Plan 2017-2021 is organized into nine research goals: health and well-being; atmosphere; sea ice; marine ecosystems; glaciers, ice caps and the Greenland ice sheet; permafrost; terrestrial and freshwater ecosystems; coastal resilience; and environmental intelligence (observations, data, and models). The Arctic Research plan will be implemented using the innovative IARPC Collaborations Website (www.arcticcollaborations.org).

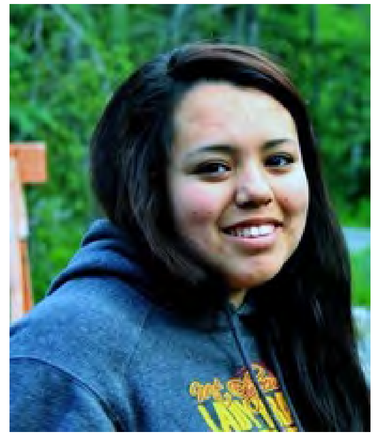
Fran Ulmer is chair of the U.S. Arctic Research Commission, where she has served since being appointed by President Obama in March 2011. In June 2010, President Obama appointed her to the National Commission on the BP Deepwater Horizon Oil Spill and Offshore Drilling. From 2007 to 2011, Ulmer was chancellor of Alaska's largest public university, the University of Alaska Anchorage (UAA). Before that, she was a Distinguished Visiting Professor of Public Policy and Director of the Institute of Social and Economic Research at UAA. Ulmer is a member of the Global Board of the Nature Conservancy and on the Board of the National Parks Conservation Association.

Ulmer served as an elected official for 18 years as the mayor of Juneau, a state representative, and as Lieutenant Governor of Alaska.

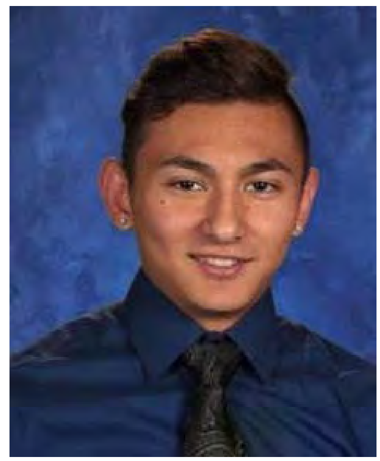
Keynote

Our Experiences as Arctic Youth Ambassadors and the Future of Alaska's Arctic

Macy Kenworthy
Cade Terada
U.S. Arctic Youth Ambassadors



Two of the Arctic Youth Ambassadors from Alaska will share their experiences with the program over the past year and their thoughts about the future of Alaska's Arctic.



Macy Rae Kenworthy is a 20-year-old U.S. Arctic Youth Ambassador from Kotzebue and Sisualik, Alaska. She graduated from Mt. Edgecumbe High School, a boarding school in Sitka, and is currently enrolled at the University of Alaska Fairbanks. Aside from the Arctic Youth Ambassadors program, Macy has taken advantage of a number of opportunities to be involved in her community, including being elected vice president of her local youth council. Along with voicing her concerns and issues, such as climate change impacts, to a broad audience including scientists and policy makers, Macy hopes to see more young people become interested and involved in their communities.

Cade (Emory) Terada is a Japanese American from Dutch Harbor Alaska. He recently graduated from Unalaska City School and is an active youth organizer for Alaska Youth for Environmental Action. He is a member of the local Teen Council where he works to empower youth in his community. His father had always encouraged him to help others as much as he possibly could. Cade enjoys hiking, cross country running, traveling and meeting new people as well as drama, debate, and forensics. Cade is interested in representing his community because of its dependence on the seafood industry. Cade credits the seafood industry for making Dutch Harbor his home. He wants to represent his community as an ambassador, a place that is changing due to climate change. As an Arctic Youth Ambassador he represented Alaska on the 2016 Students on Ice program in Northern Canada and Greenland, and has presented at national and regional conferences.

Keynote

Tracing the Evolution and Extinction of High Latitude Marine Megafauna

Nicholas Pyenson
Smithsonian Institution's National Museum of Natural History

For the past 250 million years, backboned animals have returned to the water from ancestors that once lived on land. Today, these kinds of animals include whales, sea cows, sea otters, and even sea turtles. They are all unrelated to one another, but in many cases that have evolved similar solutions to the challenges of living the life aquatic. We know that marine invaders also lived during the time of the dinosaurs, such as mosasaurs, ichthyosaurs and plesiosaurs, among others. However, we know little about the fossil record of these organisms at high latitudes, near the poles, where we find the richest ecosystems to support marine invaders today.

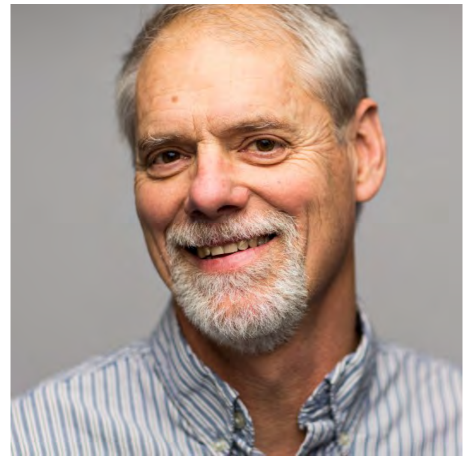
Alaska is singular among high-latitude regions in possessing a geologic history that records the evolution and extinction of many of these invaders. Starting with the extinction of Steller's sea cow on the Aleutian Islands, this history deepens heading eastwards, to Oligocene fossil marine mammals without analog from sites in Southeastern Alaska, to Mesozoic-era marine tetrapods from the Brooks Range. Understanding this record provides important benchmarks for the ecological fate of today's Arctic marine mammals in the rapidly changing Anthropocene.

Nicholas Pyenson is the curator of fossil marine mammals at the Smithsonian Institution's National Museum of Natural History, in Washington, D.C. He received his Ph.D. from the University of California, Berkeley, and completed his postdoctoral work at the University of British Columbia. As a vertebrate paleontologist, his scientific research focuses on how different kinds of four-limbed animals have repeatedly invaded oceans from land ancestry over the past 250 million years – an evolutionary cross-section of vertebrate life that includes sea turtles, seabirds, and especially marine mammals, such as whales.

A National Geographic Explorer, he has done scientific fieldwork on every continent, and led over a dozen scientific expeditions during the last decade, with a strong focus on paleontological exploration, anatomical discovery, international mentorship, and 3D digitization for museum collections. Along with his scientific collaborators, he has named over a half-dozen new species of fossil whales, discovered the richest fossil whale graveyard on the planet, and described an entirely new sensory organ in living whales.

Keynote

The Recent Marine Heat Wave in Alaska: A Dress Rehearsal for Climate Change?



Nick Bond
Joint Institute for the Study of the Atmosphere and Ocean
of the University of Washington

Alaska and its surrounding waters have experienced remarkably warm temperatures during the past few years. What happened, and how does this recent event compare with past warm events? Does it represent a preview of the regional conditions and ecosystem responses that will accompany future global climate change?

These questions will be addressed drawing on examples from the Gulf of Alaska, Bering Sea, and Arctic.

Nick Bond is a principal research scientist with the Joint Institute for the Study of the Atmosphere and Ocean of the University of Washington and is affiliated with NOAA's Pacific Marine Environmental Laboratory. He is the State Climatologist for Washington. His research covers a broad range of topics with a focus on the weather and climate of the Pacific Northwest and the linkages between the climate and marine ecosystems of Alaska.

Plenary Sessions - Tuesday, January 24

Plenary Sessions: Tuesday, January 24 -- Gulf of Alaska

TIME	TITLE	PRESENTER	SECTION
8:00 - 8:15 AM	A Perfect Storm in the Gulf of Alaska: Factors Contributing to the 2015-2016 Common Murre Die-off	Shannon Atkinson	Climate and Oceanography
8:15 - 8:30 AM	Interannual Oceanographic Variability and the Estuarine Response to the Pacific Warm Anomaly in Kachemak Bay Alaska	Kristine Holdereid	Climate and Oceanography
8:30 - 8:45 AM	Oil-Spill Risk Analysis in Cook Inlet, Alaska	Zhen-Gang Ji	Climate and Oceanography
8:45 - 9:00 AM	The Glacier Bay Buffet (A 24-hour Seafood Eatery, Open Summer Season Only)	Seth Danielson	Climate and Oceanography
9:00 - 9:15 AM	Introducing the Alaska Ocean Acidification Network	Darcy Dugan	Climate and Oceanography
9:15 - 9:30 AM	Emergence from Diapause in *Neocalanus flemingeri* Females: Physiological and Morphological Progression	Petra Lenz	Lower Trophic Levels
9:30 - 10:00 AM	**BREAK**		
10:00 - 10:15 AM	Supply and Survival: Kelp Microscopic Life Stage Challenges Across a Glacial Gradient	Sarah Traiger**	Lower Trophic Levels
10:15 - 10:30 AM	Can You Dig It? Patterns of Variability in Clam Assemblages Within Mixed-sediment Habitats Across the Gulf of Alaska	Benjamin Weitzman**	Lower Trophic Levels
10:30 - 10:45 AM	Identifying Environmental Drivers of Alexandrium Harmful Algal Blooms in Southeast Alaska	Elizabeth Tobin	Lower Trophic Levels
10:45 - 11:00 AM	Three in a Row: Continued Warm Conditions Along the Gulf of Alaska's Seward Line	Russ Hopcroft	Lower Trophic Levels
11:00 - 11:15 AM	How Many Fish are in This Barrel? Sustainably Harvesting Two Easily Caught Skate Species	Thomas Farrugia**	Fishes and Fish Habitats
11:15 - 11:30 AM	Tracking Marine Fish with an AUV Equipped with Payload Control	John Eiler	Fishes and Fish Habitats
11:30 - 1:00 PM	**BREAK - LUNCH PROVIDED**		

* Masters; ** Doctorate

Plenary Sessions: Tuesday, January 24 -- Gulf of Alaska

TIME	TITLE	PRESENTER	SECTION
1:00 - 1:15 PM	Spatial and Temporal Scales of Site Fidelity for Adult Pacific Halibut in an Alaskan Fjord	Julie Nielsen**	Fishes & Fish Habitats
1:15 - 1:30 PM	Insights into the Dynamics of Atlantic and Pacific Herring Following Population Collapse	John Trochta*	Fishes & Fish Habitats
1:30 - 1:45 PM	Insights into the Dynamics of Atlantic and Pacific Herring Following Population Collapse	Ann Eckmann*	Seabirds
1:45 - 2:00 PM	Trained Steller Sea Lions in the Open Ocean: a Decade of Shedding Light on the Energetic Consequences of Foraging in the Wild	David Rosen	Marine Mammals
2:00 - 2:15 PM	Evaluating the Accuracy of Remote Sensing Imagery from Watercraft and Unmanned Aerial Vehicles (UAVs) to Quantify Iceberg Habitats Utilized by Pinnipeds in the Gulf of Alaska	Courtney Pegus**	Marine Mammals
2:15 - 3:00 PM	**BREAK**		
3:00 - 3:15 PM	Comparing Experiences with Bycatch Across Fishermen Targeting Pacific halibut (*Hippoglossus stenolepis*)	Elizabeth Figus**	Human Dimensions
3:15 - 3:30 PM	Assessing the Resilience and Adaptive Capacity of the Community of Yakutat, Alaska, Through the Lens of Subsistence	Lauren Sill	Human Dimensions
3:30 - 3:45 PM	Twenty-five Years After the *Exxon Valdez* Oil Spill: a Synthesis of Climatic, Anthropogenic, and Ecological Drivers of Gulf of Alaska Communities	Anne Beaudreau	Ecosystem Perspectives
3:45 - 4:00 PM	Nearshore Marine Consumer Responses to Changing Prey Conditions: Combining Quantitative and Qualitative Model Input into a Conceptual Framework	Lisa Sztukowski	Ecosystem Perspectives
4:00 - 4:15 PM	Energy-based Ecosystem Modeling of Pacific Herring Trophodynamics	Szymon Surma	Ecosystem Perspectives
4:15 - 4:30 PM	Mearns Rock: Twenty-six Years and Twenty-six Photos that Put a Human Dimension on Understanding Longterm Biological Variabilty	Alan Mearns	Ecosystem Perspectives
4:30 - 5:00 PM	Gulf Watch Alaska: Results from Five Years of Ecosystem Monitoring in the Northern Gulf of Alaska	Mandy Lindeberg	Ecosystem Perspectives
6:00 - 8:30 PM	**POSTER SESSIONS**		Egan Convention Center

* Masters; ** Doctorate

Plenary Session Abstracts

Tuesday, January 24

A Perfect Storm in the Gulf of Alaska: Factors Contributing to the 2015-2016 Common Murre Die-Off

Shannon Atkinson
University of Alaska Fairbanks, skatkinson@alaska.edu
Anne Hoover-Miller
Alaska SeaLife Center, anneh@alaskasealife.org
Janet Duffy-Anderson
NOAA Alaska Fisheries Science Center, janet.duffy-anderson@noaa.gov
Elizabeth Logerwell
NOAA Alaska Fisheries Science Center, libby.logerwell@noaa.gov
Lauren Rogers
NOAA Alaska Fisheries Science Center, lauren.rogers@noaa.gov
Matthew Wilson
NOAA Alaska Fisheries Science Center, matt.wilson@noaa.gov
John Piatt
U.S. Geological Survey, Alaska Science Center, jpiatt@usgs.gov

A mass die-off of common murres (COMU; *Uria aalge*) occurred in 2015-2016 in the northern Gulf of Alaska (GOA). While mass die-offs of seabirds have been documented in several locations in the northern hemisphere, this was unusual in that it was protracted, pulsatile, and spatially variable in intensity. Christmas Bird Counts (CBC) from Kodiak, Homer and Seward, Alaska, were used to retrospectively analyze winter COMU presence. Midwater-trawl surveys of age-0 pollock and capelin from the northwestern GOA were used to assess potential climate-mediated changes in prey availability. Oceanographic indices were used to construct generalized linear regression models to assess their relationship to winter COMU presence and fish abundance. Given that typical winter distributions of COMU are offshore over the continental shelf, their nearshore presence in CBC is expected to be relatively low. Variation in COMU counts that were not considered abnormal were site-specifically correlated with ENSO, PDO, NPGO, SST and adverse weather. Abnormally high COMU CBC counts were significantly associated with previous year El Niño conditions. In 2015, COMU CBC counts were variable. Counts were not abnormal for Kodiak and Homer but were abnormally high in Seward. Water temperatures in the western Gulf of Alaska in 2015 were anomalously high (7.4 °C), and COMU forage fish, age–0 pollock (no/m^2) and capelin (g/ m^2), were anomalously low. Prolonged, cascading ecosystem events spanning 2 years, included a persistent marine heatwave that originated in 2013 (i.e., 'the blob'), strong El Niño conditions in 2015, and widespread paucity of forage fish in fall 2015. The combination of the marine heatwave and strong El Niño generated a prolonged perfect storm that diminished the prey base for COMU. Abnormally high COMU CBC counts, poor body condition, and high COMU mortality centered in Seward during December 2015, likely resulting from that perfect storm, and may illustrate ecological ramifications

experienced by other mid- and upper-trophic marine organisms in the Gulf of Alaska during these anomalous times.

Interannual Oceanographic Variability and the Estuarine Response to the Pacific Warm Anomaly in Kachemak Bay Alaska

Kristine Holderied
NOAA NOS Kasitsna Bay Laboratory, kris.holderied@noaa.gov
Kimberly Powell
NOAA NOS Kasitsna Bay Laboratory, kim.powell@noaa.gov
Dominic Hondolero
NOAA NOS Kasitsna Bay Laboratory, dominic.hondolero@noaa.gov
James Schloemer
Kachemak Bay National Estuarine Research Reserve, jwschloemer@alaska.edu
Angela Doroff
Kachemak Bay National Estuarine Research Reserve, adoroff@alaska.edu

Estuarine conditions in Kachemak Bay, located within lower Cook Inlet in south-central Alaska, are influenced by seasonal and interannual changes in freshwater input from rain, snowpack, and glacier melt, periodic intrusions of Alaska Coastal Current waters, a large (8.7 meter maximum) tidal range, and geographically- and storm-driven wind forcing. North Pacific Ocean climate variations can affect all the non-tidal forcing conditions, in addition to changing air and water temperatures. Using oceanographic data collected in monthly shipboard surveys with a conductivity-temperature versus depth (CTD) profiler on a mid-Kachemak Bay transect from 2012-2015, we investigated the estuarine response to seasonal and inter-annual climate variations, with a focus on the warming event in the northeast Pacific Ocean that started in late 2013. Continuous data collected within the bay at the Kachemak Bay National Estuarine Research Reserve water quality station at Seldovia harbor and meteorological station at Homer harbor provided additional temporal context and information on forcing conditions. Temperatures through the water column reflected the transition from colder air temperatures in 2012 to anomalously warm temperatures in 2014 and 2015, with significant interannual temperatures differences observed in winter, spring and summer months, but smaller interannual differences observed in the fall. Seasonal stratification increased significantly by May in all years, but was at its strongest earlier in 2015 (May-June) than during the summers of 2012-2014 (July). Freshwater content calculated for each transect section was less variable between years for January through August and more variable in the fall and early winter months (September to November). Relative changes in water column chlorophyll were estimated from fluorometer measurements on the CTD profiler casts, with lower values observed across all summer months in 2013, as well as in late summer in 2015, compared with other years. These changes in estuarine conditions will be used to help understand how climate variations and bottom-up changes in marine food webs may have driven observed increases in paralytic shellfish poisoning and seabird and marine mammal mortality events in Kachemak Bay in 2015 and 2016.

Gulf of Alaska - Climate and Oceanography

Oil-Spill Risk Analysis in Cook Inlet, Alaska

Zhen-Gang Ji
Bureau of Ocean Energy Management, jeff.ji@boem.gov
Caryn Smith
Bureau of Ocean Energy Management, Caryn.Smith@boem.gov
Walter Johnson
Bureau of Ocean Energy Management, walter.johnson@boem.gov

The Federal Government plans to offer for oil and gas leasing a portion of the Outer Continental Shelf (OCS) lands in the northern Cook Inlet, Alaska. Because oil spills may occur from activities associated with offshore oil and gas exploration, production, decommissioning, or transportation, the U.S. Department of the Interior (USDOI), Bureau of Ocean Energy Management (BOEM) conducted a formal oil-spill risk analysis (OSRA) to support the Environmental Impact Statement (EIS) that is completed prior to conducting the proposed lease sale of this area. The objective of this analysis was to estimate the probability of oil-spill contact, the probability of oil-spill occurrence, and the probability of oil-spill occurrence and contact to sensitive offshore and onshore environmental resources and socioeconomic features from oil spills accidentally occurring from OCS oil and gas-related activities. The occurrence of oil spills is fundamentally a matter of probability. There is no certainty regarding the amount of oil and gas that would be discovered and then produced, or the size or likelihood of a spill that could occur during the estimated life of a given lease sale. Neither can the winds, ocean currents, or sea ice that transport oil spills be known for certain. A probabilistic event, such as an oil spill occurrence or oil spill contact to an environmental, social, or economic resource, cannot be predicted, but an estimate of its likelihood (its probability) can be quantified. This study presented the methods and results of the oil-spill risk analysis conducted for the proposed Cook Inlet OCS Oil and Gas Lease Sale 244. The OSRA model estimated oil-spill trajectories using model-simulated hindcast fields of winds, sea ice movement and concentration, and surface ocean currents in the Cook Inlet and Gulf of Alaska. BOEM used the results from a coupled ice-ocean general circulation model to simulate oil spill trajectories. The wind-driven and density-induced ocean-flow fields and the ice-motion and concentration fields were simulated using a state-of-the-art three-dimensional, coupled, ice-ocean hydrodynamic model based on the Regional Ocean Modeling System (ROMS).

The Glacier Bay Buffet (A 24-hour Seafood Eatery, Open Summer Season Only)

Seth Danielson
University of Alaska Fairbanks, sldanielson@alaska.edu
Lewis Sharman
National Park Service, lewis_sharman@nps.gov

Visitors to Glacier Bay National Park and Preserve anticipate seeing and learning about humpback and orca whales, sea otters, harbor seals, sea lions, and the myriad of seabirds that feed within the Bay each summer. These vertebrate predators consume vast quantities of carbon as they visit or reside in Glacier Bay. Ultimately, all of the upper trophic level foraging depends on what must be unusually high levels of primary and secondary productivity. What is it about Glacier Bay that makes it such a special place for marine consumer food availability and park visitors? We hypothesize that tidally driven turbulent diapycnal mixing injects nutrients into the photic zone throughout the year – even during strongly stratified summer months – so when light availability and stratification are also both conducive to phytoplankton growth the primary productivity can commence at unusually high rates following the initial spring bloom. In turn, this ongoing phytoplankton bloom supports zooplankter populations that feed forage fishes, birds and marine mammals. Sufficient organic matter (e.g., decaying phytoplankton, zooplankton fecal pellets and other detritus) must also eventually reach the seafloor for the epibenthic communities and the sea otters that depend upon them. Turbulent mixing may result from a variety of mechanisms in Glacier Bay: at the seafloor by bottom friction, higher in the water column by breaking internal waves, and through highly ageostrophic vertical motions associated with upwelling tidal fronts. We present new results from a 2016 survey designed to seek evidence of mixing and internal wave activity within Glacier Bay. Observations include high-resolution towed and moored measurements made by dataloggers recording temperature, velocity, fluorescence and salinity at rates ranging from twice per second to once every 10 seconds. With this suite of instruments we observed topographically trapped lee waves, strong vertical motions, and trains of internal waves. Our data reveal coherent velocity, temperature, and fluorescence signals that vary over tens to a few hundreds of meters. We show that these fine-scale features are important factors in maintaining the Glacier Bay Buffet.

Introducing the Alaska Ocean Acidification Network

Darcy Dugan
Alaska Ocean Observing System (AOOS), dugan@aoos.org
Molly McCammon
Alaska Ocean Observing System (AOOS), mccammon@aoos.org
Carol Janzen
Alaska Ocean Observing System (AOOS), janzen@aoos.org
Holly Kent
Alaska Ocean Observing System (AOOS), kent@aoos.org

With Alaskans heavily reliant on the ocean for their lives and livelihoods, both direct and indirect effects of ocean acidification could have serious implications on the species being harvested, and the food web that sustains these fisheries. Researchers are trying to better understand the chemical and ecological systems at play so we can anticipate and respond to future changes due to ocean acidification. Currently, the direct risks to Alaska's fisheries and shellfish industry are not well understood. An Alaska-focused study on public understanding and awareness of OA risk revealed that Alaskans are three times more aware of ocean acidification than Americans in general. However, despite the heavy reliance on fishing in Alaska's economy, Alaskans do not consider ocean acidification as an immediate risk and have a limited understanding of how Alaska will be uniquely impacted by ocean acidification.

In response to this and with funding support from NOAA, the Alaska Ocean Observing System (AOOS) initiated an ocean acidification (OA) network for the state of Alaska. The Alaska OA Network is one of six in the nation, with a primary mission to engage stakeholders and impacted communities in order to expand the understanding of OA processes and associated consequences in Alaska and identify potential adaptation and mitigation actions for at risk communities. The Alaska OA Network provides and receives relevant information from the fishing and aquaculture industries, policy makers, coastal communities as well as the general public, and works closely with both OA science experts and Alaska entities interested in participating in OA research and monitoring activities. Stakeholder communities are members and provide input to the knowledge gaps and information needs for their specific regions. The Network anticipates advising on priorities for monitoring, research & modeling in both the natural and social sciences and will offer a direct avenue for training and sharing best practices for monitoring quality assurance. The Network will also work to identify funding available to support OA efforts. Through AOOS, the network promotes data sharing and acts as a resource hub for OA information in Alaska, leveraging the AOOS data portal as needed.

Emergence from Diapause in *Neocalanus flemingeri* Females: Physiological and Morphological Progression

Petra Lenz
University of Hawaii, petra@hawaii.edu
Vittoria Roncallli
University of Hawaii, roncalli@hawaii.edu
Matthew Cieslak
University of Hawaii, mcieslak@hawaii.edu
Stephanie Matthews
University of Hawaii, steph43@hawaii.edu
Cheryl Hopcroft
University of Alaska Fairbanks, cclarkehopcroft@alaska.edu
Russell Hopcroft
University of Alaska Fairbanks, rrhopcroft@alaska.edu

Neocalanus flemingeri is a keystone member of the planktonic community in the Gulf of Alaska and adjoining Prince William Sound. This calanoid copepod has a complex life history that includes dormancy of the adult females starting in late summer. Termination of dormancy occurs sometime during the winter/early spring with reproduction by this overwintering population timed such that the offspring, i.e., the nauplii and early copepodite stages co-occur with the spring phytoplankton bloom. While the general population cycle has been characterized, many questions remain as to the triggers and timing of emergence from dormancy, and how these might be affected by global climate change. Here, we used a transcriptomic approach to investigate the physiological progression that characterizes the transition from dormancy to reproduction. Dormant adult females were collected in late September from depth (400 – 700 m), maintained in the dark at 4-5 °C, and sampled at weekly intervals. Under laboratory conditions, egg production was observed starting in week seven, and reproduction was nearly completed by week 12. Survival during the incubation period ranged between 75 and 100%. While females were quiescent initially, swimming activity increased coincident with egg development. Large changes in gene expression were observed prior to any visible ovary development or oogenesis with more than 2000 gene differentially regulated compared with females at time of collection ("time zero"). The largest number of differentially expressed genes compared with time zero observed on week seven after the initiation of egg production. The gene expression data are being used to identify specific genes that could be used to classify the stage of dormancy in field-caught individuals.

Supply and Survival: Kelp Microscopic Life Stage Challenges Across a Glacial Gradient

Sarah Traiger
University of Alaska Fairbanks, sbtraiger@alaska.edu
Brenda Konar
University of Alaska Fairbanks, bhkonar@alaska.edu

Kelp provide important ecosystem services and are recreationally and commercially harvested. Kelp have two short-lived microscopic stages, one for dispersal (spores), and one that is sexually reproducing (gametophytes). Both of these cryptic stages are critical for colonizing new habitats, recovering from disturbance, and maintaining populations. Kelp forests may be at risk from environmental stress caused by climate change, including increased sedimentation rates and freshwater influx in glacially fed embayments. These changes may affect survival, reproduction, and interspecific interactions. The canopy kelp, *Nereocystis luetkeana*, occurs infrequently downstream of glacial melt, while the understory kelp, *Saccharina latissima,* is common around thick layers of sediment. Our goals were to determine 1) whether glacial melt conditions affect adult fecundity of either species, and 2) whether *N. luetkeana* and *S. latissima* gametophytes compete, and 3) whether their interaction is altered by sediments. We surveyed fecundity of *N. luetkeana* and *S. latissima* adults at two sites upstream and two downstream of glacial discharge in late summer. We found no significant differences in fecundity between regions for either species and conclude that glacial melt conditions do not affect fecundity in these species. We also examined the effect of sediment on gametophyte growth and survival over six days. In single species treatments, there was no effect of sediment on growth or survival of either species. Both species had higher survival in single than in mixed species treatments. In mixed species treatments, we found no significant difference in survival or growth between *N. luetkeana* and *S. latissima* under control conditions, but with sediment, *S. latissima* had higher survival than *N. luetkeana* and no difference in growth. We conclude that *S. latissima* is competitively superior to *N. luetkeana* in sedimented conditions. This interaction may help to explain the distribution of both species around glacial discharge. Climate change could result in further loss of *N. luetkeana* due to shifting competitive interactions with *S. latissima* at the gametophyte stage.

Can You Dig It? Patterns of Variability in Clam Assemblages within Mixed-Sediment Habitats Across the Gulf of Alaska

Benjamin Weitzman
U.S. Geological Survey, Alaska Science Center, bweitzman@usgs.gov
Daniel Esler
U.S. Geological Survey, Alaska Science Center, desler@usgs.gov
Heather Coletti
National Park Service, hcoletti@nps.gov
Brenda Konar
University of Alaska Fairbanks, bkonar@alaska.edu
Katrin Iken
University of Alaska Fairbanks, kiken@alaska.edu
Thomas Dean
Coastal Resources Associate, tomdean@coastalresources.us
James Bodkin
U.S. Geological Survey, jbodkin@usgs.gov
Allan Fukuyama
FHT Environmental, akfukuyama@frontier.com
Gary Shigenaka
NOAA Office of Response & Restoration, gary.shigenaka@noaa.gov
Dennis Lees
Littoral Ecological & Environmental Services, dennislees@cox.net

Marine bivalves are prey for a wide variety of marine and terrestrial predators, including octopus, sea stars, sea otters, sea ducks, and bears. Additionally, humans harvest marine bivalves commercially, recreationally, and for subsistence. Intertidal clam assemblages attributes (abundance, size structure, and diversity) are known to respond to local natural and anthropogenic influences, such as sea otter recolonization and oil spills. Yet, there is a dearth of understanding on broad-scale patterns of variability in clam assemblages and addressing these knowledge gaps is necessary to properly interpret and predict the effects of large-scale perturbations like climate change. To begin addressing these knowledge gaps we ask: 1) Do patterns of clam assemblage attributes vary over time, and are changes synchronous at regional or Gulf-wide scales? 2) Does spatial variation in these clam assemblage attributes correlate with physical habitat characteristics? 3) What are the relative effects of top-down predation versus bottom-up influences of habitat on clam assemblage attributes? We synthesized intertidal clam assemblage attribute data from multiple studies across the Gulf of Alaska and conducted multivariate analyses to test for patterns in clam assemblages and the scales at which they occurred. As expected, clam assemblages varied by habitat type, and preferred prey species can be strongly affected by top-down predation. However, the interplay and relative strength of bottom-up and top-down influences on clams varies depending on site characteristics. For example, our analysis revealed that

littleneck clam abundance declined across their range in the Gulf of Alaska through the late 2000’s and recovery has been limited and spatially variable. We also found that in Glacier Bay National Park and Preserve, where sea otters structure patterns of clam abundance and biomass, the top-down effects of predation were influenced by clam productivity and variation in bottom-up forces, where more highly productive clam sites were more resilient to predation over time. Understanding the processes that contribute to variation in clam assemblages will improve predictive power and therefore improve management of nearshore ecosystems in the face of local and larger scale perturbations.

Identifying Environmental Drivers of Alexandrium Harmful Algal Blooms in Southeast Alaska

Elizabeth Tobin
University of Alaska Fairbanks, edtobin@alaska.edu
Cody Crumpton
University of Alaska Southeast, ccrumpton1@hotmail.com
Ginny Eckert
University of Alaska Fairbanks, gleckert@alaska.edu

Paralytic Shellfish Poisoning (PSP) in Alaska is a persistent problem that threatens human health and the availability of shellfish resources. Regular outbreaks of PSP caused by the saxitoxin-producing marine alga, *Alexandrium sp*., make recreational and subsistence shellfish harvest unsafe, and impose economic hardships on commercial harvesters. Despite the recognized impacts of PSP, little research has been done to understand the ecological mechanisms that support *Alexandrium* bloom formation in Southeast Alaska. We conducted an intensive benthic cyst survey to identify initiation sites of *Alexandrium* blooms in areas of Northern Southeast Alaska with historically high concentrations of toxic shellfish. Regional benthic surveys revealed high densities of overwintering *Alexandrium* cysts (“seedbeds”) at Porpoise Island (Icy Strait), Game Creek (Port Frederick), Auke Bay and Bridget Cove (Favorite Channel). Weekly phytoplankton and water quality monitoring data collected from 2008-2016 in Auke Bay were analyzed to identify environmental conditions associated with toxic *Alexandrium* blooms. A robust correlation between *Alexandrium* cell abundance and particulate (intercellular) saxitoxin concentrations provides evidence that *Alexandrium* cells consistently produce paralytic shellfish toxins. Preliminary analysis indicates that *Alexandrium* cells begin to proliferate in near-surface waters when sea surface temperature (SST) reaches 7 °C. While *Alexandrium* was present across a range of SSTs (7-15 °C) and surface salinities (7-30 psu), the highest cell densities were observed during intermediate SSTs (11-13 °C) and salinities (21-23 psu). These initial findings suggest an optimum temperature/salinity window for accelerated growth of *Alexandrium* in Southeast Alaska. Identifying the locations of bloom initiation and conditions that support rapid *Alexandrium* growth can help build predictive capacity in the timing, distribution and impacts of paralytic shellfish toxins in Southeast Alaska.

Three in a Row: Continued Warm Conditions along the Gulf of Alaska's Seward Line

Russ Hopcroft
University of Alaska Fairbanks, rrhopcroft@alaska.edu
Ken Coyle
University of Alaska Fairbanks, kocoyle@alaska.edu
Seth Danielson
University of Alaska Fairbanks, sldanielson@alaska.edu
Suzanne Strom
Western Washington University, suzanne.strom@wwu.edu

During 2016 Seward Line observations entered their 20th year, with the third in a row of anomalously warm conditions. Despite El Niño's end, waters remained 1°C above normal during spring and summer, with a large warm-core eddy loitering at the continental slope. Phytoplankton community composition has been affected during springs. Warm-water species continue to be observed along the Seward Line, including occurrences of species never observed during the past 2 decades. This inventory now includes more than just copepods. Gulf wide, observations of warmer-water species have peaked during 2016.The impacts on upper trophic levels have been pronounced. We speculate on what can be anticipated in future years.

How Many Fish are in This Barrel? Sustainably Harvesting Two Easily Caught Skate Species

Thomas J. Farrugia
University of Alaska Fairbanks, tjfarrugia@alaska.edu
Gordon H. Kruse
University of Alaska Fairbanks, ghkruse@alaska.edu
Ian G. Taylor
NOAA Northwest Fisheries Science Center, ian.taylor@noaa.gov
Olav A. Ormseth
NOAA Alaska Fisheries Science Center, olav.ormseth@noaa.gov
Keith R. Criddle
University of Alaska Fairbanks, kcriddle@alaska.edu
Andrew C. Seitz
University of Alaska Fairbanks, acseitz@alaska.edu

Skates in the Gulf of Alaska, specifically big (*Beringraja binoculata*) and longnose (*Raja rhina*) skates, are abundant and frequently caught by fishermen using longline and trawl gear. However, their low reproductive output makes them vulnerable to overfishing and, consequently, they are allowed for landing as non-target catch only. The fishing industry has expressed interest in increasing skate landings, in part because of relatively high ex-vessel prices. However, management is unlikely to allow higher catch levels until skate populations are shown to be capable of sustaining increased harvest pressure. Recently, biological and economic information on these skates has made it possible to assess the feasibility of conducting sustainable skate fisheries under various fishing and economic scenarios. Such scenarios were examined using stock assessment and bioeconomic models. Specifically, we developed the first stock assessments for big and longnose skates in Alaska, using Stock Synthesis, a powerful software package with flexibility to handle data-poor assessments. We then used the output from this assessment in a simple, constrained optimization bioeconomic model to evaluate the feasibility of expanding harvest opportunities and prosecuting directed fisheries for skates in the Gulf of Alaska. The stock assessment model shows that skate populations in the Gulf of Alaska have declined, but it appears that they remain above biomass levels that would provide maximum sustainable yield. However, models also indicate that total skate landings cannot be substantially increased without jeopardizing the stock sustainability. Results from the population dynamics and bioeconomic models will be provided to state and federal fishery management agencies to help ensure the long-term sustainability and profitability of skate fisheries in Alaska.

Tracking Marine Fish with an AUV Equipped With Payload Control

John Eiler
NOAA Alaska Fisheries Science Center, john.eiler@noaa.gov
Thomas Grothues
Rutgers University, grothues@marine.rutgers.edu
Joe Dobarro
Rutgers University, dobarro@marine.rutgers.edu
Rahul Shome
Rutgers University, rahul.shome@rutgers.edu
Tom Dodson
University of Pennsylvania, tcdodson@gmail.com
Michele Masuda
NOAA Alaska Fisheries Science Center, michele.masuda@noaa.gov

Autonomous underwater vehicles (AUVs) have demonstrated superior performance for tracking acoustic-tagged fish in the marine environment. On-board sensors also provide proximal information on the surrounding conditions, making it possible to integrate fish telemetry data with geomorphic and environmental data. Until recently, AUVs were limited by the inability to modify their mission in response to changing conditions or the information being collected, which often decreased their effectiveness. However, this limitation has been substantially reduced by the development of payload control hardware that allows the vehicle to alter its pre-programmed movements based on information from on-board sensors. We developed and field tested payload control software for an AUV equipped with an acoustic receiver. The software allowed the vehicle to deviate from its anticipated route and execute search maneuvers when acoustic-tagged fish were detected. Computer simulations were used to develop and compare search patterns and strategies to enhance location estimates. Operational tests and survey missions were conducted in marine waters of southeast Alaska. Moorings equipped with reference transmitters provided acoustic targets at known locations and depths. Towed reference tags and juvenile Chinook salmon surgically tagged with acoustic transmitters provided mobile targets. Over twenty missions were conducted during April-May 2013 to determine the tracking success, detection rate, and accuracy of the location estimates obtained using both pre-programmed routes and routes with payload control maneuvers. Based on the computer simulations, three different payload control search patterns were tested and compared. The operational and telemetry results are discussed. The AUV was more effective at locating the acoustic-tagged salmon than companion tracking survey conducted by boat. The survey methods developed have the potential to improve our understanding of the distribution and migratory patterns of marine populations in the northern Pacific.

Spatial and Temporal Scales of Site Fidelity for Adult Pacific Halibut in an Alaskan Fjord

Julie Nielsen
University of Alaska Fairbanks, julie.nielsen@gmail.com
Andrew Seitz
University of Alaska Fairbanks, acseitz@alaska.edu

Adult Pacific halibut have been observed to exhibit limited movement and home range behavior on summer foraging grounds but are capable of moving large distances during winter spawning migrations. Halibut are also known to return to the same summer foraging area after undertaking winter migrations. We studied the annual movement of adult Pacific halibut in a fjord in Glacier Bay National Park, Alaska, to quantify spatial and temporal scales of site fidelity to summer foraging areas and to obtain information on migration characteristics. To determine large-scale movement, we deployed 25 Pop-up Satellite Archival Tags (PSATs) on adult halibut during the summer of 2013. Residency within the fjord was inferred by comparing PSAT depth and temperature records to stationary mooring and oceanographic survey data. To characterize small-scale movement patterns during summer and provide precise information on displacement over time, 15 halibut tagged with PSATs were double-tagged with acoustic transmitters and tracked during the summers of 2013 and 2014. Home range behavior in the release location at spatial scales < 2 km was observed for the majority (12/15) of acoustic-tagged fish during summer. Most tagged halibut exhibited strong intra- and inter-annual site fidelity at scales < 5 km year-round. Only a small proportion (6/21 fish with PSAT data) likely left the fjord in December to undertake winter spawning migrations and at least 4/6 migrants returned to the fjord following migration. Although spatial and temporal scales of site fidelity may vary in other geographic regions or habitat types, our observations of daily, seasonal, and annual site fidelity to summer foraging areas at spatial scales of less than 5 km demonstrate that halibut are capable of a high degree of site fidelity and are capable of navigating back to a previously occupied location over large distances. This behavior has implications for spatial structure in adult halibut populations, potential vulnerability to local depletion, and effectiveness of protected areas for conservation of Pacific halibut spawning stock.

Insights into the Dynamics of Atlantic and Pacific Herring Following Population Collapse

John Trochta
University of Washington, johnt23@uw.edu
Trevor Branch
University of Washington, tbranch@uw.edu

Many of the world's stocks of Pacific (*Clupea pallasii*) and Atlantic (*Clupea harengus*) herring collapsed during the past half-century. Causes of collapse are often identified and include overfishing and/or changes in oceanographic conditions, yet post-collapse trajectories are difficult to predict even when fishing ceases. However, recovery of biomass after collapse is expected when a strong recruitment, or series of recruitments occur. The relative importance of post-collapse recruitment across herring populations is often assumed, and not well examined or quantified. We examine various collapse scenarios on 50 herring biomass time series (including 18 Alaskan stocks) and describe the following biomass levels and their duration following large declines in biomass. Respective recruitment trajectories are compared with post-collapse biomass and their effects evaluated using generalized linear mixed effects models (GLMM). Other environmental influences (e.g. SST and SSH anomalies) are also explored with GLMMs. Results show that the largest 3-year declines precede biomass levels that take 16 years on average to recover to pre-collapse levels, but less than 2 years to reach half those levels, suggesting an initial partial rebound. Exceptional herring collapses are marked by shifts to low mean biomass spanning longer time frames. For example, the collapse of Prince William Sound herring in 1993 marked a significant downward shift ($p<0.05$) to an ongoing mean biomass that is 0.16 of their pre-collapse levels. Few stocks experienced similar or worse shifts. Significant positive post-collapse cross correlations ($p<0.05$) between recruitment and biomass were shown from 16 of 33 recruitment time series. Since half the recruitment series may not directly impact post-collapse biomass, we used a logistic GLMM to model the probability of biomass recovery. As expected, preliminary results suggest higher relative recruitment increases the odds of recovery, with evidence for the influence of SSH anomalies as well. While important, strong recruitment does not necessarily effect a strong recovery. The physical environment may also have an important role, impacting other processes such as natural mortality and growth during post-collapse. An improved understanding of post-collapse dynamics for fish species characterized by high fluctuations helps to tailor management expectations for recovery.

Efficacy of Thermal Imaging for the Study of Seabirds

Annie Eckmann
Christopher Newport University, ann.eckmann.10@cnu.edu
Chenoa Payne
Christopher Newport University, chenoa.payne.13@cnu.edu
Tuula Hollmen
Alaska SeaLife Center, tuulah@alaskasealife.org
John M. Maniscalco
Alaska SeaLife Center, johnm@alaskasealife.org
Michael Meyer
Christopher Newport University, michael.meyer@cnu.edu
Richard Sherwin
Christopher Newport University, rsherwin@cnu.edu

During summer 2016, two types of infrared thermal cameras (radiometric and non-radiometric) and digital cameras were used in Kenai Fjords National Park to test applications of the technology on seabird monitoring. Thermal cameras measure the heat in the environment rather than the visible light and have many benefits in wildlife monitoring, although they have not yet been widely used to study seabirds. We used a radiometric thermal camera to gather thermal and visible images of seabirds on substrates and water throughout the sampling area. The visible images were used for reference during post processing. Concurrent and repeated use of both cameras at each colony and of assemblages of birds on water at different times of day allowed several applications to be tested. Data were gathered under a wide range of weather conditions, including various levels of cloud cover, precipitation, and ambient temperatures. Ambient temperature ranged from 8.9-26.0 °C throughout the season. Target species included black-legged kittiwakes (*Rissa tridactyla*), horned puffins (*Fratercula corniculata*), tufted puffins (*Fratercula cirrhata*), and common murres (*Uria aalge*). Birds were detected with repeatedly in situations where visible light was not suitable. Common murres and horned puffins were detected when they were in crevices and camouflaged by the substrate. Tufted puffins resting at the entrance of burrows were detected through vegetation. Kittiwakes were best detected on rock ledges on cooler, cloudy days when there was greater thermal contrast between individuals and the background; conditions where traditional sampling methods are difficult. Assemblages of birds on water were better observed on warm, clear days when there was a greater thermal contrast between individuals and water. In many cases, birds were not visible in visual images due to their cryptic coloration. We found that efficacy of thermal imaging varied based on the technology (radiometric vs. non-radiometric), weather conditions, and substrate. Understanding the limitations of each technology will best ensure collection of quality data across a wide range of environments.

Trained Steller Sea Lions in the Open Ocean: A Decade of Shedding Light on the Energetic Consequences of Foraging in the Wild

David Rosen
University of British Columbia, rosen@zoology.ubc.ca
Allyson Hindle
Johns Hopkins, allyson.hindle@gmail.com
Carling Gerlinsky
University of British Columbia, c.gerlinsky@oceans.ubc.ca
Elizabeth Goundie
University of British Columbia, e.goundie@oceans.ubc.ca
Gordon Hastie
University of St Andrews, gdh10@st-andrews.ac.uk
Beth Volpov
University of British Columbia, b.young@oceans.ubc.ca
Andrew Trites
University of British Columbia, a.trites@oceans.ubc.ca

Changes in prey availability have been hypothesized to be contributing to the decline of several populations of marine mammals and seabirds in the North Pacific and Bering Sea. Yet little is known regarding how individual animals alter their foraging patterns in response to such environmental changes, and what the energetic consequences of these responses might be. For the past decade, Steller sea lions were trained to swim and dive in the open ocean to investigate the interactions between diving behavior, energetic costs, physiological constraints, and prey availability. New techniques to quantify the energy expended by wild sea lions were also developed and tested. Collectively, these studies define how the type of diving (dive bouts or single dives), the level of underwater activity, the depth and duration of dives, and the nutritional status and physical condition of the animal affect the cost of diving and foraging. They have quantified how changes in prey abundance and nutritional state impact foraging efficiency by affecting diving costs and by altering how sea lions balance between time spent at the surface acquiring oxygen and time spent at depth acquiring prey. They have also shown that dive depth, dive and surface duration, and the type of dive result in physiological adjustments (heart rate, gas exchange) that may be independent of energy expenditure. These same physiological adjustments that permit sea lions to dive successfully may directly result in the inadequacy of certain research techniques (e.g., ODBA, heart rate) to estimate the energy expenditure of wild animals. Collectively, these new insights into the physiological basis of diving behavior further our understanding of the potential scope for behavioural responses of marine mammals to environmental changes. More specifically, these studies demonstrate how changes in prey distribution or abundance can be negatively affecting the foraging success and energetic status of individual Steller sea lions, ultimately impacting one of the top predators in the Alaska marine ecosystem.

Evaluating the Accuracy of Remote Sensing Imagery from Watercraft and Unmanned Aerial Vehicles (UAV's) to Quantify Iceberg Habitats Utilized by Pinnipeds in the Gulf of Alaska

Courtney Pegus
University of Alaska Fairbanks, ccpegus@alaska.edu
Shannon Atkinson
University of Alaska Fairbanks, shannon.atkinson@alaska.edu
Terry Quinn
University of Alaska Fairbanks, terry.quinn@alaska.edu
Sanjay Pyare
University of Alaska Southeast, spyare@uas.alaska.edu

Harbor seal populations (*Phoca vitulina*) have experienced significant declines over the past 50 years which is potentially related to climate-driven changes to tidewater glacial habitats. Calving tidewater glaciers release floating ice which provides important resting substrate for approximately 10-15% of harbor seals in Alaska. Ice platforms are primarily utilized by harbor seals for pupping in the summer months (May-July) and molting in the fall (August). However, little is known about the physical characteristics and other fine-scale features of icebergs that are selected by harbor seals. Tidewater glacial habitats in the Gulf of Alaska are remote, extremely dynamic, and costly to accurately survey using conventional fixed-winged aircraft methods. This study seeks to quantify physical characteristics of icebergs that are selected by free-ranging populations of pinnipeds in the North Pacific using remote sensing images captured from watercraft and unmanned aerial vehicles (UAV). The vertical heights of icebergs that calved from the Mendenhall glacier (Juneau, AK) were surveyed during the summer 2016 and remote sensing images taken from watercraft. Preliminary results indicate that remote sensing data of vertical heights were comparable to accurate survey measurements. The mean vertical heights of icebergs surveyed differed from mean vertical heights measured using remote sensing by only 25.5±17.71 mm with 1.25±0.23 m as the mean surveyed heights (n=17) and 1.36±0.70 m as the mean heights extracted using the remote sensing technique. To further develop our technique we will compare surveyed distances of horizontal profiles (i.e. width and length of iceberg) with remote sensing images captured by UAV's. The remote sensing technique will then be used to analyze ice platforms occupied by glacial seals in three tidewater glaciers in the Gulf of Alaska having relatively different population abundances (low, medium, high). Vertical and horizontal measurements will be taken of icebergs that are occupied by harbor seals and used to evaluate the range of gradients, shapes, distance from the terminus of the glacier, and total areas of platforms that are selected by these animals. This remote sensing technique will improve our abilities to track climate-driven changes and our understanding of Alaskan marine ecosystems.

Comparing Experiences with Bycatch across Fishermen Targeting Pacific Halibut (*Hippoglossus stenolepis*)

Elizabeth Figus
University of Alaska Fairbanks, ecfigus@alaska.edu
Keith Criddle
University of Alaska Fairbanks, kcriddle@alaska.edu

Accounting for catch and bycatch is crucial for management of fisheries. But catch accounting is challenging when catches are distributed across large numbers of small vessels, as they are in the fishery for Pacific halibut (*Hippoglossus stenolepis*) in Southeast Alaska. Southeast Alaskan waters provide habitat for a diverse array of species (e.g., rockfish, lingcod, sharks) commonly taken incidental to the catch of halibut. Scientists are anxious to obtain better estimates of discard mortality, in order to anticipate fishery induced shifts in the abundance of these stocks. Although the International Pacific Halibut Commission (IPHC) longline survey uses gear similar to that used in the commercial fishery, there is concern that patterns of bycatch observed in IPHC surveys may not be characteristic of patterns of bycatch discards in the commercial fishery across seasons and areas. Moreover, there is little information about how incidental catch affects commercial fishing practices, or how fishermen perceive spatial and seasonal variations in incidental catch. This project used directed interview methods to document fishermen-observed trends in bycatch incidence. Multivariate statistical techniques were used to measure concordance between the observations of fishermen and bycatch incidence observed in IPHC surveys. Findings contribute to the development of strategies to combine the local knowledge of fishermen with fisheries-independent data for improved fisheries management. Results shed light on the potential for increased monitoring to contribute meaningful catch accounting data for the management of the halibut fishery in Southeast Alaska.

Assessing the Resilience and Adaptive Capacity of the Community of Yakutat, Alaska through the Lens of Subsistence

Lauren Sill
Alaska Department of Fish & Game, lauren.sill@alaska.gov
Malla Kukkonen
Alaska Department of Fish & Game, malla.kukkonen@alaska.gov
Joshua Ream
U.S. Fish and Wildlife Service, joshua_ream@fws.gov

The goals of this project are to investigate questions of resilience, sustainability, and adaptability of Yakutat through the lens of subsistence. Yakutat is an ideal study community for this type of project due to its unique geographic location, history, and present circumstances. The community has undergone considerable demographic, economic, social, and environmental change over the past decades; understanding how and to what extent these changes have impacted overall community health and subsistence practices is important in providing indicators of sustainability and resilience of a small, remote coastal community

Working with the local governments and residents as researchers, we employed a combination of 5 research methods (1) a synthesis of pre-existing data and concurrent research, (2) household surveys, (3) key respondent interviews, (4) participant observation, and (5) mapping of harvest activities. This suite of methods allowed us to document the contemporary characteristics of the Yakutat social-ecological system, and collect local observations about its ability to adapt to ecological and social change through time as viewed through changes in subsistence activities, levels and composition of harvest, and the spatial extent of areas and time and money needed to harvest wild resources. Analysis of the collected data is ongoing, but preliminary results suggest that overall subsistence harvest levels have declined since 2000, due to factors such as changes in the local economy, access to resources, and competition. However, ninety-nine percent of households used a subsistence resource and 95% of households attempted to harvest in 2015. Sockeye salmon and moose are the predominant species harvested. The spatial extent of the harvest is the smallest that has been recorded over 4 comprehensive surveys dating back to 1984. Analysis of resilience and adaptation is in its early stages, but some key factors likely contributing to these characteristics in the community are economic, geographic, and regulatory. The baseline quantitative resource harvest data and the supportive qualitative data collected through this project will help address critical information gaps about changing patterns of resource harvest and trade and will provide information to the community to support resource management strategies and address potential future vulnerabilities, increasing capacity for long-term sustainability.

Gulf of Alaska - Ecosystem Perspectives

Twenty-Five Years after the *Exxon Valdez* Oil Spill: A Synthesis of Climatic, Anthropogenic, and Ecological Drivers of Gulf of Alaska Communities

Kristin Marshall
Cascade Ecology, kmarsh2@gmail.com
Anne Beaudreau
University of Alaska Fairbanks, abeaudreau@alaska.edu
Richard Brenner
Alaska Department of Fish & Game, richard.brenner@alaska.gov
Mary Hunsicker
NOAA Northwest Fisheries Science Center, mary.hunsicker@noaa.gov
Ole Shelton
NOAA Northwest Fisheries Science Center, ole.shelton@noaa.gov
Eric Ward
NOAA Northwest Fisheries Science Center, eric.ward@noaa.gov

Understanding how ecosystems respond to environmental variability and large perturbations is a central problem in marine ecosystems. The *Exxon Valdez* oil spill in 1989 was an extremely large perturbation to the Gulf of Alaska (GOA) ecosystem. However, because species and populations differ in the timing and magnitude of their responses to perturbations, the long-term effects of the oil spill may be difficult to detect in areas other than nearshore environments. Multiple scales of diversity in the ecosystem may also have protected its structure and functioning from long-term impacts. A collaborative effort among Gulf Watch Alaska, the Herring Research and Monitoring program and the National Center for Ecological Analysis and Synthesis brought together researchers for a working group to investigate the consequences of the oil spill over the past 25 years. We synthesized time-series from the GOA ecosystem and fisheries and used novel statistical methods to: 1) build an understanding of the temporal and spatial scales of variation in biomass, recruitment, and diversity for herring, salmon, and groundfish in the GOA, 2) investigate the roles of climate, ecological interactions, socioeconomic factors, and fishery management in explaining variation in ecosystem components, and 3) examine the role of diversity in stabilizing the temporal dynamics of plankton and focal fish species, and the catch portfolios of individual commercial fishermen in the GOA pre- and post-oil spill. Overall, we found that climate, economic, and management shifts had more discernable and long-term impacts on fish population and fishery dynamics than the oil spill. Our synthesis improves understanding of the role of multiple sources of variability in structuring GOA communities and advances methods in spatiotemporal modeling.

Nearshore Marine Consumer Responses to Changing Prey Conditions: Combining Quantitative and Qualitative Model Input into a Conceptual Framework

Lisa A. Sztukowski
Alaska SeaLife Center, lisas@alaskasealife.org
Daniel H. Monson
U.S. Geological Survey, Alaska Science Center, dmonson@usgs.gov
Daniel Esler
U.S. Geological Survey, Alaska Science Center, desler@usgs.gov
Suresh A. Sethi
Alaska Pacific University, sasethi@gmail.com
Heather A. Coletti
National Park Service, heather_coletti@nps.gov
Benjamin P. Weitzman
U.S. Geological Survey, Alaska Science Center, bweitzman@usgs.gov
Kimberly A. Kloecker
U.S. Geological Survey, Alaska Science Center, kKloecker@usgs.gov
Tuula E. Hollmen
University of Alaska Fairbanks, tuulah@alaskasealife.org

Changes in Gulf of Alaska nearshore marine ecosystems are anticipated across multiple spatial and temporal scales, driven by an array of natural and anthropogenic influences. Ecosystem management information requirements in this dynamic environment typically outstrip ecological understanding, presenting a need to prioritize information gaps given limited resources for supporting research. Conceptual ecological models have been used to support research and facilitate communication between researchers and managers by synthesizing information, providing working hypotheses, and identifying data gaps. Bayesian Belief Network modeling provides a framework to incorporate both qualitative expert-opinion-based inputs, and quantitative empirical information. Using this approach we examined responses of two key nearshore consumer species in the Gulf of Alaska, the northern sea otter (*Enhydra lutris*) and the Barrow's goldeneye (*Bucephala islandica*), to changes in benthic invertebrate prey fields. We explored demographic consequences of changes to prey availability in both generalized and site-specific models to represent the state of knowledge about predator-prey relationships in these species, identify data gaps, and demonstrate the value of conceptual modeling for research planning and prioritization. Model results indicated that reproductive success in sea otters (pup survival until weaning) and reproductive rates in Barrow's goldeneye (number of ducklings produced per female) were the most responsive demographic parameters to changes in nearshore marine prey availability. Refinement of demographic responses to changing prey would allow linkage to population matrix models that could predict predator population dynamics in the face of various forms of environmental change. These models provide tools to

address other related ecological questions, such as investigation of prey-switching, individual-level specialization, and opportunistic foraging on ephemeral prey. Understanding such predator-prey interactions are particularly relevant for management of habitats with varying degrees of prey diversity and abundance.

Energy-Based Ecosystem Modeling of Pacific Herring Trophodynamics

Szymon Surma
University of British Columbia, s.surma@oceans.ubc.ca
Tony Pitcher
University of British Columbia, pitcher.t@gmail.com

Pacific herring (*Clupea pallasii*) is a relatively large and long-lived forage fish inhabiting Alaskan waters from Dixon Entrance to the Chukchi Sea. Throughout its range, herring acts as a conduit for energy flowing from zooplankton to higher predators. These include protected seabirds and marine mammals as well as commercial fishes. Furthermore, the ecological importance of Pacific herring is likely to be substantially enhanced by its high average energy content. Among Alaskan forage fish, herring is only exceeded in this respect by eulachon (*Thaleichthys pacificus*). For this reason, existing ecosystem models of Alaskan waters may need to be reformulated in terms of energy to fully represent the trophic role of Pacific herring. In view of the recent poor status of many Gulf of Alaska herring stocks, humpback whale recovery and calls for ecosystem-based forage fish management, there is a clear need to reexamine the importance of this large, energy-rich forage fish in Alaskan food webs.

We converted an existing mass-balanced Ecopath food web model (the study area included parts of Southeast Alaska and northern British Columbia) to an energy-balanced model using published energy content values for each functional group. Where possible, these values were derived from biological samples taken in Alaskan waters. Bringing the model into energy balance required a substantial increase in the slope of the biomass spectrum relative to that seen in the original mass-balance model. This may reflect underestimates in the published energy content and/or biomass values of several mid- and low-trophic-level functional groups. The new energy-balanced model suggests that the importance of Pacific herring as prey to several groups of predators, particularly some marine mammals and birds, may be underestimated by biomass-based diet composition figures. We also reassessed the trophic effects of depleted whale population recovery using Ecosim runs based on the new energy-balanced model. The results indicate that the effects of increased whale predation on herring stocks may also be substantially stronger than suggested by published mass-balanced model outputs. This study shows the potential for improved analysis of Alaskan forage fish trophodynamics using ecosystem modeling enriched by consideration of energy content differences between prey groups.

Mearns Rock: Twenty-six Years and Twenty-six Photos that Put a Human Dimension on Understanding Long-term Biological Variability

Alan Mearns
NOAA Office of Response & Restoration, alan.mearns@noaa.gov

With the help of local scientists and citizen volunteers, a remote sheltered rocky shoreline segment in western Prince William Sound has been photographed at low tide every summer for 26 years yielding a human-scale view of dramatic year-to-year changes in the abundance of mussels, seaweeds and other intertidal marine life. In the years following oiling in 1989, seaweeds and mussels flourished, but a few years later the oil was gone and the scene was barren of life: a few years after that, life again flourished. then once again the thick cover nearly disappeared. Indeed, the cover of marine life on “the Rock” has undergone four major episodes of “boom and bust” during the past quarter century, testifying to the huge variability that would otherwise not be noticed by people other than scientists with our time series data and graphics buried in reports. I will present the inspiration for the continued photo-monitoring, the contributions by volunteers, the photos and associated graphics, and especially examples of how the photo-series has been used in web-sites, films and books to inspire students, educators, staff and managers to learn more about variability of marine life, how difficult it is to determine when an injured resource has “recovered” and how simple annually-repeated landscape-scale photography might provide insight into the effects of climate change. It is important to view these photos on a large screen in plenary.

An accompanying multi-authored poster will offer details about the photo monitoring at this and eight other sites in the Sound.

Gulf Watch Alaska: Results from Five Years of Ecosystem Monitoring in the Northern Gulf of Alaska

Mandy Lindeberg
NOAA Alaska Fisheries Science Center, mandy.lindeberg@noaa.gov
Kris Holderied
NOAA National Ocean Service, kris.holderied@noaa.gov
Donna Aderhold
NOAA National Ocean Service, donna.aderhold@noaa.gov
Katrina Hoffman
Prince William Sound Science Center, khoffman@pwssc.org
Mayumi Arimitsu
U.S. Geological Survey, Alaska Science Center, marimitsu@usgs.gov
Brenda Ballachey
U.S. Geological Survey, Alaska Science Center, beballachey@gmail.com
Heather Coletti
U.S. Geological Survey, Alaska Science Center, heather_coletti@nps.gov
Seth Danielson
University of Alaska Fairbanks, sldanielson@alaska.edu
Dan Esler
U.S. Geological Survey, Alaska Science Center, desler@usgs.gov
Russ Hopcroft
University of Alaska Fairbanks, rrhopcroft@alaska.edu

Gulf Watch Alaska (GWA) is a long-term ecosystem monitoring program in the northern Gulf of Alaska from Prince William Sound, Kenai Peninsula, Cook Inlet and northern Shelikof Strait, funded by the *Exxon Valdez* Oil Spill Trustee Council. This multidisciplinary program includes monitoring of: oceanographic conditions and lower trophic levels; forage fish, sea birds, and marine mammals; nearshore communities; and lingering oil. GWA is focused on understanding variability and long-term trends in species injured by the 1989 *Exxon Valdez* oil spill, including how temporal and spatial variations in marine conditions and food webs affect those species. This integrated program started in 2012, but builds on multi-decadal studies funded by the Trustee Council and has facilitated access to historical and ongoing monitoring data through a public data portal (www.gulfwatchalaska.org). During the first 5 years of GWA, we documented shifts in oceanographic conditions in late 2013/early 2014 from cool to anomalously warm water temperatures, resulting in region-wide changes in water column stratification, nutrient availability, and plankton species timing and abundance. We also observed changes in higher trophic level pelagic species, from forage fish to marine birds and mammals, as well changes in nearshore communities. Some changes in nearshore species exhibited synchronicity with region-wide changes in oceanographic drivers, while other species did not, indicating that both local and remote forces can be important in these coastal ecosystems. Lingering *Exxon Valdez* oil persists at a small

number of intertidal beaches, however, direct effects on monitored marine species (including sea otters and harlequin ducks) have largely declined to background levels. By concurrently monitoring environmental drivers, pelagic and nearshore ecosystems, the GWA program provides critical information on key species populations affected by the oil spill and a greater understanding of the processes shaping their long-term fate. This rich knowledge base will become increasingly valuable as the Gulf of Alaska experiences changes in climate and as the GWA program launches into the next 5-year increment of monitoring.

Plenary Sessions - Wednesday January 25

Plenary Sessions: Wednesday, January 25 -- Bering Sea and Aleutian Islands

TIME	TITLE	PRESENTER	SECTION
8:00 - 8:15 AM	Cross-isobath Exchange in Bering Canyon	Carol Ladd	Climate and Oceanography
8:15 - 8:30 AM	Will Stanzas Dominate the Oceanography of the Bering Sea Shelf, Including the North?	Phyllis Stabeno	Climate and Oceanography
8:30 - 8:45 AM	Eddy-induced Transport Across the Bering Slope in the Bering Sea	Yongchui Zhang	Climate and Oceanography
8:45 - 9:00 AM	Statistical Downscaling of Global Projections to the Bering Sea, Based on an Ensemble of Regional Model Output	Al Hermann	Climate and Oceanography
9:00 - 9:15 AM	Time-series of Direct Primary Production Observations on the Bering Sea Shelf	Michael Lomas	Lower Trophic Levels
9:15 - 9:30 AM	Copepods Differ in Phenology, Size Distribution and Estimated Production Rates Across Warm and Cold Periods in the Eastern Bering Sea	David Kimmel	Lower Trophic Levels
9:30 - 10:00 AM	**BREAK**		
10:00 - 10:15 AM	Coccolithophores in the Bering Sea	Lisa Eisner	Lower Trophic Levels
10:15 - 10:30 AM	Spatiotemporal Variability of Nitrogen Deficits on the Eastern Bering Sea Shelf	Calvin Mordy	Lower Trophic Levels
10:30 - 10:45 AM	Detecting Fish Distribution - a Complex Task for Walleye Pollock and Other Semipelagic Species	Stan Kotwicki	Fishes and Fish Habitats
10:45 - 11:00 AM	Preliminary Assessment of the Use of Satellite-reporting Accelerometer Tags to Monitor Survival of Trawler Deck-released Halibut	Craig Rose	Fishes and Fish Habitats
11:00 - 11:15 AM	Characterizing the Diet of Arctic Lamprey *Lethenteron camtschaticum* Using Molecular Gene-based Techniques	Katie Shink*	Fishes and Fish Habitats
11:15 - 11:30 AM	Adapting a Fishing Impacts Model to Simulate Fishing Gear Modifications	Aileen Nimick*	Fishes and Fish Habitats
11:30 - 1:00 PM	**LUNCH BREAK ON YOUR OWN**		

* Masters; ** Doctorate

Plenary Sessions: Wednesday, January 25 -- Bering Sea and Aleutian Islands

TIME	TITLE	PRESENTER	SECTION
1:00 - 1:15 PM	The Importance of Marine Resources for Threatened Spectacled Eiders Breeding in Alaska	Shiway Wang	Seabirds
1:15 - 1:30 PM	40 Years of Change in the SE Bering Sea: Climate, Prey, Seabirds, and Long-term Trends	Martin Renner	Seabirds
1:30 - 1:45 PM	Historical Ecophysiology Reveals the Timing of Food Shortages Experienced by Red-legged Kittiwakes	Alexis Will**	Seabirds
1:45 - 2:00 PM	Old Ovaries, New Tricks: What Walrus Ovaries Can Tell Us About Population Fluctuations	Jenell Larson*	Marine Mammals
2:00 - 2:15 PM	Bone Steroid Hormone Concentrations Reveal Pacific Walrus Physiology from the Past 3450 Years	Patrick Charapata	Marine Mammals
2:15 - 2:30 PM	Looking Back to the 19th Century to Move Northern Fur Seals Forward into an Ecosystem Based Fisheries Management Plan	Jeremy Sterling	Marine Mammals
2:30 - 3:00 PM	BREAK		
3:00 - 3:15 PM	Adaptation to Environmental Change in Three Aleutian Island Communities	Jennifer Schmidt	Human Dimensions
3:15 - 3:30 PM	Visualizing Impacts of Projected Changes in Marine Vessel Traffic Using Spatially and Seasonally Explicit Simulation Models	Tahzay Jones	Human Dimensions
3:30 - 3:45 PM	Are Some Vessels Within a Fleet More Resilient to Climate Variability Than Others? A Case Study from the Bering Sea Pollock Fishery	Jordan Watson**	Human Dimensions
3:45 - 4:00 PM	Alaskan decision makers speak up on coastal resilience and adaptation: 'click here' to help connect the AMSS community with their science needs	Aaron Poe	Ecosystem Perspectives
4:00 - 4:15 PM	Assessing the Risk of Marine Invasive Species in the Bering Sea	Jesika Reimer	Ecosystem Perspectives
4:15 - 4:30 PM	The Bering Sea Warm Stanza Continues: Ecosystem Effects and Potential Outcomes	Elizabeth Siddon	Ecosystem Perspectives
4:30 - 4:45 PM	The "Warm Blob" and a Cold Sea: Large-scale Trophic Perturbations in the Aleutian Islands	Douglas Causey	Ecosystem Perspectives
4:45 - 5:00 PM	**Best Student Poster Presentation Winners Announced**		

* Masters; ** Doctorate

Plenary Session Abstracts

Wednesday, January 25

Cross-isobath Exchange in Bering Canyon

Carol Ladd
NOAA Pacific Marine Environmental Laboratory, carol.ladd@noaa.gov
Wei Cheng
University of Washigton, Wei.Cheng@noaa.gov
Janet Duffy-Anderson
NOAA Alaska Fisheries Science Center, janet.duffy-anderson@noaa.gov
Colleen Harpold
NOAA Alaska Fisheries Science Center, Colleen.Harpold@noaa.gov
Kim Martini
University of Washigton, dr.kim.martini@gmail.com
Calvin Mordy
University of Washigton, Calvin.W.Mordy@noaa.gov
Phyllis Stabeno
NOAA Pacific Marine Environmental Laboratory, Phyllis.Stabeno@noaa.gov

Shelf-basin exchange is widely recognized as having an important influence on the ecosystem of the eastern Bering Sea. Transport of nutrient-rich oceanic water across the shelf-break fuels primary productivity over the shelf. Transport of basin-origin zooplankton taxa is critical to the zooplankton prey base structure over the continental shelf, and the vulnerable young of several commercially important fish species require transport from spawning grounds over the slope to nursery habitats over the shelf for successful growth and survival. However, shelf-basin exchange in the Bering Sea is highly heterogeneous, with enhanced cross-shelf transport associated with submarine canyons. We combine *in situ* physical oceanography measurements and numerical simulations to examine shelf-basin exchange over Bering Canyon, the southernmost canyon along the eastern Bering Sea shelf-break, and examine results in conjunction with observations of zooplankton and ichthyoplankton community structure and transport. Both observations and modeling results suggest a disconnect between flow in the Aleutian North Slope Current west of ~168°W and flow in Bering Canyon and on the shelf. In addition, more on-shelf flux of dense basin water occurs during summer/fall than during winter/spring with implications for the flux of nutrients and biota onto the shelf. Most of the ichthyoplankton collected with a depth-discrete multi-net were collected in the upper 50 m of the water column and on the south side of Bering Canyon (near the Aleutians), potentially reflecting transport pathways. Rockfish were particularly abundant in 2015 samples reflecting the warm conditions of that year. Our goal is to identify key processes that control cross-isobath flow, nutrient flux and larval transport, and how these processes vary episodically and seasonally.

Will Stanzas Dominate the Oceanography of the Bering Sea Shelf, Including the North?

Phyllis Stabeno
NOAA Pacific Marine Environmental Laboratory, phyllis.stabeno@noaa.gov
Janet Duffy-Anderson
NOAA Alaska Fisheries Science Center, janet.duffy-anderson@noaa.gov
Al Hermann
University of Washigton, Albert.j.hermann@noaa.gov
Calvin Mordy
University of Washigton, calvin.w.mordy@noaa.gov
Elizabeth Siddon
NOAA Alaska Fisheries Science Center, elizabeth.siddon@noaa.gov

The Bering Sea oceanographic conditions vary and in recent years have been either warm or cold with few intermediate years. Multi-year runs (or stanzas) amplify the response of the ecosystem to physics. In 2014 the southeastern Bering Sea entered a second warm stanza, which persisted in 2015 and 2016. The downscaling regional forecast, using a 10km-resolution model driven by global output from NOAA's Climate Forecast System, predicts continued warm conditions in the southeastern Bering Sea, with temperatures similar to those in 2015 and 2016. This second warm stanza has the warmest integrated temperatures in the 22-year time series at the biophysical mooring “M2” (56.9°N, 164.1°W). In fact, minimum depth-integrated winter temperatures in 2015 and 2016 were warmer than maximum summer temperatures in several preceding years. Before 2000 the southern Bering Sea shelf was dominated by year-to-year variability. This pattern was followed by three multi-year stanzas: warm (2001-2005); cold (2007-2013); and warm (2014 -2017 [predicted]). The occurrence of a second warm stanza supports the conclusion that the southeastern Bering Sea has undergone a shift from year-to-year variability to multi-year stanzas. Warm and cold years have always been defined on the southern shelf and have a close relationship to the ice extent in March and April. We now have long enough time series on the northern shelf to examine the patterns and forcing mechanisms there. On the northern shelf, the 13-year time series at M8 (62.2°N, 174.7°W) shows a much more subtle pattern of warm and cold. While ice on the southern shelf sets up temperature conditions for following spring-fall, on the northern shelf ice plays less of a role in determining warm conditions. In fact, the timing of ice retreat at M8 influences surface temperatures, but that influence is limited to the spring and early summer. In contrast to the southern Bering Sea, advection is an important contributing factor for determining ocean bottom temperature in the late summer and fall. Warm or cold conditions have fundamental influence on the ecosystem, including commercial and subsistence harvest, and understanding how these patterns change is critical.

Bering Sea - Climate and Oceanography

Eddy-Induced Transport Across the Bering Slope in the Bering Sea

Changming Dong
University of California, Los Angeles, cmdong@gmail.com
Yongchui Zhang
University of California, Los Angeles, yczhang@atmos.ucla.edu
Yi Chao
University of California, Los Angeles, ychao001@gmail.com

Bering Sea is located between Aleutian Low and Siberia High and its special topography enriches strong eddy activities along the Bering Slope. The eddy-induced transport across the Bering Slope significantly impacts the variability of heat flux and sea ice. In this paper, Regional Oceanic Model System (ROMS) coupled with a sea ice module is employed to study the seasonal and interannual eddy-induced transport across the Bering Slope. The model domain covers the whole Bering Seanad, part of the Chukchi Sea and south of Aleutian Islands with an averaged spatial resolution of 5km. The external forcing are momentum, heat, and freshwater flux at the surface and adaptive nudging to gyre-scale SODA reanalysis fields at the boundaries. The 15-year simulation is analyzed and assessed against observational data. The model well reproduces the seasonal and interannual variation in the coverage of sea ice compared with the satellite-observed sea ice data. Sea surface temperature (SST) patterns from the ROMS agrees well with AVHRR data. The mechanism for seasonal and interannual variation in the Bering Sea is connected to Siberia-Aleutian index. The ROMS simulates a well-developed eddy street along the Bering Slope, which is advected westward by the Bering Slope Current along the slope. However, the eddy kinetic energy simulated by ROMS is stronger than the AVISO altimetry-measured SSHA data. The discrepancy can be explained due to the difference in the resolution. The result shows that eddy-induced transport significantly modules the seasonal and interannual variability of the SST and sea ice. Moreover, the model also simulates polynia generation and evolution around St. Lawrence Island.

Statistical Downscaling of Global Projections to the Bering Sea, Based on an Ensemble of Regional Model Output

Albert Hermann
University of Washington, albert.j.hermann@noaa.gov
Wei Cheng
University of Washington, wei.cheng@noaa.gov

We compute the covariance between 1) the large-scale forcing patterns from IPCC global model projections and 2) regional indices generated by a 10-km resolution model of the Bering Sea (Bering10K), driven by nine separate realizations of that large-scale forcing. This analysis – a model-based form of statistical downscaling – proceeds using both simple regression and multivariate EOF analysis of the output from global and regional models. Such EOF-based methods– sometimes referred to as “regression on the pattern level” – have in fact been widely used in both global and regional climate prediction. Ideally this would enable the direct use of forecast realizations of the IPCC climate models to effectively predict the Bering Sea indices, without the need to rerun simulations with Bering10K for each global realization. At a minimum, this method provides an economical way to estimate forecast uncertainty and other statistics of the regional indices, given the large number of global realizations which have emerged (and will continue to do so) under IPCC Assessments Reports.

Time-series of Direct Primary Production Observations on the Bering Sea Shelf

Michael Lomas
Bigelow Laboratory for Ocean Sciences, mlomas@bigelow.org
Lisa Eisner
NOAA Alaska Fisheries Science Center, lisa.eisner@noaa.gov
Jeanette Gann
NOAA Alaska Fisheries Science Center, jeanette.gann@noaa.gov
Steven Baer
Bigelow Laboratory for Ocean Sciences, sbaer@bigelow.org
Calvin Mordy
Joint Institute for the Study of the Atmosphere and Ocean, calvin.w.mordy@noaa.gov
Phyllis Stabeno
NOAA Pacific Marine Environmental Laboratory, phyllis.stabeno@noaa.gov

The eastern Bering Sea shelf is a highly productive ecosystem, supported by high rates of primary production occurring in short intense bursts, mostly associated with the spring bloom. Recently however, the importance of fall productivity has been highlighted as necessary to provide juvenile fish the energy reserves needed to survive the winter period. Based upon several different primary productivity models, recent studies have concluded that annual primary productivity will increase 0-40% with warming of the Bering Sea, however this remains to be validated by direct observation. Here we present a time-series of field measurements of primary production from 2006 to 2016. Cruises were conducted in the spring and the fall across the Bering Sea shelf, focused largely on the 70m isobath. The data suggest that rates of primary productivity have increased significantly (t-test, $p<0.05$) over the past ten years, as surface water temperatures have increased and the volume of the spring/summer cold pool ($<2^{o}$C) has decreased. The increase in primary productivity varies with region, but is consistent with a predicted increase of up to 40%. Further analysis of the underlying seasonal nutrient field, specifically the nutrient-based net community production, will tell us if the increased primary productivity will likely translate (or not) to a greater flow of carbon to higher trophic levels.

Copepods Differ in Phenology, Size Distribution and Estimated Production Rates Across Warm and Cold Periods in the Eastern Bering Sea

David Kimmel
NOAA Alaska Fisheries Science Center, david.kimmel@noaa.gov
Janet Duffy-Anderson
NOAA Alaska Fisheries Science Center, janet.duffy-anderson@noaa.gov

We hypothesized that differences in temperature would impact timing of peak life history stage abundance (phenology), size distribution, and estimated production of copepods. To test this, we compared archived data on selected copepod species across 3 months (May, July, September) in the eastern Bering Sea, during a period of warmer water temperatures (2001-2005) and a period of colder water temperatures (2007-2011). For most copepod species, warmer conditions resulted in an acceleration of development resulting in later life history stages earlier in the year; the opposite trend was observed in colder conditions. Abundances of smaller bodied copepods did not differ significantly between the warm and cold periods whereas abundances of larger bodied copepods increased during the cold period. Production during the warm period was highest earlier in the year and higher for smaller bodied copepods whereas production in cold period was dominated by larger sized copepods. The results suggest that production among smaller-bodied copepods during warm periods peaks earlier in the year providing adequate forage for early stage larval fish. In contrast, colder years have reduced production among smaller sized copepods in the early year, but significant production among larger bodied copepods during summer and fall providing a key prey base for forage fish species and juvenile groundfish. The results also show how food webs may affect recruitment dynamics due to changes in the prey size spectrum and the timing of productivity.

Coccolithophores in the Bering Sea

Lisa Eisner
NOAA Alaska Fisheries Science Center, lisa.eisner@noaa.gov
Carol Ladd
NOAA Pacific Marine Environmental Laboratory, carol.ladd@noaa.gov
Sigrid Salo
NOAA Pacific Marine Environmental Laboratory, sigrid.a.salo@noaa.gov

Blooms of coccolithophores, a small unicellular phytoplankton with calcite plates (liths) that give the water a milky aquamarine appearance, are easily observed by satellite ocean color instruments due to their high reflectivity. Blooms may be detrimental to the Bering Sea ecosystem by lengthening trophic webs and hindering feeding by visual predators (e.g. seabird die offs have been associated with blooms). To evaluate years with higher coccolithophore abundances, indices were developed by counting the number of satellite ocean color pixels associated with coccolithophores for August – September, 1998-2016. Two indices were calculated, one for the middle shelf (50 – 100 m depth) and one for the inner shelf (0 – 50 m depth), since blooms are often largely confined to these areas. Initial results south of 60°N indicate coccolithophore abundance was particularly high during the early part of the record (1998 – 2000). In 2001, the index dropped below 10% and remained low until 2006. A higher index (> 10%) was observed in 2007, 2009, 2011, and 2014 for the middle shelf and in 2011 and 2014 for the inner shelf. Preliminary data suggest that 2016 will be another high index year for the middle shelf. Indices will be compared with in situ observations of chlorophyll a, nutrients and hydrography to characterize conditions that may promote bloom formation on the Bering Sea shelf.

Spatiotemporal Variability of Nitrogen Deficits on the Eastern Bering Sea Shelf

Calvin Mordy
University of Washigton, mordy@uw.edu
Lisa Eisner
NOAA Alaska Fisheries Science Center, lisa.eisner@noaa.gov
Albert Hermann
University of Washigton, albert.j.hermann@noaa.gov
David Kimmel
NOAA Alaska Fisheries Science Center, david.kimmel@noaa.gov
Carol Ladd
NOAA Pacific Marine Environmental Laboratory, carol.ladd@noaa.gov
Michael Lomas
Bigelow Laboratory for Ocean Sciences, mlomas@bigelow.org
Kathy Mier
NOAA Alaska Fisheries Science Center, kathy.mier@noaa.gov
Peter Proctor
University of Washigton, peter.proctor@noaa.gov
Raymond Sambrotto
Columbia University, sambrott@ldeo.columbia.edu
Phyllis Stabeno
NOAA Pacific Marine Environmental Laboratory, phyllis.stabeno@noaa.gov
Eric Wisegarver
NOAA Pacific Marine Environmental Laboratory, eric.wisegarver@noaa.gov

In the Bering Sea, 6.5 – 7.5 Tg yr^{-1} of fixed nitrogen is lost as nitrogen gas (N_2) through sedimentary processes, an amount equivalent to ~16% of total N uptake by phytoplankton [Horak et al., DSR II, 2013]. The majority of nitrogen loss (75 – 80%) occurs on the expansive eastern shelf of the Bering Sea. These results were based upon direct measurements of the N_2 flux in sediment cores, but are too sparse to broadly examine spatiotemporal variability of nitrogen loss over the shelf. The loss of fixed-nitrogen can be estimated from deviations in nutrient ratios in the water column, specifically the N residual or N deficit from a regional N – P relationship. Spatiotemporal variability of this deficit may result from numerous factors including unmeasured pools of P and N (e.g. DON, DOP) that may be erroneously ascribed as “missing nitrogen,” cross-shelf exchange between slope waters and the shelf, bottom temperatures which may partially control benthic microbial processes, residence time on the shelf during which the nitrogen deficit may accumulate, export of organic matter and its composition, and forcing factors that may be related to production and export including wind mixing and ice coverage.

In this study, nutrient data from 42 hydrographic cruises spanning 2003 – 2015 were used to examine the spatiotemporal variability of the nitrogen deficit on the Bering Sea shelf. This deficit was greater on the middle shelf than over the slope, and the largest deficits (> 10 μM) were concentrated on the northern middle shelf. Significant interannual variability was observed at four locations along the middle shelf. Multiple regression was used to determine what parameters have the most influence on the nitrogen deficit including ice cover, bottom temperature, winter replenishment of slope water, chlorophyll concentration, wind mixing, and zooplankton abundance. On the southeastern shelf, winter replenishment and bottom temperatures had little influence these deficits while chlorophyll concentrations and wind mixing had significant influence. Temporal variability was correlated over the entire middle shelf. These results have implications on nutrient availability and the fate of primary and secondary production on the middle shelf.

Detecting Fish Distribution - A Complex Task for Walleye Pollock and Other Semipelagic Species

Stan Kotwicki
NOAA Alaska Fisheries Science Center, stan.kotwicki@noaa.gov
Patrick Ressler
NOAA Alaska Fisheries Science Center, Patrick.Ressler@noaa.gov
James Ianelli
NOAA Alaska Fisheries Science Center, Jim.Ianelli@noaa.gov
Andre Punt
University of Washigton, aepunt@uw.edu
John Horne
University of Washigton, John.Horne@noaa.gov

Spatial distributions of fish populations are best estimated using data from fishery-independent surveys. To assure complete sampling of midwater and demersal components of so-called semipelagic species (which inhabit both water column and seafloor habitats), it is necessary to perform both acoustic-trawl (AT) and bottom-trawl (BT) surveys. Semipelagic walleye pollock (*Gadus chalcogrammus*) in the Eastern Bering Sea (EBS) have been surveyed in summertime by AT and BT surveys for over 30 years. In stock assessments, studies of spatial ecology, and ecological models, these survey estimates have usually been treated as separate indices, or data from only one of the surveys has been used, which could cause bias and additional uncertainty. Here we developed a method in which AT and BT survey data are combined to estimate pollock abundance throughout the whole water column at survey spatial resolution. Whole water column abundance is estimated using “bias ratio” (i.e. proportional relation between biases associated with each survey method) and the vertical overlap between AT and BT survey data as a function of environmental conditions. Uncertainty for the combined estimates accounts for both the uncertainty in each individual survey’s estimate, as well as the uncertainty arising from the process of estimating bias ratio and overlap to produce combined estimate. Using simulations, we show that combined estimates are likely to provide more reliable whole water column estimates and maps of pollock spatial distribution than either survey can by itself. Use of these combined survey estimates could improve studies of spatial ecology and ecological modeling as well as future projections of fish distribution. Finally, our method of combining AT and BT data can in principle be easily extended to other semipelagic species in Alaska and around the world.

Preliminary Assessment of the Use of Satellite-Reporting Accelerometer Tags to Monitor Survival of Trawler Deck-Released Halibut

Craig Rose
FishNext Research LLC, fishnextresearch@gmail.com
Julie Nielsen
Kingfisher Marine Research, julie.nielsen@gmail.com
Timothy Loher
International Pacific Halibut Commission, tim@iphc.int
Suresh Sethi
Alaska Pacific University, sasethi@gmail.com
Andrew Seitz
University of Alaska Fairbanks, acseitz@alaska.edu
John Gauvin
Alaska Seafood Cooperative, gauvin@seanet.com
Paige Drobny
Spearfish Research, paige@spearfishresearch.com
Michael Courtney
University of Alaska Fairbanks, mbcourtney@alaska.edu

Under existing catch handling regulations for Bering Sea trawl fisheries, trawl-caught halibut cannot be released prior to observer sampling in vessels' fish processing factories. The resulting delayed release produces high halibut discard mortality rates. In response, trawlers are working with NMFS to develop methods to quickly sort and release halibut from catches on deck, while accounting for their numbers, size, and viability. To evaluate expedited release efforts, information on the survival of released halibut is needed. Satellite tags have been used to monitor survival of fish that swim continuously (sharks, tuna), where swimming cessation indicates fish death. Because halibut periodically remain motionless for extended periods, using (in)activity signatures to detect death is a considerable challenge. We worked with Wildlife Computers to develop particular activity recording metrics for the Halibut-sPAT tag. These tags reported summarized accelerometer data to monitor halibut survival by tracking fish activity behaviors. Trawl bycaught halibut are smaller than halibut previously studied with satellite tags, raising concerns that tags could affect halibut performance and survival.

In the summer of 2016, one hundred and sixty halibut were tagged with Halibut-sPAT tags during deck release from three trawlers targeting flatfish in the Bering Sea. Tags reported two-hour summary values of the number of rapid increases in tag tilt (swim starts) and the percentage of time tags tilted beyond a pre-specified threshold (swimming %) while attached for up to 60 days. Ten longline-caught halibut selected to be in excellent condition were tagged to characterize 'natural' fish activity. We also tagged 6 seafloor anchors and 4 halibut carcasses, providing sedentary or carcass-based

tag metrics. Data patterns from these reference tag sets provided context for survival interpretation of tag data from trawl releases. Challenges in distinguishing survival/death from other outcomes (e.g., tag loss) are discussed and indicated survival outcomes are compared to viability-assessments, fish size, capture and handling metrics (e.g., catch size, time-on-deck), and variability between vessels and fishery targets. Preliminary results from 2016 deployments indicate that satellite-tagging with accelerometer data can be a viable method to evaluate release survival for an important flatfish species with frequently sedentary behavior.

Characterizing the Diet of Arctic Lamprey *Lethenteron camtschaticum* Using Molecular Gene-Based Techniques

Katie Shink
University of Alaska Fairbanks, kshink@alaska.edu
Andres Lopez
University of Alaska Fairbanks, jalopez2@alaska.edu
Trent Sutton
University of Alaska Fairbanks, tmsutton@alaska.edu
James Murphy
NOAA Alaska Fisheries Science Center, jim.murphy@noaa.gov

Documenting predator/prey interactions is essential to help build our understanding and guide our management of marine ecosystems. The overarching goal of this study is to improve our understanding of the Bering Sea ecosystem by assessing the role of Arctic lamprey *Lethenteron camtschaticum* as predators. To accomplish this goal, evaluations have been initiated to (1) characterize the diet of marine-phase Arctic lamprey; and (2) assess if predation varies with body size or location. Adult, marine-phase Arctic and incidentally caught Pacific lampreys were collected in 2014 (n = 128) and 2015 (n = 129) during the Northeast Bering Sea Trawl Survey (NOAA). A visual examination of gut contents revealed the presence of: scales, otoliths, eggs, vertebrate, fin rays, and pyloric caeca, suggesting a predatory feeding approach. The remaining gut contents were homogenized and total genomic DNA was extracted. The 12s ribosomal DNA sub-unit was targeted during PCR amplification. Pooled PCR products were used to prepare next generation sequencing libraries for the Illumina MiSeq platform. The preliminary run yielded 2.7 million reads. The raw reads were processed through a bioinformatics pipeline to form a final sequence library, which was compared to the NCBI public sequence database using the Basic Local Alignment Search Tool (BLAST). Preliminary results identified salmon *Oncorhynchus* spp., cod *Gadus* spp., Pacific sand lance *Ammodytes hexapterus*, Pacific herring *Clupea pallasii*, capelin *Mallotus villosus*, rainbow smelt *Osmerus mordax*, and yellowfin sole *Limanda aspera* as prey species. The results from this research will inform researchers and management agencies about the ecosystem roles and interactions between Arctic lamprey and prey species.

Adapting a Fishing Impacts Model to Simulate Fishing Gear Modifications

Aileen M. Nimick
Alaska Pacific University, animick@alaskapacific.edu
Bradley P. Harris
Alaska Pacific University, bharris@alaskapacific.edu
Craig S. Rose
FishNext Research, fishnextresearch@gmail.com
T. Scott Smeltz
Alaska Pacific University, tsmeltz@alaskapacific.edu

The Magnuson-Stevens Fisheries Conservation and Management Act mandates that fisheries management councils minimize adverse fishing effects to essential fish habitat. The National Research Council has identified three fishing effect mitigation tools – harvest reduction, habitat closures, and gear modifications. The New England and the North Pacific councils have created mathematical models that estimate fishing impacts to the seabed to support the determination of whether the impacts are considered adverse, the other fisheries councils use qualitative approaches. Ideally fishing effects models should be able to assess the relative efficacy of these three management tools. The New England and the North Pacific models can examine impacts associated with changes in harvest levels and the use of area closures; because they assess habitat impacts in a two-dimensional (width X distance) framework they are limited in their ability to incorporate information about gear modifications. We created a generic three-dimensional component-specific feature susceptibility model, adapted from the North Pacific council's Fishing Effects Model. We modified the model framework to include component-specific fishing gear information in three dimensions, and the habitat feature susceptibility groups to account for feature height. In this way we are able to calculate *volume* impacted by fishing gear, rather than *area* swept and account for gear – habitat feature interactions which occur above the seabed. This analysis presents the preliminary results from a case study examining the relative effects of the adoption of elevated sweeps in the Bering Sea Flatfish Fishery.

The Importance of Marine Resources for Threatened Spectacled Eiders Breeding in Alaska

Shiway Wang
Sedna Ecological, Inc., shiway@gmail.com
Tuula Hollmen
University of Alaska Fairbanks, tuula_hollmen@alaskasealife.org
Margaret Petersen
U.S. Geological Survey, Alaska Science Center, mrpetersen@usgs.gov
Matthew Sexson
U.S. Geological Survey, Alaska Science Center, mgsexson@usgs.gov
Suzanne Budge
Dalhousie University, suzanne.budge@dal.ca
Sara Iverson
Dalhousie University, sara.iverson@dal.ca

Spectacled eiders winter and stage in marine habitats, and their breeding outcome likely depends on the availability of adequate prey resources. However, information about timing and sources of critical nutrient acquisition to reproduction is lacking for this threatened eider species. We used quantitative fatty acid signature analysis (QFASA) to estimate the diets of spectacled eiders breeding on the Yukon Delta, Alaska in 2008, and on the Arctic Coastal Plain, Alaska in 2009 and 2010. As expected, diet upon arrival to breeding grounds and through the early breeding season comprised of marine food items consistent with prey found at their wintering area in the Bering Sea (amphipods, Macoma spp., Nereis. spp., Nuculana belloti and N. radiata). The proportions of these diet items varied between years, which likely reflected the interannual variability in the availability of these marine food items. As the breeding season progressed (3-4 weeks later) marine fatty acids from the wintering grounds continued to dominate in adult eider adipose tissue (89%-92%) along with smaller proportions of freshwater and terrestrial food items in their diets (8%-11%). These results indicate that nesting adult eiders used mainly endogenous reserves acquired from their marine wintering grounds but also foraged at their breeding sites. In contrast, 64% of duckling diets in 2010 consisted primarily of freshwater food items. The remaining 36% of duckling FAs came from marine sources, likely from maternal input during embryo development. We provide the first empirical evidence suggesting the predominate use of capital breeding strategies in spectacled eiders in Alaska, thus furthering the importance of marine non-breeding areas as critical habitat for reproduction.

Alaska Marine Science Symposium 2017

40 Years of Change in the SE Bering Sea: Climate, Prey, Seabirds, and Long-term Trends

Martin Renner
Tern Again Consulting, 34c102e0@opayq.com
Sigrid Salo
NOAA Pacific Marine Environmental Laboratory, sigrid.a.salo@noaa.gov
Lisa Eisner
NOAA Alaska Fisheries Science Center, lisa.eisner@noaa.gov
Patrick Ressler
NOAA Alaska Fisheries Science Center, patrick.ressler@noaa.gov
Carol Ladd
NOAA Pacific Marine Environmental Laboratory, carol.ladd@noaa.gov
Kathy Kuletz
U.S. Fish and Wildlife Service, kathy_kuletz@fws.gov
Jarrod Santora
University of California, Santa Cruz, jsantora@ucsc.edu
Hunt George
University of Washigton, geohunt2@u.washington.edu

Much can change over 40 years. Using data from the North Pacific Pelagic Seabird Database, we analyzed changes in the seabird community of the southeast Bering Sea from 1975 to 2014, to examine long-term trends, and changes in relation to the timing of sea-ice retreat, and prey densities. Timing of spring sea-ice retreat shapes the southeast Bering Sea food web. Averaged over all seabird species, densities in early-ice-retreat-years was 10.1 % [95 %CI: 1.1 %–47.9 %] of that in late-ice-retreat-years. Euphausiids and the copepod *Calanus marshallae/glacialis* were 0.41 and 0.06 times as abundant in early-ice-retreat-years, respectively, whereas near-surface densities of age-0 walleye pollock *Gadus chalcogrammus* were 51 times higher in early-ice-retreat-years. Looking at long-term trends, some seabird species experienced modest increases, but many species declined substantially. During this time, the region transitioned twice from a series of years with late ice retreat to a series of years with early ice retreat: 1977/78 and again in 2013/14. During these transitions the at-sea densities of 24 of 31 species declined within the study area, 11of them by > 50%.Canonicalcorrespondence analysis shows that fluctuations in the timing of sea-ice-retreat were more than twice as important as long-term trends for the seabird community structure. Our results suggest a mechanistic understanding of how present and future changes in the timing of sea-ice may affect top predators like seabirds in the southeastern Bering Sea and open new questions about the forces driving long-term trends and open new questions to the driving forces of long-term trends.

Historical Ecophysiology Reveals the Timing of Food Shortages Experienced by Red-Legged Kittiwakes.

Alexis Will
University of Alaska Fairbanks, awill4@alaska.edu
Evgenia Kitaiskaia
University of Alaska Fairbanks, ekitaiskaia@alaska.edu
Alexander Kitaysky
University of Alaska Fairbanks, askitaysky@alaska.edu

In 1976/1977 an oceanographic regime shift precipitated changes in the ecosystem of the southeastern Bering Sea. As a result some species of seabirds breeding on the Pribilof Islands went into decline. Red-legged kittiwakes breeding on St. George Island had an especially precipitous drop in their numbers. It is hypothesized that the causal mechanism for this decline was stress incurred as a result of food shortages. It is unclear, however, when during the annual cycle these food shortages occurred. Here we employ historical ecophysiology to determine whether food shortages occurred during the non-breeding or breeding season. We collected head feathers (grown at the end of the non-breeding period) and first primary feathers (grown at the close of the breeding season) from preserved and wild-caught birds from 1976 to the present. We analyzed head and flight feathers for stable isotope signatures of Carbon and Nitrogen to characterize the foraging niche (location and trophic level) of birds at the end of the non-breeding and breeding seasons. Feathers were also analyzed for corticosterone (CORT) which is passively deposited in feather tissues during molt and serves as an indicator of a bird's exposure to nutritional stress during these two life stages. Using these parameters we will determine (1) whether the regime shift was associated with a change in diet during the breeding and/or non-breeding season; (2) when in their annual cycle individuals experienced food shortages; and (3) whether temporal changes in diets and nutritional stress correspond to the population dynamics of red-legged kittiwakes on St. George I. Our results will contribute to the explanation of how historic and recent regime shifts have driven the population trends of red-legged kittiwakes on St. George I. and provide insight into how future regime shifts might affect the Bering Sea ecosystem.

Old Ovaries, New Tricks: What Walrus Ovaries Can Tell Us about Population Fluctuations

Jenell Larsen
University of Alaska Fairbanks, jtlarsen@alaska.edu
Shannon Atkinson
University of Alaska Fairbanks, shannon.atkinson@alaska.edu

Predictions on the continued melting of sea ice in the Arctic have created concerns for the future of ice-dependent species. The Pacific walrus (*Odobenus rosmarus divergens*) is currently a species of concern and managers will decide whether this species should be listed under the Endangered Species Act in 2017. The current population status is poorly understood despite attempts at estimating population trends over the past 40 years. While aerial surveys have been used for population estimates, survey methods resulted in unacceptably large confidence intervals. In an attempt to better estimate population trends, modeling and statistical approaches have been used. The results of these studies may be further supported by the use of an anatomical approach. This study sought to determine if the reproductive capacity of female Pacific walruses has changed as a response to changes in carrying capacity or changes within their environment. Reproductive capacity was assessed using ovarian weights, volumes and total corpora counts. Corpora counts served as a proxy of the reproductive capacity of an animal over its lifespan, including ovulations resulting in successful pregnancy and those not resulting in conception. Ovaries were analyzed from three time frames: 1975 (n=45), 1994-1999 (n=46) and 2008-2010 (n=49). Pairs of ovaries and ages of animals were provided by Alaska Native hunters from Gambell, Savoonga and Little Diomede. Differences in preservation methods of ovaries were tested. Mean ovarian volume and weight were greatest in the 1990s and smallest in in 1975. Differences in mean number of corpora across time were significant when animals were binned by age class. Mean number of corpora was higher in younger animals from 2008-2010, whereas mean number of corpora were higher in older animals harvested in 1975. These findings suggest walruses were likely reproductively limited in 1975 as a result of approaching carrying capacity. In 2008-2010 reproductive capacity is greater in younger animals than in previous decades. These results support findings from previous studies on trends in population fluctuations and aid in our understanding of reproductive responses of walruses to environmental change.

Bone Steroid Hormone Concentrations Reveal Pacific Walrus Physiology from the Past 3450 Years

Patrick Charapata
University of Alaska Fairbanks, pmcharapata@alaska.edu
Lara Horstmann
University of Alaska Fairbanks, lara.horstmann@alaska.edu
Nicole Misarti
University of Alaska Fairbanks, nmisarti@alaska.edu

The Pacific walrus (*Odobenus rosmarus divergens*) is an iconic Arctic marine mammal that Alaskan Natives rely on as a nutritional, cultural, and economic resource. A decrease in important sea ice habitat and unknown population numbers have led to walruses being listed as a candidate for the Endangered Species Act. Yet, there is no clear understanding of how walruses might be affected by changing climate. In this study, steroid hormone concentrations (i.e., cortisol, estradiol, progesterone, and testosterone) were analyzed from walrus bones, spanning ~ 3450 years, to track changes in hormone concentrations linked to reproduction and stress over time. Our results show modern walrus samples from 2014 and 2015 have similar bone cortisol concentrations (median = 59.16 ± (SD) 1118.54 ng/g lipid) to archaeological walruses (aged 3450 years before present (BP) – 200 BP, 43.26 ± 345.32 ng/g lipid, $P = 0.38$) and historical walruses (aged 200 BP – 20 BP, 81.33 ± 1591.60 ng/g lipid, $P = 0.07$) indicating a possible physiological resiliency to the current receding sea ice in the Arctic. Bone progesterone and testosterone concentrations are significantly correlated with published walrus population estimates ($r = -0.21$, $P = 0.003$ and $r = -0.29$, $P < 0.001$, respectively), and differences in progesterone and estradiol concentrations contributed the most to the variation seen among samples grouped by decades (1830s–2010s) and sample time periods (i.e., archaeological, historical, and modern). Possible local production of estradiol in walrus bone indicates a relatively shorter reservoir time in cortical bone compared with the other steroid hormones, thus contributing to variation seen among samples from different time periods. Data from 2014–2015 show that the current walrus population has significantly lower ($P = 0.04$) reproductive hormone concentrations compared with walruses during times of rapid population increase. This may be due to low calf production and/or be suggestive of a population at carrying capacity. These data provide marine mammal management with a new tool to monitor long-term changes in stress and reproductive hormones that may relate to population size.

Looking Back to the 19th Century to Move Northern Fur Seals Forward into an Ecosystem Based Fisheries Management Plan

Jeremy Sterling
NOAA Alaska Fisheries Science Center, jeremy.sterling@noaa.gov
Noel Pelland
NOAA Alaska Fisheries Science Center, noel.pelland@noaa.gov

In 1873 H.W. Elliot estimated the Pribilof Island northern fur seal (NFS) population at 4.7 million seals, more than ten times the 2016 population estimate. Currently, NFS are managed under the Marine Mammal Protection Act which based its “depleted” status and recovery criteria on mid-twentieth century population estimates of 1.8-2.1 million seals. Recovery, or removal from its depleted status, requires the population to double and identifying specific management actions that promote NFS recovery remains a challenge due to an incomplete understanding of the climatic or ecological factors that affect NFS vital rates. However, unpublished research conducted on NFS in the mid-1990s and mid-2000s found evidence that pup growth, an important parameter for early survival, is correlated with maternal trip duration, numbers of pollock, and the structure of the Bering Sea eddy field. The focus of this talk is to review these conclusions and demonstrate that they are supported consistently by the extensive record of NFS historical data and unpublished research. Observations dating back to the 1800s show spatial variability in pollock and squid consumption, as well as identifying these two species as their primary prey. Reanalysis of NFS pelagic diet studies in the 1960s, 1970s, and 1980s indicate a positive relationship between Bering Sea pollock abundance and the frequency of occurrence of pollock found in NFS stomachs. Trip durations, derived from R. Gentry’s observations (1974-1992) of NFS adult females, significantly decreased 1.5 days following the 1978, 1982, 1984 pollock year classes, while pup weights increased. Collectively, the above results do not support the hypothesis that abundant pollock has a negative impact on the NFS population. These results, along with ongoing migration analyses, are now being used to link northern fur seals to Alaska Fishery Science Center’s ecosystem based models in order to evaluate the relative direct and indirect impacts of climate and fishing on fur seal foraging behavior and population dynamics. We emphasize that a review of historical data on this well-studied marine predator species is essential for confirming factors that control population vital rates across time periods that vary widely in NFS population size, climatic conditions, and prey abundance.

Bering Sea - Humans

Adaptation to Environmental Change in Three Aleutian Island Communities

Jennifer Schmidt
University of Alaska Institute of Social and Economic Research, jischmidt0@gmail.com
Meredith Marchioni
Framingham State University, mmarchioni@framingham.edu
Matt Berman
University of Alaska Institute of Social and Economic Research, mdberman@alaska.edu

Global changes in climate are affecting ecosystems and residents around the world, but changes are accelerated in the Arctic. Thinning of the Arctic sea ice, increases in air temperatures, and changes in ocean temperatures have cascading effects on biomass and availability of subsistence and commercial harvested species in the Aleutian Islands. Our research used both qualitative and quantitative methods to gain a better understanding of how environmental and social changes influence subsistence and commercial harvests in Atka, Akutan, and Nikolski. We conducted interviews with residents of these communities in 2016 to document their perceptions of ecological change and how they have adapted to these changes. An initial review of the data displays prominent environmental changes observed over the past 20 years and how these changes have increased in rapidity in the more recent 10 years. Weather station data indicate air temperatures have increased, especially in fall, with the greatest changes in Akutan. Precipitation was much more variable with increases in Akutan, but decreases in Atka and mixed trends in Nikolski. Surveys, interviews, mapping exercises, and participant observation revealed similar data as is published by climactic and ecological scholars. Furthermore, study results reveal a network of ecological, economic, and socio-cultural factors impacting the subsistence practices of residents. Initial results indicate that increased availability of non-wild foods, exclusion from sharing networks, conflicts with employment, and personal choices are associated with decreased harvests. We illustrate the initial results of our data analysis in a model of influential factors and the weight of their impact on residents' ability to continue to live in their communities, and to carry out their subsistence practices.

Visualizing Impacts of Projected Changes in Marine Vessel Traffic Using Spatially and Seasonally Explicit Simulation Models

Robert Itami
GeoDimensions Pty Ltd, bob.itami@geodimensions.com.au
Douglas Burn
U.S. Fish and Wildlfie Service, douglas_burn@fws.gov
Martin Robards
Wildlife Conservation Society, mrobards@wcs.org
Tahzay Jones
National Park Service, tahzay_jones@nps.gov
Aaron Poe
Aleutian and Bering Sea Islands Landscape Conservation Cooperative, aaron_poe@fws.gov
Benjamin Matheson
Northwest Boreal Landscape Conservation Cooperative, benjamin_matheson@fws.gov
Randy Gimblett
University of Arizona, gimblett@ag.arizona.edu
Peter Neitlich
National Park Service, peter_neitlich@nps.gov

Decreases in summer Arctic sea ice extent have supported increases in Arctic vessel traffic, and raised awareness about the Bering Sea as a critical international shipping corridor. Communities and managers have expressed increasing concern about marine vessel traffic and its associated potential for oil spills as well as disturbance of key species and traditional subsistence practices—both of which are already threatened by a changing climate. To address heightened concerns about changes in marine vessel traffic, we developed a simulation model to better show how various projections and predictions associated with increased marine traffic in the Bering Sea might look in the coming decades. These simulations are able to help communities and managers better understand future patterns of traffic in the Bering Sea region as a whole, and look more specifically at possible changes in key areas of concern like the Bering Strait. Using data collected by vessel-based Automatic Identification Systems (AIS) from 2010 – 2013 in the Bering Sea, we analyzed large vessel (tankers, bulk carriers, and container ships) activity to develop a traffic network map for the Bering. Following vessel activity analysis and considering vessel type, transit routes, route timing, routing speed, and ports of call, we developed a novel agent-based, spatially-explicit, baseline model of current marine vessel traffic patterns. We then applied projections about changes in traffic volume from the 2015 report by the US Committee on the Marine Transportation System detailing the 10-year projections of traffic through the Bering Strait to develop a possible future scenario of vessel activity. We will share methods and results from our baseline simulation that for the first time brings the daily vessel traffic picture for the entire Bering Sea ‘to life’ and share preliminary results of projected future patterns of traffic relative to important resource and subsistence areas in the Bering Strait. We will

also share our plans to use this simulation modeling technology as a tool to engage local communities and managers in thinking about spatial timing and frequency of impacts to areas of concern from different types of vessels.

Are Some Vessels Within a Fleet More Resilient To Climate Variability Than Others? A Case Study from the Bering Sea Pollock Fishery

Jordan Watson
University of Alaska Fairbanks, jordan.watson@noaa.gov
Alan Haynie
NOAA Alaska Fisheries Science Center, alan.haynie@noaa.gov

Pollock recruitment and spawning biomass in the Bering Sea has fluctuated significantly in concert with environmental changes since the early 2000s. As pollock spatial distributions, densities, and abundances have responded to climatic variability, fishers have reacted in turn. Utilizing ~30,000 trips made by Bering Sea pollock catcher vessels from 2003 – 2014, we found strong correlations between the distances that vessels traveled to fish and both pollock survey abundance and bottom temperatures. During years when colder than average waters drove pollock populations farther from port (during the summer B season) and closer to the edge of the Bering Sea shelf, many vessels traveled farther, following fish and maintaining high catch per unit effort (CPUE), despite low overall pollock abundance. The temperature and abundance relationships remain difficult to disentangle, however, as recent warm years have all occurred in concert with abundant pollock. Without low abundance warm years for comparison, it is difficult to project the impacts that warming may have on pollock fleets. However, if warm waters yield predicted poor recruitment, then pollock may require more effort to catch, even when closer to port. This increased effort (decreased CPUE) represents an additional cost to fishers because vessels use significantly more fuel while fishing than while transiting.

Longer trips offer complicated trade-offs for fishers. The far-ranging trips overall had statistically similar net earnings per trip day as the shorter trips, suggesting that the higher CPUEs were enough to offset the costs, but many vessels are unable to profitably make these longer trips. As climate changes further and variability of pollock populations is potentially exacerbated, understanding the ability of different vessels within the fleet to adapt is critical to predicting the resiliency of the pollock fleet.

Alaskan Decision Makers Speak Up on Coastal Resilience and Adaptation: ‘Click Here’ to Help Connect the AMSS Community with Their Science Needs

Aaron Poe
Aleutian and Bering Sea Islands Landscape Conservation Cooperative, aaron_poe@fws.gov
Chris Beck
Agnew::Beck, Chris@agnewbeck.com
Heather Stewart
Agnew::Beck, hstewart@agnewbeck.com
Karen Pletnikoff
Aleutian Pribilof Islands Association, karenp@apiai.org
Karen Murphy
Western Alaska Landscape Conservation Cooperative, karen_a_murphy@fws.gov
Amy Holman
NOAA Alaska Region, amy.holman@noaa.gov
Joel Reynolds
Western Alaska Landscape Conservation Cooperative, joel_reynolds@fws.gov
Davin Holen
Alaska Sea Grant, dlholen@alaska.edu

The Bering Sea/Bering Strait and Chukchi Sea form one of the richest, most pristine and biologically productive ocean systems on the planet. The same unique characteristics that support this area’s productivity – particularly the annual variations in sea ice – make this region especially vulnerable to the impacts of climate change. One of the deliverables from the series of Promoting Coastal Resilience and Adaptation in Alaska workshops are a series of four outreach posters. They are meant to convey the current understanding and concerns of the local residents to decision-makers at the state and federal levels. This poster, the first in a set of four, synthesizes current information on the region’s physical, chemical and biological dimensions of the marine systems and key expected climate impacts on those systems. The poster targets non-specialist audiences, including western Alaska communities and local, regional, state, and national legislators. While the posters have been vetted and improved through four workshops in coastal hub communities (Nome, Kotzebue, King Salmon, and Unalaska), now we are asking AMSS participants to review and help refine the poster before final production. Come provide your perspective and learn more about these efforts promoting Coastal Resilience and Community Adaptation in western Alaska, jointly hosted by the Aleutian Pribilof Islands Association and the Aleutian Bering Sea Islands, Arctic, North Pacific, and Western Alaska Landscape Conservation Cooperatives.

Assessing the Risk of Marine Invasive Species in the Bering Sea

Jesika Reimer
Alaska Center for Conservation Science, UAA, jpreimer@alaska.edu
Aaron Poe
Aleutian and Bering Sea Islands Landscape Conservation Cooperative, aaron_poe@fws.gov
Anthony Fischbach
U.S. Geological Survey, Alaska Science Center, afischbach@usgs.gov
Bonnie Bernard
Alaska Center for Conservation Science, UAA, blbernard@alaska.edu

The Bering Sea generates half of the seafood harvest in the United States and sustains the subsistence culture of dozens of coastal Alaskan communities. Potential introductions of marine invasive species through ballast water exchange and hull fouling from global and regional vessel traffic is a heightened concern in Alaska and throughout the Arctic. The Bering's history of geographic isolation has kept the potential for marine invasive species introductions relatively low, but new patterns in global shipping traffic and an expanding footprint of development in the Arctic may heighten the risk of introductions. The region's climate has also changed resulting in warm water species moving northward and decreased seasonal sea ice that has served as a historic barrier to other species from the north Pacific. The Bering Sea is a high volume corridor for international shipping, is central to expanding Arctic commerce, and hosts substantial commercial fishing traffic from the northwest coast of the U.S. and Canada. These vectors, combined with its range of marine environments, make it a bellwether for more broadly assessing risk from marine invasive species in Alaska. To assess the risk of invasive species to the Bering Sea we have developed a quantitative invasiveness ranking system and have applied it to a list of more than 70 marine species that may threaten commercial fishing and subsistence activities vital to the region's communities. Using species-specific biological characteristics in relation to shipping traffic pathways and water temperature profiles for the Bering Sea, we spatially illustrate regions in the Bering Sea that are most likely to experience future increases in invasive species abundance. In addition, we have developed outreach and engagement activities targeted for local communities and the maritime industry based on our work that will raise awareness and promote early detection and prevention practices for these species. Our work, including the ranking system, the identified species of greatest risk, spatial depiction of high risk infestation areas, and resulting outreach efforts are a useful model for managers elsewhere in the state to evaluate risk and raise awareness of the threat from marine invasive species.

The Bering Sea Warm Stanza Continues: Ecosystem Effects and Potential Outcomes

Elizabeth Siddon
NOAA Alaska Fisheries Science Center, elizabeth.siddon@noaa.gov
Janet Duffy-Anderson
NOAA Alaska Fisheries Science Center, Janet.Duffy-Anderson@noaa.gov
Alex Andrews
NOAA Alaska Fisheries Science Center, Alex.Andrews@noaa.gov
Dan Cooper
NOAA Alaska Fisheries Science Center, Dan.Cooper@noaa.gov
Lisa Eisner
NOAA Alaska Fisheries Science Center, Lisa.Eisner@noaa.gov
Ed Farley
NOAA Alaska Fisheries Science Center, Ed.Farley@noaa.gov
Ron Heintz
NOAA Alaska Fisheries Science Center, Ron.Heintz@noaa.gov
David Kimmel
NOAA Alaska Fisheries Science Center, David.Kimmel@noaa.gov
Jesse Lamb
NOAA Alaska Fisheries Science Center, Jesse.Lamb@noaa.gov
Steve Porter
NOAA Alaska Fisheries Science Center, Steve.Porter@noaa.gov
Adam Spear
NOAA Alaska Fisheries Science Center, Adam.Spear@noaa.gov
Phyllis Stabeno
NOAA Pacific Marine Environmental Laboratory, Phyllis.Stabeno@noaa.gov

In 2016, the southeastern Bering Sea shelf experienced above-average thermal conditions for the third consecutive year. Additionally, latent heat in the system combined with minimal ice cover in spring resulted in a small, retracted cold pool (‘puddle’), thereby denying age-0 walleye pollock (*Gadus chalcogrammus*) a potential metabolic refuge. Preliminary observations and rapid on-board assessments indicated (i) sea surface temperatures as high as 14°C with a ~3°C positive anomaly over the entire shelf, (ii) moderately low (spring) to extremely low (fall) zooplankton abundance and biomass, (iii) zooplankton composition dominated by small, lipid-poor taxa (both spring and fall), (iv) a coccolithophore bloom covering much of the southern middle domain, yet (v) high abundances of larval and juvenile age-0 pollock. Zooplankton Rapid Assessments (broad taxa composition) conducted during the late summer shelf survey showed very few larger, lipid-rich *Calanus marshallae*, but also low levels of the smaller *Pseudocalanus* spp. that commonly typify the inner domain. An on-board assessment of larval pollock distribution was determined by counting the number of pollock collected at each station. Preliminary counts indicated an eastward distribution over the inner and middle domains with juveniles persisting to the east by late summer. Spatial

mismatches between pollock and lipid-rich prey were evident in spring and late summer. Multiple-year climate stanzas of warm conditions precipitate a trophic cascade that leads to a restructuring of the prey base, reduced energetic condition of age-0 pollock, and reduced overwinter juvenile pollock survival success. Such climate-mediated shifts in prey energy availability (and subsequent energetic provisioning by pollock) are exacerbated by spatial mismatches between juvenile pollock and prey ‘hot spots’ which contribute to fisheries recruitment failures. The summer of 2017 looms as a potential fourth consecutive warm year for the Bering Sea ecosystem. In the previous warm period (2000-2005), the pollock population experienced a marked 40% decline. If 2017 is warm, poor quality zooplankton prey, inadequate energetic provisioning by age-0 pollock, and, ultimately, another poor pollock recruitment year are expected.

The "Warm Blob" and a Cold Sea: Large-Scale Trophic Perturbations in the Aleutian Islands

Douglas Causey
University of Alaska Anchorage, dcausey@alaska.edu
Veronica Padula
University of Alaska Anchorage, vmpadula@alaska.edu
Shiway Wang
University of Alaska Anchorage, shiway@gmail.com

The Arctic regions are experiencing rapid change in marine and terrestrial environments from many sources, primarily caused by climate change and anthropogenic impacts of increased development and pollution. Several endemic species, such as Red-faced Cormorants (*Phalacrocorax urile*) are currently undergoing dramatic population declines, likely related to climate-related change in food availability and trophic structure of the local marine environment. In this study, we are analyzing the constituent stable isotopes (eg. H, C, N, O, S) of blood and feather samples collected from 16 avian species collected in the far Western Aleutian Islands (eg., Near, Rat, and Delarof Islands) since 2000. Our preliminary results indicate that the community-wide spatial and temporal dynamics of marine bird ecosystems are far greater in the last decade (2009 – 2016) than has been evident over recent decades. We also find that the magnitude of change is lesser here in the low Arctic (*e.g.*, western Aleutian Islands 53°N) compared to High Arctic coastal marine ecosystems (*e.g.*, 78°N). In particular, we show that the ecological patterns observed within such widespread arctic species as puffins (*Fratercula* spp.), Northern Fulmars (*Fulmarus glacialis*), and Black-legged Kittiwake (*Rissa tridactyla*) indicate diets are strongly perturbed on small geographic and temporal scales of 10^1 km and decades. Moreover, we find that the variance in environmental and ecological parameters is increasing rapidly over time. We hypothesize that these fine-scale changes are related to mid-scale oceanographic and trophic-level changes (eg., the "Warm Blob"), in addition to larger-scale perturbations possibly related to a cascade of climate-related factors

Plenary Sessions – Thursday, January 26

Plenary Sessions: Thursday, January 26 -- Arctic

TIME	TITLE	PRESENTER	SECTION
8:00 - 8:15 AM	High-Resolution Prediction and Real-Time Observations of Arctic Sea Ice and Currents	Andrew Mahoney	Climate and Oceanography
8:15 - 8:30 AM	Surface Current Patterns in the Northeastern Chukchi Sea and Their Response to Wind Forcing	Ying-Chih Fang**	Climate and Oceanography
8:30 - 8:45 AM	The ARCtic Tracer Release EXperiment (ARCTREX): Results from the Release of Passive Tracers in the Chukchi Sea	Peter Winsor	Climate and Oceanography
8:45 - 9:00 AM	Circulation of the Chukchi Sea Shelfbreak and Slope from Moored Timeseries	Min Li**	Climate and Oceanography
9:00 - 9:15 AM	Transport and Hydrographic Variability in Barrow Canyon on the Northeastern Chukchi Sea Shelf	Thomas Weingartner	Climate and Oceanography
9:15 - 9:30 AM	New Observations of Surface Water Carbonate Chemistry	Burke Hales	Climate and Oceanography
9:30 - 10:00 AM	**BREAK**		
10:00 - 10:15 AM	Infaunal Communities on the Beaufort Sea Shelf and Slope: Insights from Morphological and Environmental DNA Sequencing Approaches	Sarah Hardy	Lower Trophic Levels
10:15 - 10:30 AM	Tracing Sea Ice Algal Production Into Various Benthic Feeding Types on the Chukchi Sea Shelf	Tanya Schollmeier**	Lower Trophic Levels
10:30 - 10:45 AM	Using Optical Measurements to Investigate Under-ice Warming, Primary Production and Photo-oxidation in the Upper Arctic Ocean	Victoria Hill	Lower Trophic Levels
10:45 - 11:00 AM	Temperature Impacts on the Eggs and Larvae of Alaskan Gadids	Louise Copeman	Fishes and Fish Habitats
11:00 - 11:15 AM	Arctic Coastal Ecosystems: Evaluating the Functional Role and Connectivity of Lagoon and Nearshore Habitats	Johanna Vollenweider	Fishes and Fish Habitats
11:15 - 11:30 AM	Environmental Drivers of Benthic Fish Distribution In and Around Barrow Canyon in the Northeastern Chukchi Sea and Western Beaufort Sea	Elizabeth Logerwell	Fishes and Fish Habitats
11:30 - 1:00 PM	**BREAK - LUNCH PROVIDED**		

* Masters; ** Doctorate

Plenary Sessions: Thursday, January 26 -- Arctic

TIME	TITLE	PRESENTER	SECTION
1:00 - 1:15 PM	Dispersal Patterns and Summer Ocean Distribution of Adult Dolly Varden in the Beaufort Sea, Evaluated with Satellite Telemetry	Michael Courtney	Fishes and Fish Habitats
1:15 - 1:30 PM	Assessing Hydrocarbon Sensitivity and Measuring Current CYP1A Activity in Arctic Marine Birds and Waterfowl	Ann Riddle*	Seabirds
1:30 - 1:45 PM	Frequency of Injuries From Line Entangelements, Killer Whales, and Ship Strikes on Bering-Chukchi-Beaufort Seas Bowhead Whales	J. Craig George	Marine Mammals
1:45 - 2:00 PM	Influence of Benthic Communities and Environmental Characteristics on Bearded Seal Foraging Ecology	Michael Cameron	Marine Mammals
2:00 - 2:15 PM	Thermal Detection of Polar Bears on Sea Ice Using an Automated Image Collection and Analysis System	Erin Moreland	Marine Mammals
2:15 - 2:30 PM	Combined Seal and Polar Bear Aerial Survey on Ice in the Western Chukchi Sea and Eastern Part of the East Siberian Sea, Spring 2016	Irina Trukhanova	Marine Mammals
2:30 - 3:00 PM	**BREAK**		
3:00 - 3:15 PM	Exposure Risks and Health Effects of Algal Toxins in Marine Mammals Using Both Environmental Surveillance and Biomedical Laboratory Models	Kathi Lefebvre	Marine Mammals
3:15 - 3:30 PM	Living with Sea Ice: Voices from Barrow and Kotzebue	Karen Brewster	Human Dimensions
3:30 - 3:45 PM	Scientific Research and Subsistence: Protocols to Ensure Co-Existence	Candace Nachman	Human Dimensions
3:45 - 4:00 PM	Social Indicators in Alaska: Arctic Communities	Stephen Braund	Human Dimensions
4:00 - 4:15 PM	The Arctic Marine Pulses Model: Linking Annual Oceanographic Processes to Contiguous Ecological Domains in the Pacific Arctic	Sue Moore	Ecosystem Perspectives
4:15 - 4:45PM	An Integrated Look at the Alaska Beaufort Sea	Jeremy Kasper	Ecosystem Perspectives
4:45 - 5:00 PM	**Best Student Oral Presentations Winners Announced and Closing Remarks**		

* Masters; ** Doctorate

Plenary Session Abstracts

Thursday, January 26

Interannual variabilities of Pacific Water inflow into the Arctic basin via Barrow Canyon

Motoyo Itoh
Takashi Kikuchi
Shigeto Nishino
Institute of Arctic Climate and Environmental Research (IACE)
Japan Agency for Marine-Earth Science and Technology (JAMSTEC)

Over the past few decades, sea ice retreat during summer has been enhanced in the Pacific sector of the Arctic Basin, in part due to increasing summertime heat flux of Pacific-origin water from the Bering Strait. Barrow Canyon, in the northeast Chukchi Sea, is a major conduit through which the Pacific-origin water enters the Arctic Basin. Our study focuses on the quantitative estimate of volume, heat and freshwater fluxes through Barrow Canyon by mooring observations with hydrographic surveys. We conducted year-round mooring observations at one station from 2000 to 2001 and at three stations from 2001 to 2016 in the mouth of Barrow Canyon. The annual mean poleward volume, heat and freshwater fluxes through Barrow Canyon were 0.49 Sv, 31 mSv and 2.25 TW. Annual mean Pacific Water transport through Barrow Canyon represents 55% of the long-term mean Pacific Water inflow through the Bering Strait. The annual averaged heat flux displayed substantial interannual variability, ranging from 0.93 TW to 3.34 TW. Annual averaged volume and freshwater fluxes in recent years from 2010 to 2016 were slightly lower than the 2000–2008 averages, mainly due to relatively strong northeasterly wind. In contrast, heat fluxes for the period 2010–2014 were higher than the 2000–2008 averages, and 1.3 times larger than the average value from 2001 to 2016. It tended to be three highest maximum in 2007, 2010 and 2012, when summer sea ice extent extraordinary retreats in the Arctic Ocean, mainly because of the warming of Pacific Summer Water. Heat fluxes observed in these years are sufficient to melt 1-m-thick ice over an area of 360,000 km2, which is nearly equals to the total land area of Japan. They were 3–4 times larger than that observed in summer 1993. The heat possibly contributes to both sea-ice melt in summer and a decrease in sea-ice formation during winter because this water typically subsides just below the surface mixed layer in the Arctic Basin.

High-Resolution Prediction and Real-Time Observations of Arctic Sea Ice and Currents

Jinlun Zhang
University of Washigton, zhang@apl.washington.edu
Andrew Mahoney
University of Alaska Fairbanks, armahoney@alaska.edu

The decline of Arctic sea ice allows greater marine access to the Arctic Ocean than ever before. This presents challenges and opportunities in the region for a variety of economic activities such as fisheries, marine transportation, and resource exploration. Increased economic activities in the Arctic Ocean in turn pose challenges to the operations of the US Coast Guard, such as search and rescue missions. To meet these emerging challenges, it is important to enhance our ability to observe in real time and predict Arctic sea ice and currents over a range of time scales from days to months for various Arctic regions. This is one of the goals of the Arctic Domain Awareness Center (ADAC), led by the University of Alaska Anchorage supported by the Department of Homeland Security. ADAC has developed an Arctic sea ice and ocean forecast system using the High-resolution Ice-Ocean Modeling and Assimilation System (HIOMAS). HIOMAS is constructed based on the Pan-arctic Ice–Ocean Modeling and Assimilation System (PIOMAS) with higher horizontal and vertical resolution than PIOMAS for the whole Arctic including the Northwest Passage. It is able to assimilate satellite sea ice concentration to obtain “best possible” initial conditions for forecast. Daily to seasonal forecast is driven by the forecast forcing from the National Centers for Environmental Prediction (NCEP) Climate Forecast System (CFS). The CFS forecast ranges from hours to months with 6-hourly forecast atmospheric data widely accessible in real time, thus ideal for forcing the HIOMAS forecast. A range of observations are used for HIOMAS calibration and validation, including NASA IceBridge ice thickness, buoy drift, and radar observed ice motion. In this presentation, we will present the capabilities of coastal radar to provide real-time data supporting Arctic Domain Awareness and show that HIOMAS is able to create realistic initial conditions of sea ice thickness and motion. We will also examine the model performance in predicting sea ice movement and edge location.

Surface Current Patterns in the northeastern Chukchi Sea and Their Response to Wind Forcing

Ying-Chih Fang
University of Alaska Fairbanks, yfang2@alaska.edu
Rachel Potter
University of Alaska Fairbanks, rapotter@alaska.edu
Hank Statscewich
University of Alaska Fairbanks, hstatscewich@alaska.edu
Thomas Weingartner
University of Alaska Fairbanks, tjweingartner@alaska.edu

Surface current observations were collected using high-frequency radars (HFR) deployed along the northwest Alaskan coast in the villages of Barrow, Wainwright and Point Lay during the ice-free season in 2010 – 2014. Twelve surface current patterns are retrieved using the Self-Organizing Map (SOM) for HFR and North America Regional Reanalysis (NARR) winds. In the subtidal band, temporal changes of the SOM-derived patterns follow the variability of the local winds. Patterns can be generalized as two predominant groups of northeastward- and southwestward-flowing current fields along with one transitioning stage during the onset or relaxation of local northeasterly winds. These patterns resemble the first two eigenmodes of empirical orthogonal functions (EOF) analysis of the HFR data. The first principal component (PC1) of the surface currents is significantly correlated (~0.8) to that of the winds and qualitatively matches the time series of the SOM-derived patterns. The sign of PC1 changes when the speed of the local northeasterly winds exceeds 6 ms^{-1}, at which point the northeastward-flowing current field reverses toward the southwest providing evidence of the wind forcing needed to overcome the poleward pressure gradient between the Pacific and Arctic Oceans. The transitioning stage features alongshore currents bifurcating or converging in the vicinity of Icy Cape. Varying frictional spindown timescales due to variations in depth in the study domain may explain the dynamics of this pattern.

The ARCtic Tracer Release EXperiment (ARCTREX): Results from the Release of Passive Tracers in the Chukchi Sea

Harper Simmons
University of Alaska Fairbanks, hlsimmons@alaska.edu
Peter Winsor
University of Alaska Fairbanks, pwinsor@alaska.edu
Robert Chant
Rutgers University, chant@marine.rutgers.edu
Elias Hunter
Rutgers University, hunter@marine.rutgers.edu
Hank Statscewich
University of Alaska Fairbanks, hank.stats@alaska.edu

Results from three passive tracer experiments in the Chukchi Sea as part of the ARCTREX project are presented with the goal to characterize and quantify advective processes and diapycnal mixing in the Chukchi Sea. 55 kg of Rhodamine dye was injected in the surface layer of on three occasions, September 10, 2014 (release 1), September 15, 2014 (release 2), and September 9, 2015 (release 3). The dye was subsequently tracked using a shipboard flow through system and a towed undulating vehicle equipped with Rhodamine fluorometers. Release 1 was carried out in a moderately quiescent, highly stratified region and quickly dispersed throughout the mixed layer to a depth of ~15m. Over the next 3-4 days variability in the patch was characterized by weak advection and mixing by weak (~0.1 PSU) horizontal frontal features that steered and strained the dye patch. In contrast to release 1, a highly energetic region near a strong (1 PSU) frontal feature was chosen for release 2. Release 2 also quickly mixed to 15-20 m, then advected north at 30 cm/s. After approximately 4.5 hours it vanished from the surface layer and subducted along downward sloping isohalines. Release 2 was subsequently strained into a thin subsurface layer between the 31 and 31.2 PSU isohalines. It remained subsurface for the next 1.5 days. Release 3 was also injected near a front, albeit less energetic than release 2 and was tracked for 2 days. As in release 1 the dye mixed across a weak persistent front for the duration it was tracked. While the patch advected slowly initially, a wind event strained the dye patch horizontally and quickly advected it to the southwest. The salinity of the dye increased by ~.1 PSU over the course of release 1. These results suggest dispersion due horizontal advection/stirring processes are important in addition to vertical shear processes.

Arctic - Climate and Oceanography

Circulation of the Chukchi Sea Shelf Break and Slope from Moored Time Series

Min Li
Woods Hole Oceanographic Institution, mli@whoi.edu
Robert Pickart
Woods Hole Oceanographic Institution, rpickart@whoi.edu

Using data from a year-long mooring array in the northeastern Chukchi Sea, we identify the main flow features in the vicinity of the shelf break/slope and describe the variability on timescales of seasons to days. The array consisted of seven moorings spanning the outer-shelf to the mid-slope, deployed from September 2013 to September 2014. It was the first such high-resolution array deployed in this region. Two main flow features are evident: a shelf break jet that, in the mean, flows to the east and is bottom-intensified. Offshore of this is a stronger current that can be characterized as a free jet flowing to the west. This feature has only recently been identified and is referred to as the Chukchi slope current. Our data reveal that it is present throughout the year. The monthly-mean vertical sections indicate that the slope current is surface-intensified in summer and fall, with maximum speeds of order 25 cm/s, while in winter and spring the flow weakens and is characterized by a sub-surface maximum in velocity. The current advects different Pacific-origin water masses seasonally, and transports Atlantic water year-round. The shelf break jet is strongest in the fall, although the maximum flow is less than 10 cm/s. Both currents are highly energetic on timescales of a few days. The nature of this mesoscale variability is explored.

Arctic - Climate and Oceanography

Transport and Hydrographic Variability in Barrow Canyon on the Northeastern Chukchi Sea Shelf

Thomas Weingartner
University of Alaska Fairbanks, tjweingartner@alaska.edu
Chase Stoudt
University of Alaska Fairbanks, castoudt@alaska.edu
Rachel Potter
University of Alaska Fairbanks, rapotter@alaska.edu
Hank Statscewich
University of Alaska Fairbanks, stats@alaska.edu
Elizabeth Dobbins
University of Alaska Fairbanks, eldobbins@alaska.edu
Peter Winsor
University of Alaska Fairbanks, pwinsor@alaska.edu
Seth Danielson
University of Alaska Fairbanks, sldanielson@alaska.edu

We used 5 years (2010 – 2015) of moored current meters at the head of Barrow Canyon to construct time series of the mean daily transport entering the canyon. Approximately 55% of the transport variance can be explained by a regression using North American Regional Re-analysis winds over the Chukchi and Bering seas. These winds were then used to construct a hindcast of the mean daily transport from 1979 through the summer of 2015 and, subsequently, a mean annual cycle derived from this climatology. The long term mean transport is ~0.16Sv and the mean annual cycle consists of three seasons: 1) downcanyon (into the Arctic Ocean) transport occurs from May – September at an average rate 0.45 Sv (1 Sv = 10 m^3 s^{-1}), 2) upcanyon transport occurs from October – December and averages 0.1 Sv, and 3) a mean transport of 0 Sv from January – April. This seasonality implies that the circulation over the greater Chukchi shelf must also adjust seasonally, with this adjustment having important implications on the ultimate disposition of Pacific-derived waters crossing the Chukchi shelf.

The probability density functions (pdfs) of mean daily transport differ significantly between summer and fall-winter. While both are skewed by large upcanyon events, these are quite rare in summer but much more frequent in winter. Consequently, the summer pdfs are leptokurtic whereas the winter pdfs are platykurtic. The majority of downcanyon events in winter have a duration of 1 – 4 days, whereas 50% of the downcanyon events of summer exceed 7 days duration. These seasonal differences in downcanyon event duration may have important implications for the formation of Arctic Ocean eddies. In contrast 90% of all summer upcanyon events are $\leq$ 4 days duration, and therefore not of sufficient duration to advect water from the slope onto the shelf. In contrast ~50% of all upcanyon events exceed 4 days in fall and winter, so slope waters should easily reach the head of the canyon in these seasons.

Arctic - Climate and Oceanography

New Observations of Surface Water Carbonate Chemistry

Burke Hales
Oregon State University, bhales@coas.oregonstate.edu
Aaron Jones
Oregon State University, jonesaar@oregonstate.edu
Taro Takahashi
Columbia University, taka@ldeo.columbia.edu
Laurie Juranek
Oregon State University, ljuranek@ceoas.oregonstate.edu

We recently made continuous high-resolutions observations of the CO2 partial pressure (pCO2) and total dissolved carbonic acid (TCO2) in surface waters of the Bering Strait, Chukchi and Beaufort Seas, and Arctic Basin waters, using a pair of automated combined CO2 analyzers (aka Burke_O_Lators) during a cruise aboard the *RV Sikuliaq* in September of 2016. Along with coincident measures of temperature and salinity, the pCO2/TCO2 pair can be used to contain the carbonate system, and this measurement pair is less sensitivity to state-variable and fresh-water considerations than are either direct measurements of pH or alkalinity. Direct comparison of our pCO2 measurements to a lower-frequency onboard LDEO pCO2 analyzer, the gold-standard for measurement of this parameter, showed agreement to within < 2µatm, while analysis of SIO CRM for TCO2 showed native accuracy to within < 0.3 %. pCO2 values were always below atmospheric saturation across the study region, and reached values below 140 µatm, reflecting what appeared to be a recently terminated surface phytoplankton bloom. Along with this low pCO2 was an expected high pH, with values often exceeding 8.2. Mineral stability, however, was significantly lower than would be expected for these pCO2/pH values for the global ocean, due to the high solubility of CO2 in these cold, relatively fresh waters. Calculated alkalinity showed distinct salinity dependences between the surface waters of the Arctic Basin, and the shelf waters of the Beaufort and Chukchi Seas.

Infaunal Communities on the Beaufort Sea Shelf and Slope: Insights from Morphological and Environmental DNA Sequencing Approaches

Sarah Hardy
University of Alaska Fairbanks, smhardy@alaska.edu
Holly Bik
University of California, Riverside, holly.bik@gmail.com
Jyostna Sharma
University of Texas, jsharma06@gmail.com

Rapid change is occurring in the Arctic concurrently with increased human activity, yet our knowledge of the structure and function of high-Arctic sediment communities is still rudimentary. The Beaufort Sea is particularly poorly sampled, and largely unexplored at slope depths, providing little information with which to assess the impacts of petroleum exploration activities now beginning in this area. We investigated diversity and community structure of benthic meiofauna on the continental shelf and slope of the Beaufort Sea across a range of depths (50 to 1000 m) using traditional taxonomic and environmental DNA sequencing approaches, and compared results to additional sites in the adjacent NE Chukchi Sea petroleum lease-sale area. These data represent the first baseline surveys of benthic metazoan meiofauna in the Chukchi and Beaufort seas using high-throughput gene sequencing of environmental DNA extracts from sediment samples. Despite their importance to sediment biogeochemical processes and marine food webs, meiofauna are notoriously difficult to characterize because components of the fauna are poorly preserved in sediment samples, lack obvious morphological features, and are extremely small in size (~45 um – 1 um); thus, they have been largely ignored in many regions including the Arctic. We demonstrate the utility of DNA-based approaches as an alternative to the standard microscopy techniques for rapid assessment of meiofaunal community structure. We used amplicon sequencing of the 18S rRNA gene to assess metazoan eukaryotic community structure in sediments from 120 locations distributed throughout the NE Chukchi and US and Canadian Beaufort Sea shelf and slope, and generated a morphology-based inventory of the Nematoda at a subset of these sites based on expert taxonomic identifications. Morphology data was compared with the results of 18S amplicon surveys to determine that similar information is obtained through both approaches. Moreover, the Nematoda 18S dataset was correlated with the full Metazoa 18S dataset, suggesting this group may reflect important environmental drivers governing the assembly of whole communities in this region. Sequencing data revealed an abundance of protists in sediments which have been mostly ignored in studies of ecosystem dynamics in this region, and may represent an important component of the food web.

Tracing Sea Ice Algal Production into Various Benthic Feeding Types on the Chukchi Sea Shelf

Tanja Schollmeier
University of Alaska Fairbanks, tschollmeier@alaska.edu
Katrin Iken
University of Alaska Fairbanks, kbiken@alaska.edu
Alexandra Oliveira
University of Alaska Fairbanks, alex.oliveira@bluwrap.com
Matthew Wooller
University of Alaska Fairbanks, mjwooller@alaska.edu

The Arctic marine environment has two main sources of primary production, sea ice algae and open ocean phytoplankton. The ongoing reduction of seasonal sea ice coverage in the Chukchi Sea due to climatic changes could shift the contribution of primary production increasingly towards pelagic primary production. This shift could, in turn, affect the timing, amount, and quality of the organic matter reaching the benthos. We analyzed the contribution of ice particulate organic matter (iPOM) to various common benthic invertebrate feeding types by examining the concentrations and carbon isotope values of three fatty acids (FAs), 16:4(n-1), 16:1(n-7) and 20:5(n-3). These FAs are prominent in diatoms and were used as an iPOM biomarker under the assumption that diatoms are more abundant in iPOM than in phytoplankton. The highest concentrations of the three FAs were found in subsurface deposit feeders, indicating that they consumed the most iPOM, and were at their lowest concentrations in suspension feeders. These results were not confirmed by the stable carbon isotope results, where little differences in stable carbon isotope values of FAs were found between deposit and suspension feeders. We proposed that FA stable carbon isotope values are a better iPOM biomarker than FA concentrations, which are likely not sufficiently source specific. Higher stable carbon isotope values of 16:1(n-7) in omnivores indicate a greater consumption of iPOM in this feeding type. This greater consumption of iPOM in omnivores is likely achieved through the accumulation of this FA derived from iPOM in other invertebrates on which omnivores then prey upon.

Using Optical Measurements to Investigate Under-Ice Warming, Primary Production and Photo-Oxidation in the Upper Arctic Ocean

Victoria Hill
Old Dominion University, vhill@odu.edu
Bonnie white
University of Washigton, bonnie@apl.washington.edu
Mike Steele
University of Washigton, mas@apl.washington.edu

Four ice-tethered buoys were deployed in first year sea ice in March and April of 2014 and 2015 in the Arctic Ocean. In water observations of light, temperature and fluorescence (CHL and DOM) were collected over 12 months, with the aim to investigate the link between light availability under the ice, water column warming, primary production and photo-oxidative loss of DOM. These observations represent some of the first high temporal observations (1 hour intervals) under first year sea ice in the early spring, and throughout the melting phase. Increased light penetration through melt ponds and leads preceded the formation of the near surface temperature maximum. Wide scale warming was observed once open water conditions were reached. Light availability throughout the late spring while sea ice was still in place was determined to be sufficient to support phytoplankton growth under the ice, supporting previous observations of massive under-ice blooms. Daily reductions in DOM fluorescence during open water periods indicated photo-oxidative loss, which will be modeled from irradiance and diffuse attenuation observations. The data from the buoys provides unprecedented observations of the upper water column under current ice pack conditions, increasing in our understanding of the physical, biological and chemical impacts of a thinner and more fractured ice pack.

Temperature Impacts on the Eggs and Larvae of Alaskan Gadids

Louise Copeman
Oregon State University, lcopeman@coas.oregonstate.edu
Ben Laurel
NOAA Alaska Fisheries Science Center, ben.laurel@noaa.gov
Mara Spencer
NOAA Alaska Fisheries Science Center, mara.spencer@noaa.gov
Paul Iseri
NOAA Alaska Fisheries Science Center, paul.iseri@noaa.gov

Temperature fundamentally impacts the development and energy loss rates of marine fish eggs in a non-linear, species-specific manner. As such, fish assemblages may be differentially impacted by new 'match-mismatch' scenarios resulting from ocean warming and loss of sea-ice. In our experiments we incubated the eggs and larvae from two Arctic gadids (Arctic cod, *Boreogadus saida* and saffron cod, *Eleginus gracilis*) and two boreal gadids (walleye pollock, *Gadus chalcogrammus* and Pacific cod, *Gadus macrocephalus*) across a range of temperatures (-1 to 16 °C). We examined multiple temperature-dependent hatch characteristics, including time-to-hatch, hatch success, and size-at-hatch for each species. Further, we compared the size, mass and lipid and fatty acid composition of all four species at the beginning and end of egg incubation. The length of egg incubation in the Arctic gadids was significantly longer than the boreal gadids (e.g., 30 to 40 days versus 15 to 22 days at 4 °C) but Arctic larvae hatched at a significantly larger size (i.e.~30-40% larger) than both boreal species. The Arctic species were also much more temperature sensitive in terms of hatch success and impacts on size-at-hatch. For example, hatch success in Arctic cod and saffron cod occurred over a very narrow range (-1 to 5 °C) and declined rapidly above 3.5 °C. In contrast, hatch success in the boreal gadids was observed up to 8 and 12 °C in Pacific cod and walleye pollock, respectively. Arctic species were more lipid rich with Arctic cod and saffron cod having 26 and 15 µg of lipid per egg and 17 to 14 µg of lipid per larvae, respectively. This starkly contrasted with the lipid content of eggs from Pacific cod (8 µg/egg) and walleye pollock (3 µg/egg). Together these data indicate that warming of the spring thermal environment will impact Arctic and boreal gadids differently. Arctic gadids appear to have specialized eggs that are adapted to surviving extended periods under the ice, but are poorly adapted to surviving changes in their thermal environment compared to the boreal gadids.

Arctic Coastal Ecosystems: Evaluating the Functional Role and Connectivity of Lagoon and Nearshore Habitats

Johanna Vollenweider
NOAA Alaska Fisheries Science Center, johanna.vollenweider@noaa.gov
Ron Heintz
NOAA Alaska Fisheries Science Center, Ron.heintz@noaa.gov
Kevin Boswell
Florida International University, kevin.boswell@fiu.edu
Brenda Norcross
University of Alaska Fairbanks, bnorcross@alaska.edu
Chunyan Li
Louisiana State University, cli@lsu.edu
Mark Barton
Florida International University, mbart034@fiu.edu
Leandra Sousa
North Slope Borough, leandra.sousa@north-slope.org
Craig George
North Slope Borough, Craig.George@north-slope.org
Alexei Pinchuk
University of Alaska Fairbanks, aipinchuk@alaska.edu

The ecological function of nearshore Arctic habitats is poorly understood, particularly their connectivity and contribution to overall productivity of the Arctic Large Marine Ecosystem. We assessed “seasonal” variation in Arctic nearshore fish communities in relation to habitat and the degree of connectivity between three water bodies (Chukchi Sea, Beaufort Sea, Elson Lagoon) adjacent to Barrow, Alaska during the ice-free, summer season (July – August) 2013 - 2015. Through weekly beach seining, trawl collections along fixed transects, concurrent oceanographic measurements, and laboratory processing of fish samples, we tested the hypothesis that species composition, size, energy content, feeding ecology, and age structure of fish communities do not vary among habitats. Over 40 species of fish inhabit the nearshore, the majority of which were juveniles. The Arctic nearshore is “reset” every year through ice scouring, as observed from bathymetric features using fine-scale habitat mapping. As summer progresses, fish move into newly-available habitat and species diversity and abundance increases on a weekly time-scale. Fish community structure varies by water body as a result of wind-driven ocean currents. Chukchi sites were most different from the other water bodies, with annual differences in the fish community likely stemming from influences of the adjacent Alaska Coastal Current and Barrow Canyon. Inter-annual differences in community composition in western Beaufort sites were likely derived from storm-driven ocean mixing, whereas the fish community in the partially-enclosed Elson Lagoon was invariable from year to year. Stable isotopes indicate many trophic levels, likely from a diverse zooplankton assemblage. In the marine water bodies, a

terrestrial-derived basal resource was identified, while terrestrial organic matter from tundra runoff and marine primary producers advected in were apparent in the lagoon. Different trophic pathways did not result in differences in fish condition amongst water bodies, rather fish condition in the nearshore was low relative to off-shore regions. While Arctic nearshore habitats provide an important link between terrestrial and oceanic habitats, the highly volatile environmental conditions in these regions take an energetic toll on juvenile fish.

Environmental Drivers of Benthic Fish Distribution In and Around Barrow Canyon in the Northeastern Chukchi Sea and Western Beaufort Sea

Elizabeth Logerwell
NOAA Alaska Fisheries Science Center, libby.logerwell@noaa.gov
Kimberly Rand
NOAA Alaska Fisheries Science Center, kimberly.rand@noaa.gov
Seth Danielson
University of Alaska Fairbanks, SLDanielson@alaska.edu
Leandra Sousa
North Slope Borough, Leandra.Sousa@north-slope.org

We investigate the relationships between Arctic fish and their environment with the goal of illustrating mechanisms of climate change impacts. A multidisciplinary research survey was conducted to characterize fish distribution and oceanographic processes in and around Barrow Canyon in the northeastern Chukchi Sea in summer 2013. Benthic fish were sampled with standard bottom trawl survey methods. Oceanographic data were collected at each trawl station. The density of Arctic cod (*Boreogadus saida*), the most abundant species, was related to bottom depth, salinity and temperature. Arctic cod were more abundant in deep, cold and highly saline water in Barrow Canyon that was likely advected from the Chukchi Shelf or from the Arctic Basin. We hypothesize that Arctic cod occupied Barrow Canyon to take advantage of energy-rich copepods transported in these water masses. A similar habitat selection occurred in the Beaufort Sea, documented by a comparable multidisciplinary survey conducted in 2008. These linkages between oceanographic variables and benthic fish distribution and abundance suggest that advection, sea ice dynamics and pelagic-benthic coupling are important for the ecology of benthic Arctic fishes. These processes have been and will likely continue to be impacted by climate change. Our results improve the understanding of the mechanistic linkages between climate change and benthic Arctic fish ecology.

Dispersal Patterns and Summer Ocean Distribution of Adult Dolly Varden in the Beaufort Sea, Evaluated With Satellite Telemetry

Michael Courtney
University of Alaska Anchorage, mbcourtney@alaska.edu
Andrew Seitz
University of Alaska Fairbanks, acseitz@alaska.edu
Brendan Scanlon
Alaska Department of Fish & Game, brendan.scanlon@alaska.gov
Randy Brown
U.S. Fish and Wildlfie Service, randy_j_brown@fws.gov

In Arctic Alaska, Dolly Varden *Salvelinus malma*is highly valued as a subsistence fish; however, little is known about its marine ecology. Therefore, we are using pop-up satellite archival tags (PSATs) to study the oceanic behavior, distribution and migration of Dolly Varden that spend summers in the Beaufort Sea. While attached to a fish, the PSATs collect temperature, depth and ambient light data, after which they release from the fish and transmit the collected data and provide an end location to satellites. To date, we have tagged and released 40 Dolly Varden (54–81 cm) in both freshwater (n = 18) and nearshore marine waters (n = 22). Preliminary results provided the first evidence of distant offshore dispersal of Dolly Varden in the Beaufort Sea, demonstrating that offshore areas may be important feeding areas for this species. While occupying offshore feeding areas, tagged fish were surface oriented, occupying mean depths ranging from ~0–1 m, and water temperatures ranging from 0–6°C. Additionally, tagged fish demonstrated other dispersal types including foregoing an oceanic migration, movement in nearshore marine waters, and rapid transit to several rivers on Alaska’s North Slope. Information gained from this study challenges several commonly held assumptions about the life history and marine distribution of anadromous Dolly Varden and, thus is pertinent to future management considerations by subsistence users, biological resource managers, and mineral and energy developers and regulators.

Assessing Hydrocarbon Sensitivity and Measuring Current CYP1A Activity in Arctic Marine Birds and Waterfowl

Ann Riddle
University of Alaska Fairbanks, annr@alaskasealife.org
Tuula Hollmen
University of Alaska Fairbanks, tuulah@alaskasealife.org
Robert Suydam
North Slope Borough, robert.suydam@north-slope.org
Robert Sarren
North Slope Borough, robert.sarren@north-slope.org
Raphaela Stimmelmayr
North Slope Borough, raphaela.stimmelmayr@north-slope.org

With prospects of development of oil and gas resources and commercial shipping in the Chukchi and Beaufort seas, establishing reference data and assessing sensitivity of Arctic wildlife to hydrocarbon exposure will provide essential information needed for management and conservation for species potentially impacted by an oil spill. Targeting a broad selection of Arctic marine birds and waterfowl, we used species-specific cell culture to assess hydrocarbon sensitivity by measuring liver cytochrome P450 (CYP1A). We have established reference CYP1A enzyme responses for liver cell lines in ten Arctic marine bird species and a control bird species (mallard, *Anas platyrhunchos*) by exposing cells for 24 hours to positive control reference reagents (e.g. the hydrocarbon chrysene). We also exposed cell lines from five Arctic marine bird species and mallard control to various amounts of Alaska North Slope crude oil to determine CYP1A activity in a compound mixture. Results show differences in species response to control reagents and crude oil. To measure levels of current CYP1A activity in Arctic birds we validated field protocols for collecting liver samples from three bird species of subsistence importance; king eiders (*Somateria spectabilis)*, common eiders (*Somateria mollissima),* and greater white-fronted geese (*Anser albifrons*). Birds were sampled near Barrow, Alaska during spring and fall hunts over three years. Results suggest differences in CYP1A enzyme activity levels among species and years. Cell culture sensitivity and liver CYP1A activity results from this project provides valuable tools and information for monitoring Arctic bird populations, identifying sensitive species, and future assessments in the event of an oil spill.

Frequency of Injuries From Line Entanglements, Killer Whales, and Ship Strikes On Bering-Chukchi-Beaufort Seas Bowhead Whales

J. Craig George
North Slope Borough, craig.george@north-slope.org
Gay Sheffield
University of Alaska Fairbanks, gay.sheffield@alaska.edu
Dan Reed
Alaska Department of Fish & Game, djreed@gci.net
Barbara Tudor
North Slope Borough, barbara.tudor@north-slope.org
Raphaela Stimmelmayr
North Slope Borough, raphaela.stimmelmayr@north-slope.org
Brian Person
North Slope Borough, brian.person@north-slope.org
Todd Sformo
North Slope Borough, todd.sformo@north-slope.org
Robert Suydam
North Slope Borough, robert.suydam@north-slope.org

We analyzed scarring data for Bering-Chukchi-Beaufort (BCB) Seas bowhead whales (*Balaena mysticetus*) harvested by Alaska Native hunters to quantify the frequency of line entanglement (fishing gear), ship strikes, and killer whale inflicted injuries. We had 904 records in our long-term database for whales landed between 1990 and 2012, and after data quality screening, found 521 records containing information on scarring. Logistic regression was used to evaluate different combinations of explanatory variables (i.e., body length, year, sex) to develop a prediction model for each scar type. We also provide a list of bowheads entangled in commercial fishing gear that were harvested, found dead, or observed alive. Our findings suggest that ~12% of harvested bowheads show entanglement scars. The frequency of entanglement scars is highly correlated with body length where ~50% of large bowheads (>17 m) exhibit entanglement scars while whales < 9 m rarely show such scars. Scars associated with ship strikes are infrequent and occur on ~2% of all harvested whales; body length was not a significant factor. Scarring from attempted killer whale predation was evident on ~8% of landed whales. As with entanglement injuries, the frequency of killer whale scars was much higher (> 40%) on whales >16 m and statistically more frequent in the second half of the study (2002-2012). Increased killer whale injuries in the recent decade are consistent with studies conducted on Eastern Canada-West Greenland bowheads. The findings presented here reflect the most thorough analysis of injury rates from entanglement, ships, and killer whales for the BCB bowheads conducted to date. They indicate that: (1) entanglement rates from pot fishing gear (crab/cod) are relatively high (>40%) for very large and presumably older bowheads, (2) collisions with ships are infrequent at present, and (3) scarring from killer whales is frequent (~50%) on very large adult whales

(> 17 m). Considering that bowhead habitat is changing rapidly (e.g., sea ice reduction), industrial ship traffic in the Arctic is increasing, and commercial fishing operations are expanding north, we strongly recommend that monitoring of scarring/injuries on harvested bowheads continue into the future.

Influence of Benthic Communities and Environmental Characteristics on Bearded Seal Foraging Ecology

Michael Cameron
NOAA Alaska Fisheries Science Center, michael.cameron@noaa.gov
Brett McClintock
NOAA Alaska Fisheries Science Center, brett.mcclintock@noaa.gov
Arny Blanchard
University of Alaska Fairbanks, alblanchard@alaska.edu
Peter Boveng
NOAA Alaska Fisheries Science Center, peter.boveng@noaa.gov
Justin Crawford
Alaska Department of Fish & Game, justin.crawford@alaska.gov
John Goodwin
Native Village of Kotzebue, jgoodwin@otz.net
Jacqueline Grebmeier
University of Maryland, jgrebmei@umces.edu
Stephen Jewett
University of Alaska Fairbanks, scjewett@alaska.edu
Bob Lauth
NOAA Alaska Fisheries Science Center, bob.lauth@noaa.gov
Josh London
NOAA Alaska Fisheries Science Center, josh.london@noaa.gov
James Lovvorn
Southern Illinois University, lovvorn@siu.edu
Brenda Norcross
University of Alaska Fairbanks, bnorcross@alaska.edu
Lori Quakenbush
Alaska Department of Fish & Game, lori.quakenbush@alaska.gov
Alex Whiting
Native Village of Kotzebue, alex.whiting@qira.org

Bearded seals (*Erignathus barbatus*) are large phocids that inhabit circumpolar arctic and subarctic waters. They are benthic feeders, consuming epifaunal and infaunal invertebrates and demersal fishes, primarily at depths < 200 m. Our goals were to locate ecologically important areas and to identify specific factors driving bearded seal habitat selection in the northeastern Chukchi Sea during the largely ice-free period from late-June to late-November.

Instead of merely examining space use, we modeled the foraging movements of bearded seals as a function of specific biological and environmental features (e.g., benthic prey composition and abundance, and sediment type), using a two-stage analysis. In the first stage, we used a multistate movement model to identify benthic foraging activity based on biotelemetry data collected from seven adult and subadult

bearded seals. In the second stage, we fit point process models for resource selection using benthic prey data and other environmental covariates as predictors of the foraging locations identified in the first stage.

Bearded seals exhibited positive selection (i.e., preference) for a diverse array of invertebrates (e.g., bivalves and crabs) and fishes (e.g., snailfishes, smelts, cod, and sculpins). For some of these taxa (e.g., sculpins and crabs) only the smaller age-classes were selected for, supporting previous observations from stomach samples. In addition, areas of mud or finer sand were selected against (i.e., avoided), while coarser sand was preferred.

Many of the taxa that were positively selected for have spatial distributions that are concentrated within 50-90 km of the Alaska coastline, a region identified as an ecological hotspot for bearded seal foraging. Indeed, this area appears to constitute a summer “smorgasbord” for these benthic foragers. In contrast, one location farther offshore (71° 20’N 163° 00’W) contained a suite of prey and sediment types that appeared to be avoided by bearded seals. A post-hoc examination found this location to be coincident with the Burger Prospect, an area of significant activity related to oil and gas exploration. Further research will be required, to determine whether disturbance from these activities caused bearded seals (or their preferred prey) to avoid the area.

Arctic - Mammals

Thermal Detection of Polar Bears on Sea Ice Using an Automated Image Collection and Analysis System

Erin Moreland
NOAA Alaska Fisheries Science Center, erin.moreland@noaa.gov
Paul Conn
NOAA Alaska Fisheries Science Center, paul.conn@noaa.gov
Eric Regehr
U.S. Fish and Wildlfie Service, eric_regehr@fws.gov
Erin Richmond
NOAA Alaska Fisheries Science Center, erin.richmond@noaa.gov
Cynthia Christman
NOAA Alaska Fisheries Science Center, cynthia.christman@noaa.gov
Michael Cameron
NOAA Alaska Fisheries Science Center, michael.cameron@noaa.gov
Peter Boveng
NOAA Alaska Fisheries Science Center, peter.boveng@noaa.gov

Instrument-based aerial surveys have proved to be an efficient approach to estimating broadly distributed populations of ice-associated seals by increasing survey range, decreasing disturbance of animals, and reducing error relative to surveys with human observers. Automating data collection and image processing increases efficiency of the survey and post processing of collected imagery. Despite the success of detecting seals on ice, reliability of detecting polar bears has remained uncertain. Recent advances in infra-red technology and the software available to digitally interpret thermal data have led to improvements in polar bear detections. Recent research confirms that modern thermal imagers have adequate sensitivity to detect polar bears on the ice despite the low emissivity of polar bear hairs.

During 2016 surveys of the Chukchi Sea, long wavelength infra-red (LWIR) imagers were used to detect polar bears on sea ice. Automated thermal detection was tested against bears identified by on-board observers. The automated system and its efficacy detecting polar bears in a sea ice environment will be presented.

Combined Seal and Polar Bear Aerial Survey on Ice in the Western Chukchi Sea and Eastern Part of the East Siberian Sea, Spring 2016

Vladimir Chernook
State Research and Design Institute for the Fishing Fleet, chernook@mail.ru
Dmitrii Glazov
Severtsov Institute of Ecology and Evolution, dglazov@yandex.ru
Denis Litovka
Chukotka branch of TINRO-CENTER, dennis.litovka@gmail.com
Aleksandr Vasiliev
State Research and Design Institute for the Fishing Fleet, vasilev9grf@gmail.com
Nikita Platonov
Severtsov Institute of Ecology and Evolution, nikita.platonov@gmail.com
Irina Trukhanova
University of Washington, irina_trukhanova@yahoo.com
Ilia Mordvintsev
Severtsov Institute of Ecology and Evolution, ilia.mordvintsev@gmail.com
Mikhail Stishov
WWF Russia, mstishov@wwf.ru

In the framework of the Chukchi – East Siberian Survey (ChESS) project a Russian team completed an aerial survey of ringed and bearded seals and polar bears in the eastern East Siberian Sea and the western Chukchi Sea. To collect comparable data and combine survey results, the survey was conducted using procedures that were coordinated with American colleagues, who conducted a similar survey simultaneously in the eastern Chukchi Sea. The Russian survey was conducted aboard the research aircraft AN-26 "Arktika" on 18-26 April (4 flights) and 12-18 May (4 flights), 2016. Survey transects (12,800km length) were bounded by the Chukotka coast in the South, and by the Exclusive Economic Zone of Russia in the East and North. The typical flight altitude was 250m, or as low as 150m under low cloud conditions. The flight speed was 270-320km/h. The animals were surveyed by instruments: an IR-scanner "Malachite-M" and Nikon D800 digital color cameras. When the IR-scanner detected a "hot spot", digital cameras were triggered automatically to provide visual images for subsequent species ID. Visual observations through the aircraft bubble windows complemented instrumental surveying and were carried out by four observers, two on each side of the aircraft. The visual observation strip width was about 1000m; the IR-scanner, about 500m. Preliminary data analysis indicated that the density of seals on ice was higher in May than in April. The highest ringed seal density was in Kolyuchinskaya Bay. Thirty-four polar bears were detected during the survey. A large amount of supplementary data (sea ice characteristics, seal water access holes and polar bears tracks) was collected. The observers detected and photographed over 2000 polar bear tracks. Detection of seals and polar bears, both visual and instrumental, will allow estimation of the number

of animals on ice and comparison of the distributions of polar bears and seals. The work has been funded by the National Marine Fisheries Service, NOAA, USA and WWF Russia.

Exposure Risks and Health Effects of Algal Toxins in Marine Mammals Using both Environmental Surveillance and Biomedical Laboratory Models

Kathi Lefebvre
NOAA Northwest Fisheries Science Center, Kathi.Lefebvre@noaa.gov
David Marcinek
University of Washigton, dmarc@uw.edu
Kathy Burek Huntington
Alaska Veterinary and Pathology Services, avps.kbh@gmail.com
Lori Quakenbush
Alaska Department of Fish & Game, lori.quakenbush@alaska.gov
Anna Bryan
Alaska Department of Fish & Game, anna.bryan@alaska.gov
Raphaela Stimmelmayr
North Slope Borough, Raphaela.Stimmelmayr@north-slope.org
Gay Sheffield
University of Alaska Fairbanks, ggsheffield@alaska.edu
Heather Ziel
NOAA Alaska Fisheries Science Center, heather.ziel@noaa.gov
Tracey Goldstein
University of California, Davis, tgoldstein@ucdavis.edu
Jonathon Snyder
U.S. Fish and Wildlfie Service, jonathan_snyder@fws.gov
Tom Gelatt
NOAA Alaska Fisheries Science Center, tom.gelatt@noaa.gov
Frances Gulland
The Marine Mammal Center, Gullandf@TMMC.org
Bobette Dickerson
NOAA Alaska Fisheries Science Center, bobette.dickerson@noaa.gov
Verena Gill
Bureau of Ocean Energy Management, verena.gill@boem.gov

The Wildlife Algal-Toxin Research and Response Network (WARRN-West) provides environmental surveillance for the presence of algal toxins in marine wildlife from the Arctic Ocean to Southern California. Over the last decade the program has analyzed several thousand samples from stranded and harvested animals from more than a dozen species. Additionally, the biomedical diagnostics part of this program has performed controlled laboratory studies using mammalian models to identify health effects of exposure to the algal toxin domoic acid. Data on the prevalence of algal toxins in marine mammals as well as results from controlled laboratory studies will be presented. The effects of acute high level exposure and chronic low-level exposure to domoic acid will be compared. A new paradigm of chronic low-level toxicity has been identified in which a reversible impairment of spatial memory, learning, and activity occurs in the absence of gross morphological lesions in the brain of mammals.

Arctic - Humans

Living with Sea Ice: Voices from Barrow and Kotzebue

Karen Brewster
University of Alaska Fairbanks, karen.brewster@alaska.edu

Building upon the current Northern Alaska Sea Ice Project Jukebox website (www.jukebox.uaf.edu/seaice), where researchers can listen to recordings made in 1978, 2008, 2009, and 2013 with local experts in Barrow, Alaska talking about their traditional knowledge about and observations of changing sea ice, oral history interviews were conducted in 2016 in Barrow and Kotzebue, Alaska. The goal of the Jukebox project is to provide continuity in documentation of changing nearshore sea ice conditions and of "unusual" years. This expanding record is useful to researchers trying to understand the ice environment as well as social scientists studying human adaptation, decision making, and risk taking behavior. In 2016, we expanded our coverage to include documentation of traditional knowledge of nearshore and shorefast sea ice in Kotzebue. This will serve as both a comparative dataset for a location with vastly different ice conditions than Barrow, and as the start of another longitudinal research plan in that area.

Using the people's own words, this project demonstrates how the nearshore sea ice has changed over the past thirty-eight years and how the Inupiat are adapting to these changes. The presentation will focus on similarities and differences between ice conditions and experiences as discussed by the local experts in Kotzebue and Barrow.

This is a NPRB funded project and this presentation represents a final report of the project (project end date of June 30, 2017) as required under NPRB grants. We did not give a presentation in 2016, as the project was not yet fully underway by the abstract submission deadline.

Scientific Research and Subsistence: Protocols to Ensure Co-Existence

Candace Nachman
NOAA National Marine Fisheries Service, Candace.Nachman@noaa.gov
Douglas DeMaster
NOAA Alaska Fisheries Science Center, douglas.demaster@noaa.gov
Amy Holman
NOAA National Ocean Service, amy.holman@noaa.gov

Commercial, industrial, and research interests in the Arctic are expanding rapidly, including in the waters of the U.S. Exclusive Economic Zone. The potentials are numerous and exciting, which has given rise to the need for guidelines to ensure interactions among waterway users do not conflict. Of particular concern is the potential for adverse impacts to the U.S. Arctic coastal communities that rely on sea life for nutritional and cultural health, through subsistence hunts from small craft. Recent events have raised concerns over research surveys potentially interfering with subsistence hunts in the Bering, Chukchi, and Beaufort Seas. Incidents have led to calls by Native Alaskan communities to restrict science activities and defensive reactions by science agencies and Principal Investigators. With a common goal of wanting to mitigate this potential interaction, Federal agencies made a commitment in the National Strategy for the Arctic Region to coordinate and consult with Alaska Natives and also to pursue responsible Arctic stewardship, with understanding through scientific research and traditional knowledge. The effort to create a "Standard of Care" for research surveys incorporates best practices by many in the AMSS community in order to ensure potential conflicts between the scientific research community and subsistence hunters are avoided and to encourage mutual assistance and collaboration between researchers and hunters. The guidelines focus on enhancing communication between researchers and Native Alaskans before, during, and after research occurs. In this presentation, we will outline the importance of establishing these guidelines, describe the general process, and highlight examples of positive interactions with Alaska Native hunters during scientific research operations using this protocol.

Social Indicators in Alaska: Arctic Communities

Stephen Braund
Stephen R. Braund & Associates, srba@alaska.net
John Kruse
Stephen R. Braund & Associates, Jack.Kruse@arctichost.net

The Bureau of Ocean Energy Management (BOEM) is the federal agency responsible for monitoring and mitigating the adverse impacts associated with offshore resource development. In 2011, BOEM commissioned a study entitled *Social Indicators in Alaska: Arctic Communities,* the intent of which was to "provide updated sociocultural and economic baseline data for analysis of potential local and regional impacts from offshore exploration and development activities that may occur in federal waters off the North Slope of Alaska." The study called for the development of a set of social domains, and within each domain, a set of quantitative indicators of human well-being; these indicators were then measured through implementation of a household survey in the six coastal North Slope communities of Point Hope, Point Lay, Wainwright, Barrow, Nuiqsut, and Kaktovik. With the help of the North Slope Borough Department of Wildlife Management, the study team established the North Slope Management Board (NSMB), which included representatives from each of the six study communities as well as a representative from the Alaska Eskimo Whaling Commission (AEWC). In April 2011, the NSMB assisted the study team in selecting a set of social indicators under the following six domains: 1) Economic Well-Being; 2) Health and Safety; 3) Cultural Continuity; 4) Local Control; 5) Physical Environment; and 6) Education. The study team subsequently developed a questionnaire and submitted the questionnaire to the Office of Management and Budget for approval. After receiving OMB and community approval for the research, the study team implemented the household survey from January 2016 through March 2016 and completed 684 household surveys on the North Slope. The report includes the results of the 2016 household survey, and also provides comparative results of social indicators studies from 1977, 1988, and 2003. Results are reported under five aggregate data comparison groups: 1) Impacts by Community; 2) Social Indicators by Community; 3) Social Indicators for North Slope Iñupiat over Time; 4) Social Indicators by Gender; and 5) Social Indicators for Arctic Indigenous

The Arctic Marine Pulses Model: Linking Annual Oceanographic Processes to Contiguous Ecological Domains in the Pacific Arctic

Sue Moore
NOAA Fisheries, sue.moore@noaa.gov
Phyllis Stabeno
NOAA Pacific Marine Environmental Laboratory, phyllis.stabeno@noaa.gov
Jacqueline Grebmeier
University of Maryland, jgrebmei@cbl.umces.edu
Stephen Okkonen
University of Alaska Fairbanks, okkonen@alaska.net

The Pacific Arctic marine ecosystem extends from the northern Bering Sea, across the Chukchi and into the East Siberian and Beaufort seas. Food webs in this ecosystem are short, a simplicity that belies the biophysical complexity underlying trophic linkages from primary production to humans. Existing advective and pelagic-benthic coupling models describe processes that connect certain aspects of marine food webs, but do not offer a comprehensive approach to understanding the Pacific Arctic ecosystem. In the course of the Synthesis of Arctic Research (SOAR) project, an Arctic Marine Pulses (AMP) model was developed that depicts seasonal biophysical 'pulses' across a latitudinal gradient by linking processes in four previously-defined contiguous ecological domains, including the: (i) Pacific Arctic domain; (ii) Seasonal Ice Zone domain; (iii) the Marginal domain (i.e., the shelf break and slope); and (iv) Riverine Coastal domain. Some of the biophysical processes included in the AMP model, such as pelagic-benthic coupling on the broad shelves of the northern Bering and Chukchi seas and advection and upwelling of zooplankton along the western Beaufort shelf, have been the focus of long-term studies. Other aspects such as biological processes associated with shifts in seasonal sea-ice phenology and trophic responses to riverine outflow have received less attention. The AMP model provides an annual spatiotemporal framework to guide research on dynamic ecosystem processes during the recent period of rapid biophysical changes in the Pacific Arctic. The model aims to encourage integrated research to track seasonal sea-ice and current-flow dynamics, coincident with variability in nutrients, benthic and pelagic production, and upper-trophic species occurrence to provide a foundation for the development of predictive human-inclusive ecosystem models for the Pacific Arctic region. We suggest that the AMP model, with its focus on phenology, might facilitate communication between conventional science approaches to marine research and seasonal-cycle based indigenous knowledge of marine ecosystems. The goal of improving our understanding of the state and variability of the Pacific Arctic marine ecosystem is a shared one and we conclude with views on how the AMP model can support that goal while contributing to the development of a pan-Arctic ecosystem model.

An Integrated Look at the Alaska Beaufort Sea

Jeremy Kasper
University of Alaska Fairbanks, jlkasper@alaska.edu
Ken Dunton
University of Texas at Austin, ken.dunton@utexas.edu
Justin Blank
Fairweather Science, LLC, justin.blank@fairweather.com
Bodil Bluhm
Department of Arctic and Marine Biology, UiT - The Arctic University of Norway, Tromsø, bodil.bluhm@uit.no
Catherine Coon
BOEM, Alaska OCS Region, Anchorage, catherine.coon@boem.gov
Gregory Durell
NewFields, gdurell@newfields.com
Katrin Iken
University of Alaska Fairbanks, kbiken@alaska.edu
Alexandra Ravelo
University of Alaska Fairbanks, amravelo@alaska.edu
Susan Schonberg
University of Texas at Austin, susan.schonberg@utexas.edu
John Trefry
Florida Institute of Technology, Melbourne, jtrefry@fit.edu
Tim Whiteaker
University of Texas at Austin, whiteaker@utexas.edu

The Arctic Nearshore Impact Monitoring in Development Area (ANIMIDA) project phase III (2014-2016) is the latest in a series of BOEM funded ecosystem studies of the Beaufort Sea designed to describe parts of this shelf in terms of its physical oceanography, benthic infauna and epifauna, and contaminant foot print (e.g. hydrocarbons, trace metals). In contrast to the Chukchi, the shelf of the Beaufort Sea is well known for its strong physical gradients that distinctively influence the distribution of benthic fauna. We found infaunal and epifaunal communities were relatively depauperate in species richness and abundance/biomass near the 20 m isobath, but the absence of benthic biota was most pronounced in the Colville River delta, likely related to a combination of sediment transport, bottom fast ice, scour by deep-draft ice, and extreme temporal and spatial variations in salinity throughout the annual cycle. Deeper shelf areas were generally more species rich, but a region of high infaunal diversity and biomass were observed north of Barter Island from nearshore to the shelf break, an area historically known for upwelling events. Stable carbon and nitrogen isotopic composition of benthic organisms, particulate organic matter and zooplankton revealed a mixture of carbon sources available to benthic consumers, consisting mostly of phytoplankton, benthic microalgal matter and terrestrial sources. Contaminant concentrations in sediments and biota are near background levels throughout most of

the Beaufort (with the notable exception of higher levels around historic exploratory drilling sites). Fish, amphipods, and clams also contained background levels of hydrocarbons. These patterns reflect the very dynamic nature of the Beaufort Sea shelf, which is characterized by strong land-ocean interactions that have likely contributed to the notable lack of accumulated contaminants despite decades of industrial activity in the region. In 2015 ANIMIDA scientists also successfully sampled the two newest lines in the Distributed Biological Observatory network at 152W and 143W. These two lines represent the first expansions of the DBO monitoring network that will eventually result in the formation of a circumpolar long term monitoring effort to understand ecosystem change due to climate change in polar Arctic regions.

Workshops: Friday, January 27

TIME	TITLE	ROOM
9:00 AM - NOON	Arctic IERP and Collaboration Opportunities	Aft Deck
11:00 AM - 5:15 PM	Alaska Coastal Marine Institute Review	Quarter Deck
1:00 PM - 5:00 PM	The U.S.-Canada Transboundary Fish and Lower Trophic Survey	Aft Deck
8:00 AM - NOON	The Alaska Marine Mammal Stranding Network	Quadrant Room
1:00 PM - 5:00 PM	Cook Inlet Beluga Management, Research, and Partnership Opportunities	Quadrant Room
8:00 AM - 11:00 AM	Introduction to Metadata Workshop	Resolution Room

Poster Abstracts

Exploring Short-Term Variation in Ocean Circulation Patterns to Better Understand Hydrographic Factors Relevant to Harmful Algal Blooms in Kachemak Bay, Alaska

Angela Doroff
University of Alaska Anchorage, adoroff@alaska.edu
Mark Johnson
University of Alaska Fairbanks, majohnson@alaska.edu
Georgina Gibson
University of Alaska Fairbanks, gagibson@alaska.edu
Catie Bursch
University of Alaska Anchorage, cmbursch@alaska.edu

Phytoplankton in Kachemak Bay are monitored throughout the year; by mid-May in 2016 the KBNERR monitoring program had documented thick phytoplankton blooms of *Psuedo-nitzschia* and *Chaetoceros* and had identified *Alexandrium* cells in the water. Paralytic shellfish poisoning (Saxitoxin) is produced by a species of *Alexandrium* and amnesic shellfish poisoning (domoic acid) is produced by *Psuedo-nitzschia.* Variation in the prevalence and severity of Saxitoxin events varies considerably throughout Alaska coastal waters likely due to the interplay between environmental and hydrographic factors and the biology of Saxitoxin-producing species. In Kachemak Bay, we explored short-term variation in circulation patterns with satellite drifters and a ROMS circulation model to better understand the prevalence and timing of Saxitoxin events in relation to local advection patterns and convergence and divergence patterns that may affect phytoplankton blooms. In 2016, preliminary data from deep (15 m drogued) and surface (1 m drogued) satellite drifter data suggest that the toxic forms of *Psuedo-nitzschia* and *Alexandrium* may have been resident and not transported into Kachemak Bay by intrusions of the Alaska Coastal Current during the time of this study. During 2012-2013, average drift days in the inner and outer Bay, respectively, were 19.4 and 8.2 days for deep and surface drifters combined. Model velocity fields suggest that on longer (monthly) timescales the inflow/outflow patterns in Kachemak Bay are relatively consistent. However, preliminary examination of water velocity at the surface and 15 m depth indicate daily to bi-weekly variability to this pattern and in the location of patches of convergence.

A Longitudinal Study of Fluctuating Radiation Levels in Prince William Sound Alaska; A Conclusion to a Four Year Study

Jedediah Dean I
quantum.torpedo5@gmail.com

Is it radioactive? That's what everyone asks when I tell them that I tested items from Prince William Sound (PWS) beaches with my family. I'm concerned with what has, and what will wash up on Alaskan beaches. I've been concerned ever since the earthquake and tsunami in March 2011. When it occurred, it damaged the Fukushima-Daiichi nuclear reactor in Japan. It's been leaking radioactive material ever since the accident, spewing radioactive water into the Pacific Ocean and contaminating the environment. I believe that when the reactor was damaged it contaminated tsunami debris, and it's now washing onto our coasts. I've been testing beaches across PWS for gamma radiation, which could only come from a few sources, and the reactor in Japan is suspect. Procedures for this experiment:

- Obtain testing equipment
- Arrive at site(s)
- Test area- follow experimental procedure
- Repeat testing procedures at every site
- Record Data

The purpose of my experiment was to test if items washing up on our beaches, such as natural items (trees, logs, seaweed etc.), flotsam (buoys, Styrofoam, etc.), and marine mammals, have elevated radiation levels. This past year, I tested flotsam, as I did all four years, but I also tested sea life, mainly focused on halibut, salmon, and rockfish. During my third season of testing, I found increasing levels of radiation on the several beaches. In two locations radiation levels were approximately thirty times higher than the previous years, and all tested locations had higher radiation levels than previous years, along with this past final year of scanning. This was the final year of a four-year research project, in which I will present my findings and conclusions on the subject.

Effects of the 2013-2016 Warm Anomaly in Prince William Sound

Robert Campbell
Prince William Sound Science Center, rcampbell@pwssc.org

Survey data and high frequency observations made with a profiling mooring show that the surface waters of Prince William Sound switched from a generally negative temperature anomaly to a positive one in the last quarter of 2013, approximately the same time as the formation of the large warm anomaly in the Gulf of Alaska. Buoy observations suggest that the local mechanism was the same as hypothesized as in the GoA: reduced winter heat flux caused by atmospheric conditions.

Temperatures were ~1.5-2°C above average over most of the water column for 2014 to 2016, and as high as 4°C above average in August 2015 and 2016. The effect was great enough to overwhelm a cooling and freshening trend (presumably caused by precipitation and loss of ice mass) observed in surface waters of the Northwest portion of the Sound in recent years.

The spring bloom in central PWS was remarkably different between 2014 and 2016: 2014 was possibly the earliest on record with nitrate concentrations approaching zero several weeks ahead of schedule. The 2015 bloom was approximately on time, but was quite small and episodic, and often did not result in a full drawdown of nitrate. The 2016 bloom was also among the smallest on record. Increased near-surface stability has resulted in a shallowing of the seasonal pychnocline, with most productivity centered at the resulting nitricline.

Modeling Inorganic Carbon Dynamics in Near-Shore Environments of the Gulf of Alaska

Seth Danielson
University of Alaska Fairbanks, sldanielson@alaska.edu
Claudine Hauri
University of Alaska Fairbanks, chauri@alaska.edu
Katherine Hedstrom
University of Alaska Fairbanks, kshedstrom@alaska.edu
Jordan Beamer
Oregon Water Resources Department, jordan.beamer@gmail.com
David Hill
Oregon State University, david.hill@oregonstate.edu

The few available observations document a seasonal manifestation of subsurface aragonite undersaturation in coastal waters of the Gulf of Alaska. Climate induced enhancement of glacial melting is prone to accelerate the progression of ocean acidification in the Gulf of Alaska even further. If it expands in time and space, such undersaturation could engender detrimental consequences for CO2 sensitive organisms and potentially lead to altered food web structures, ultimately imparting large ecosystem and socio-economic consequences. However, the currently limited spatial and temporal data coverage precludes a detailed conceptual understanding of the physical and biological mechanisms controlling the local carbon dynamics and thus impedes our ability to anticipate and mitigate future changes. We will show some first results from our high resolution, carbon based biogeochemical regional model (ROMS-Cobalt, 4.5 km) that is forced explicitly with coastal freshwater discharges, to better represent the ongoing climate change driven melting of glaciers. The model results will give insights into seasonal and interannual variability of enhancing and inhibiting controls of ocean acidification and to detangle the complex interplay of mechanisms that drive aragonite undersaturation.

Investigating the Relationship between Zooplankton and Particle Penetration

Jessica Pretty
University of Alaska Fairbanks, jlpretty@alaska.edu
Andrew McDonnell
University of Alaska Fairbanks, amcdonnell@alaska.edu

Particle dynamics in the ocean is a particularly important topic in constraining the ocean's role in the global carbon cycle. The objective of this research is to investigate the influence of zooplankton on sinking particle flux. More specifically, this research aims to describe how the abundance of zooplankton relates to the change in particle size distribution with depth in two distinct regions: the Equatorial Pacific and the North Pacific Gyre. Data collected by the Underwater Vision Profiler (UVP5), an optical instrument, and an Acoustic Doppler Current Profiler (ADCP) are used to estimate three parameters: the relative abundance of zooplankton, the particle size distribution of material in the water column, and the magnitude of vertical migration of zooplankton. It is postulated that regions with a larger amplitude of zooplankton diel vertical migration correlate positively with regions of increased particle flux, where increased concentrations of large particles make it to a deeper depth (>1000 meters). The data used in this research were collected during the P16N Hydrography cruise on the R/V Ronald H. Brown in May and June 2015.

Building a Baseline for Ocean Acidification Trends in Coastal Communities of South-Central Alaska

Jacqueline Ramsay
Alutiiq Pride Shellfish Hatchery, jacqueline@alutiiqpridehatchery.com
Wiley Evans
Hakai Institute, wiley.evans@hakai.org
Jeff Hetrick
Alutiiq Pride Shellfish Hatchery, jjh@seward.net
Burke Hales
Oregon State University, bhales@coas.oregonstate.edu

Alaskan coastal waters are especially vulnerable to ocean acidification (OA) and yet many of the monitoring efforts to date have focused on the coastal ocean outside of 1 km from land. Only limited information exists in the near-shore band, and here we have optimized a land-based monitoring platform to process seawater samples collected by citizen scientists from native communities around south-central Alaska. To date we have developed partnerships with six (7) coastal communities including: Cordova, Homer, Nanwalek, Port Graham, Seldovia, Seward and Valdez. At each site, weekly surface seawater samples are collected and shipped to the Alaskan Ocean Acidification and Shellfish research lab located at the Alutiiq Pride Shellfish Hatchery in Seward for analysis on our Burke-O-Lator CO_2 partial pressure (pCO_2) / total CO_2 (TCO_2) analyzer. A few select sites have more expanded sampling taking place that includes full water column profiles on a routine basis. This project offers the opportunity to document OA conditions near shore and relate those to the more traditional oceanographic work occurring away from shore, as well as provide information on OA that is specific and relevant to the local environment of south-central Alaskan native communities. In this presentation we will present some of our preliminary results.

What Changes in a Zombie Crab? Differences in Metabolites between Healthy King Crabs and Those Infected with a Parasite

Leah Sloan
University of Alaska Fairbanks, lmsloan@alaska.edu
Lara Horstmann-Dehn
University of Alaska Fairbanks, lara.horstmann@alaska.edu
Sarah Hardy
University of Alaska Fairbanks, smhardy@alaska.edu

King crabs are an essential component of Alaskan seafloor ecosystems and they support highly productive fisheries, thus changes in king crab abundance can have far reaching impacts. Parasites can represent a significant stressor in crustacean populations, rendering previously healthy stocks more vulnerable to fishing pressures. *Briarosaccus* is a king crab parasite that castrates host crabs, thereby preventing host reproduction and potentially altering host abundance. Once infected, the crabs act like "zombies", for they become mere bodies controlled by this internal parasite. Despite the physiological, morphological, and behavioral changes these parasites cause in the host, how the parasite "takes control" of its host and manipulates its behavior remains unknown. We are using the newly emerging metabolomics technique to compare the metabolite profiles (e.g., signaling molecules and products of body's metabolism) of infected and healthy red (*Paralithodes camtschaticus*) and golden (*Lithodes aequispinus*) king crabs. Tissue samples (hemolymph, hepatopancreas, and muscle) were collected in Southeast Alaska during surveys and on commercial vessels with observers. After processing hundreds of metabolites were identified. There were distinct differences in the metabolic profiles found in infected and healthy crabs. Some metabolites were higher in healthy crabs, while others were higher in infected crabs. For example, in the hepatopancreas of infected red king crab ostruthin, an antimicrobial agent, was upregulated, while methylimidazoleacetic acid, a histidine metabolite, was downregulated. In the hemolymph of infected golden king crab, both the neurotransmitter indoleamine and the amino acid glutamine were downregulated. Differences in the metabolic profiles were found in all tissue types, which indicates that physiological processes throughout the bodies of crab hosts change when infected with *Briarosaccus.* It may be through this method that the parasite can manipulate the behavior of crabs and prevent them from reproducing. These findings help us understand how the internal physiology and reproduction of king crabs is altered when infected by the parasite, *Briarosaccus*.

Population Dynamics of Pinto Abalone Aggregations in Sitka Sound, Alaska

Lauren Bell
Sitka Sound Science Center, lbell@sitkascience.org
Taylor White
University of California, Santa Cruz, twhite1@ucsc.edu
Mike Donnellan
Alaska Department of Fish & Game, mike.donnellan@alaska.gov
Kyle Hebert
Alaska Department of Fish & Game, kyle.hebert@alaska.gov
Peter Raimondi
University of California, Santa Cruz, raimondi@ucsc.edu

The absence of basic population data for pinto abalone (*Haliotis kamtschatkana*) in Alaska poses an ongoing challenge to informed management of this important subsistence species at the northernmost end of its range. In 2014, the National Marine Fisheries Service determined that listing pinto abalone as “Endangered” or “Threatened” under the Endangered Species Act was not warranted, citing the lack of population assessments in Alaska. Southeast Alaska is currently the only region where harvest of pinto abalone remains legal, though only for personal use and subsistence fisheries. This is despite significant historical harvest pressures, such as a ‘boom and bust’ commercial fishery for pinto abalone in Southeast Alaska which saw a 96% decline in absolute harvests from peak catch in 1979-80 to commercial fishery closure in 1996. In addition, regional sea otter populations have rebounded in recent decades, substantially increasing predation pressure on abalone. To address these concerns, the Sitka Sound Science Center, Alaska Department of Fish and Game, and University of California Santa Cruz have initiated a long-term monitoring program of pinto abalone populations in Sitka Sound, Alaska. Findings from the first two years of aggregation-targeted surveys and recruitment indices at eight subtidal index sites are presented here. A repeated sampling design allowed for comparisons of population densities and size structures among sites and between summer months (June and August) at each site. Paired 30 x 2 m swath transects placed at -4 and -9 m depth (MLLW) at most sites revealed depth-specific patterns in abalone aggregations, with consistently greater abundances and larger average size at shallower depths. Individual abalone at most sites were highly mobile and exposed, i.e., accessible for harvest by sea otters or free-divers. Results of each bi-annual sampling event indicate that less than one-fifth of abalone across sites were equal to or larger than 89 mm, the legal minimum size for harvest. Methodology and results from these two years of work have already informed survey extensions across other regions of Southeast Alaska, with a collective goal towards utilizing these data to evaluate the sustainability of continued pinto abalone harvest in Alaskan waters.

Trends in Intertidal Seastar Abundance and Diversity across the Gulf of Alaska: Looking for Impacts of Seastar Wasting

Brenda Konar
University of Alaska Fairbanks, bhkonar@alaska.edu
Katrin Iken
University of Alaska Fairbanks, kbiken@alaska.edu
Heather Coletti
National Park Service, heather_coletti@nps.gov
Tom Dean
Coastal Resource Associates, tomdean@coastalresources.us
Dan Esler
U.S. Geological Survey, Alaska Science Center, desler@usgs.gov
Ben Weitzman
U.S. Geological Survey, Alaska Science Center, bweitzman@usgs.gov
Kim Kloecker
U.S. Geological Survey, Alaska Science Center, kkloecker@usgs.gov
Mandy Lindeberg
NOAA Alaska Fisheries Science Center, mandy.lindeberg@noaa.gov
Benjamin Pister
National Park Service, benjamin_pister@nps.gov

Seastars are ecologically important in intertidal systems. They can be predators, grazers and/or scavengers and thus play a key role in trophic cascades. In 2014, seastar wasting expanded north from California and reached the Gulf of Alaska, where numerous seastars were found exhibiting symptoms of this disease in Kachemak Bay and Prince William Sound. Gulf Watch Alaska and similar long-term monitoring programs have been surveying seastars for approximately ten years in Kachemak Bay, Katmai National Park and Preserve, Kenai Fjords National Park, and Prince William Sound. These data were recently examined to determine if effects of seastar wasting could be detected. Our analyses demonstrated that a decline in seastar density was found in Kenai Fjords National Park but was not obvious for the rest of the central Gulf of Alaska, probably because of the general high temporal variability in seastar densities in all surveyed regions. In addition to high temporal variability in abundance, diversity and dominance of individual species varied greatly among regions. While the disease has not yet discernably impacted the density of intertidal seastars in the central Gulf of Alaska, monitoring of these important species will continue. Continued monitoring will also provide insights into seastar response as environmental conditions change over time.

Spatial Variability in Mussel Size Frequency Distribution in the Gulf of Alaska

Katrin Iken
University of Alaska Fairbanks, kbiken@alaska.edu
Brenda Konar
University of Alaska Fairbanks, bhkonar@alaska.edu
Dan Esler
U.S. Geological Survey, desler@usgs.gov
Ben Weitzman
University of Alaska Fairbanks, bpweitzman@alaska.edu
Heather Coletti
National Park Service, heather_coletti@nps.gov
Dan Monson
U.S. Geological Survey, dmonson@usgs.gov
Brenda Ballachey
U.S. Geological Survey, bballachey@shaw.ca
Jim Bodkin
U.S. Geological Survey, jldbodkin@gmail.com

Mussels (*Mytilus trossulus*) are key components of Alaskan intertidal communities, where they act as primary space competitors, contribute to the overall diversity and productivity of intertidal systems, and are a key prey item for higher trophic levels. Yet, the dynamics that drive mussel populations at local and regional scales in the Gulf of Alaska (GoA) are not well understood. Here we investigated size-frequency distribution of mussels at five sites each in four GoA regions (Western Prince William Sound, Kenai Fjords National Park, Kachemak Bay, Katmai National Park and Preserve), as part of the Gulf Watch Alaska Program in 2014, 2015, and 2016. On a regional scale and across all years, the overall size-frequency distributions of mussels were relatively similar. However, in all years Kachemak Bay had the highest proportion of newly settled mussels (≤5 mm, between 30-48% of the mussels measured in that region), except for 2014, where abundance of mussels ≤5 mm peaked at Kenai Fjords with 67%. In all years, abundance of newly settled mussels was always lowest in Western Prince William Sound (14-17%), with intermediate numbers at Katmai (24-34% each), and in 2015 and 2016 at Kenai Fjords (21-25%). Katmai had the largest occurrence of larger mussels (>30 mm) of all regions in all years. Variability in size-frequency distribution was high among sites within each region in all years; this variability was particularly strong in the new settlement cohort. In many cases, the same sites per region had the highest (or very high) new settlement in all three years. It seems that larval supply and/or post-settlement dynamics vary across regions, but also among sites within each region. Differences in large mussels at the site level could indicate local differences due to predation, other physical removal pressures (storms, ice scour, etc.), or available food supply for mussels.

Intertidal and Subtidal Colonization of New Rock at the Kodiak Airport

Leyla Arsan
Birch Leaf Consulting, LLC, leyla.arsan@birchleafconsulting.com
Tom Lance
Sun'aq Tribe of Kodiak, talance@sunaq.org
Kelly Krueger
Sun'aq Tribe of Kodiak, kkrueger@sunaq.org

New armor rock placed at the Kodiak Airport is being monitored to document recruitment and colonization of invertebrates and algae and provide information regarding the associated rate of increase in ecological function post-construction. Few data are available regarding colonization rates or recolonization rates post-disturbance in southcentral Alaska or high northern latitudes. As part of the Kodiak Airport Runway Safety Area Expansion, new armor rock was placed in the intertidal and subtidal area along the coastal edge of several runways. The fill is being monitored for colonization rates, species abundance, and assemblage parameters (percent cover of algae and invertebrates). A reference site with similar habitat characteristics (substrate, exposure, depth, and salinity) is also being monitored. Sites will be sampled annually from 2016 to 2018. This study will provide information regarding nearshore marine disturbance recovery in hard-bottom habitats in southcentral Alaska. Because of the potential impacts of rock armor on aquatic habitats, on both a local scale and a cumulative landscape scale, the colonization rate of rock armor and the timeframe to which it develops higher ecological functions is important. The need and quantity of mitigation for projects that disturb marine substrates or add new fill to existing substrates is currently based on assumptions and this project will provide data to better inform mitigation decisions in the future.

Giant kelp (*Macrocystis pyrifera*) and Hydrographic Variability in Nearshore Sitka Sound, Alaska

Eva Sandri
U.S. Coast Guard Academy, eva.m.sandri@uscga.edu
Sydney Mills
U.S. Coast Guard Academy, sydney.c.mills@uscga.edu
Lauren Bell
Sitka Sound Science Center, lbell@sitkascience.org
Lucy Vlietstra
U.S. Coast Guard Academy, lucy.s.vlietstra@uscga.edu

The purpose of this study was to examine the role of giant kelp (*Macrocystis pyrifera*) forests in minimizing hydrographic variability in Sitka Sound, Alaska. This study was conducted in conjunction with a broader monitoring study of climate change and kelp beds in the region. We compared temporal variability in water temperature at the surface and bottom depths of two kelp beds of similar size, Galankin and Ellsworth, from 9 July 2015 to 20 July 2016. The same parameters were measured at two adjacent control sites without kelp. Water temperature at each site was measured every 15 minutes during the study period with a combination of autonomous HOBO data loggers (UTBI-001, U24-002-C, Onset Computers, Inc.). We also developed vertical temperature profiles of the water column at kelp and control sites during June-July 2016 using a 6500 YSI sonde. Overall, the mean size of Galankin was 3,893 m^2, and the mean size of Ellsworth was 3,019 m^2. Surface temperature varied between 5 °C and 19.3 °C at Galankin and between 3.9°C and 19.4 °C at Ellsworth, with winter temperatures being distinctly lower than summer ones at both sites. In contrast, the control sites displayed a larger range of surface temperatures: 4.4°C to 19.4 °C at Galankin and 4.4°C to 20.5 °C at Ellsworth. Bottom temperatures at the kelp sites were not as variable during the year, and they contrasted little with those at control sites. Vertical profiles showed contrasting hydrographic structure within kelp beds relative to control sites, especially at depths near the surface. Our findings address the role of *Macrocystis* kelp beds as a thermal buffer in coastal ecosystems, an important finding in the face of increasing ocean temperatures across the Gulf of Alaska. Future work will incorporate additional water parameters measured with a YSI-equipped harbor buoy (EMM68, YSI Inc.) recently deployed in the nearshore Sitka Sound.

Abalone Aggregations and Critical Densities in Sitka Sound Alaska

Taylor White
University of California, Santa Cruz, twhite1@ucsc.edu
Lauren Bell
Sitka Sound Science Center, lbell@sitkascience.org
Peter Raimondi
University of California, Santa Cruz, raimondi@ucsc.edu

Pinto abalone (*Haliotis kamtschatkana*) are broadcast spawners and their population viability depends on maintaining sufficient densities for fertilization. Populations with densities consistently below a critical level may be subject to an “Allee Effect”, which could compromise both genetic and demographic structure. Densities critical to abalone fertilization success can vary species to species and within a species. The few data on pinto abalone indicate these densities can range from 0.12 to 0.62/m^2. It is not yet known whether these values are sufficient to facilitate fertilization making it difficult to assess the viability of individual populations. Therefore, determining pinto abalone aggregation structure and comparing density data with abalone recruitment are important steps in determining future success of the species in its northernmost range. The goal of our abalone “neighborhood” surveys in Sitka Sound is to evaluate whether within-aggregation densities, abalone sizes and neighbor distances are sufficient for successful broadcast spawning when compared to measured recruitment. These surveys were performed at permanent monitoring sites previously established by the Sitka Sound Science Center and Alaska Department of Fish and Game in Sitka Sound, Alaska. At each site, abalone were surveyed within a 50m^2 grid centered over the first 10m of the permanent swath transects. Each abalone was measured and the distance to nearest neighbors was determined. Pinto abalone mature around 50mm so size estimates will be used to establish the reproductive density for each site. Nearest neighbor analysis for mature individuals will provide individually based spatial information on the reproductive neighborhood. We also estimate exposure to predation for all sites within Sitka Sound and preliminary analyses suggest site specific differences in exposure. Additional seasonal surveys will allow for an understanding of temporal aggregation shifts. These data and analyses will contribute to informed policy decisions (e.g. determination of ESA status), and management for spatially specific sustainable take.

Exploring Primary Productivity Processes during 2012-2016 through Continuous Time-Series Data on Water Quality in Kachemak Bay

James Schloemer
Kachemak Bay National Estuarine Research Reserve, jwschloemer@alaska.edu
Angela Doroff
Kachemak Bay National Estuarine Research Reserve, adoroff@alaska.edu
Catie Bursch
Kachemak Bay National Estuarine Research Reserve, cmbursch@alaska.edu
Steve Baird
Kachemak Bay National Estuarine Research Reserve, sjbaird@alaska.edu
Rosie Robinson
Kachemak Bay National Estuarine Research Reserve, rmrobinson3@alaska.edu

Kachemak Bay is a complex estuary with multiple fresh water inputs including glacial melt water (late summer/fall) and a tidal range of up to 9 m. Beginning in 2001, continuous monitoring of water quality variables provided high-resolution information on seasonal fluctuations and monthly variability of abiotic conditions in the Kachemak Bay estuary. Beginning in 2012, our community-based phytoplankton monitoring program collected and summarized weekly data on surface phytoplankton throughout the year. Water temperatures during the study period included an anomalous cold-water year, a transition year, followed by three anomalous warm-water years. Warmer temperatures may facilitate the onset of HABs and in 2015-2016 our monitoring programs identified toxic events and informed regional closures for shellfish harvest in the Bay. We examine the onset and duration of phytoplankton proliferation relative to water temperature, salinity, photosynthetically active radiation, dissolved oxygen, as well as chlorophyll fluorescence. The diversity of phytoplankton occurring in Kachemak Bay consists of diatoms (32 genera/ 11 common) and dinoflagellates (12 genera/ 5 common), providing additional complexity given genera-specific bloom conditions, however, the annual onset of phytoplankton production and depletion are evident in these data. Diatoms generally become abundant in early spring; during 2012, 2014, and 2015 (phytoplankton became abundant April 01 ± 1 week); 2013 (March 23 ± 1 week); 2016 (May 01 ± 1 week). Dinoflagellates became abundant for periods in mid-late fall; 2013 (August 01 - 14 and September 15 – November 14); 2014 (September 01 – 07); 2015 (October 8 – 31); 2016 (August 23 – September 7); 2012 (no dominance observed). By November 14 of all years there were low levels of phytoplankton in the system until the following spring. Despite favorable growth conditions there were isolated periods of low presence during 2013, 2014, and 2015. These data suggest influence by other system factors and the need for more thorough inspection of its components.

Seasonal Variation of Zooplankton Communities and Abundance in Prince William Sound, AK 2009-2016

Caitlin McKinstry
Prince William Sound Science Center, cmckinstry@pwssc.org
Rob Campbell
Prince William Sound Science Center, rcampbell@pwssc.org

In the northern Gulf of Alaska, large lipid rich copepods constitute the majority of zooplankton biomass during the critical grazing period of the spring phytoplankton bloom. These and other zooplankters comprise the prey field for ecologically and economically important predators such as juvenile pink salmon, herring, other fishes, seabirds, and marine mammals. Little information exists regarding shifts in zooplankton community structure throughout the year in the Prince William Sound (PWS). From 2009-2016, the Gulf Watch Alaska long term monitoring program sampled zooplankton at 12 stations around PWS. Bongo net trawls (0-50m) carried out 5-10 times per year collected 188 species of zooplankton with *Oithona similis*, *Limacina helicina*, *Pseudocalans spp.*, and *Acartia longiremis* as the most common plankters in 519 samples. Community assemblages determined via hierarchical cluster analysis and indicator species analysis produced six distinct communities. These analyses were validated with nonmetric multidimensional scaling using a Bray-Curtis dissimilarity matrix (3D stress = 0.17). Zooplankton communities remained low in abundance in the winter (894.7 ± 112.7 no. m^{-3}) and were characterized by warm-water indicator species including *Mesocalanus tenuicornis* and *Calanus pacificus*. Zooplankton abundance peaked at 38784.1 no. m^{-3} (± 10106.4 se) in the late spring/early summer. The winter assemblage diverged based on location into three communities as indicated by small copepods, meroplanktonic larvae, and large calanoid copepods (*Neocalanus flemingeri*, *Eucalanus bungii*, *Calanus marshallae*) at open water stations. Large calanoid communities persisted into late summer and spread into PWS bays. In the early fall, zooplankton communities sound-wide began to converge back to the winter community as indicated by a transitional gelatinous carnivore community. ANOVA showed significantly higher zooplankton abundance in 2010 (542.45 no. m^{-3} ± 55.13) compared to all other years and lowest in 2013 (149.36 no. m^{-3} ± 12.91). The BIOENV-BEST method showed significant correlations with mixed layer average salinity, sea surface temperature, mixed layer depth, chlorophyll maximum (via CTD), depth of chlorophyll max, location, and bottom depth ($r = 0.24$, $p < 0.05$), and Julian day ($r = 0.44$, $p < 0.05$).

Implications of Environmental Changes to a Nearshore Zooplankton Community

Emily Fergusson
NOAA Alaska Fisheries Science Center, emily.fergusson@noaa.gov
Ron Heintz
NOAA Alaska Fisheries Science Center, ron.heintz@noaa.gov
Courtney Weiss
Ocean Associates, Inc., courtney.weiss@noaa.gov

Climate modeling scenarios that indicate increasing temperatures in the GOA suggest pending changes in the quality of prey for planktivorous fishes. Evidence from the Bering Sea, California Current, and Bay of Fundy suggest that the direct effects of warming will include altered community structure and reduced lipid content in fish prey while indirect effects of warming may include the introduction of species from lower latitudes. The AFSC has been monitoring water temperatures and zooplankton communities in Icy Strait, AK, a major fish migration corridor in the Alexander Archipelago, for 20 years. Here, we examine how the zooplankton community in Icy Strait responds to changes in environmental drivers such as temperature and salinity using multivariate statistical analysis during the summer months of 1997 - 2016. There is a strong positive correlation between the summer average upper 20-m water column temperatures in Icy Strait to the Multivariate ENSO Index over this period. Zooplankton total density is negatively correlated to the summer water temperatures. This has been remarkably evident with the warm waters of 2015 and 2016 with decreased zooplankton biomass, but also with the appearance of uncommon species, such as *Limacina helicina*, in high numbers late in the season when the water is at its warmest. Identifying how the zooplankton community responds to environmental changes will lead to a better understanding of the mechanisms contributing to observed changes in zooplankton community structure, lipid content, appearance of low latitude species, as well as the nutritional consequences of these changes to planktivorous fishes.

Assessment of Plankton Populations and Community Structures in Glacier Bay, National Park

Faith Stemmler
University of Alaska Fairbanks, fmstemmler@alaska.edu
Russell Hopcroft
University of Alaska Fairbanks, rrhopcroft@alaska.edu

Glacier Bay, National Park sees nearly a half million visitors each year through its waterways. Previous oceanographic studies over the past decade in this Alaskan fjord have investigated physics and chemistry; we build on these measurements by adding assessment of phytoplankton and zooplankton communities. We collected zooplankton at eight stations distributed across both arms and the central bay, separated for the upper and lower water column. The community was dominated numerically by the copepods *Acartia longiremis*, *Metridia okhotensis*, *Metridia pacifica*, *Pseudocalanus* spp., and *Oithona similis*. *Pseudocalanus* spp. abound in the upper 50 m water column during daytime, while *Metridia* is more prominent at depth. Upper column waters near the glaciers feature genera such as *Centropages*, *Oithona*, and *Oncea*, while more open regions of the bay include *Pseudocalanus*, *Acartia*, and *Calanus*. Preliminary observations show zooplankton fauna in Glacier Bay to be similar to other fjordal systems in the Gulf of Alaska, but with communities distinctive from open coastal waters. In opposition with the Alaskan glacial fjord system in the Prince William Sound, Glacier Bay does not show a spring biomass of *Neocalanus*, which requires depths deeper than the central bay would allow for reproductive and life cycle phases.

Paralytic Shellfish Toxins in Kachemak Bay, Alaska: Environmental Factors Affecting *Alexandrium* Growth

Dominic Hondolero
NOAA National Ocean Service, Dominic.Hondolero@noaa.gov
Steve Kibler
NOAA National Ocean Service, steve.kibler@noaa.gov
Kris Holderied
NOAA National Ocean Service, kris.holderied@noaa.gov
Wayne Litaker
NOAA National Ocean Service, wayne.litaker@noaa.gov

Harmful Algal Blooms (HABs) in Alaska have been documented as far back as the Russian colonization in the late 1800s. *Alexandrium*, a dinoflagellate that causes Paralytic Shellfish Poisoning (PSP), is widespread along the Gulf of Alaska coast and has been implicated in human mortalities in Southeast Alaska and the Kodiak Islands. Although Kachemak Bay is a short distance from Kodiak (<150 km), PSP events do not occur as frequently as they are observed in the Islands. Field sampling during 2014-2015 showed a stepwise increase in late summer *Alexandrium* abundances, leading to the first closure of commercial shellfish harvesting due to shellfish toxicity in October 2015. More shellfish toxicity occurred during an early *Alexandrium* bloom in spring, 2016, and cell concentrations reached dangerously high levels with widespread shellfish toxicity. These PSP events have increased concern about *Alexandrium* in Kachemak Bay and have prompted efforts to improve HAB forecasting. Researchers from the NOAA Kasitsna Bay Laboratory have been involved in phytoplankton monitoring in Kachemak Bay since 2010 and are also developing risk assessment tools to improve HAB forecasting. Intensive sampling efforts were conducted from May through October of 2016, focusing on oceanographic data, dissolved nutrient levels and *Alexandrium* abundances. Our results indicate that *Alexandrium* concentrations were, in general, positively correlated with water temperature. However, a decline in dinoflagellate cell concentrations during mid-summer diatom blooms indicate nutrient availability and competition may limit *Alexandrium* abundance. The results of this study will be used to inform risk assessment tools and improve HAB forecasting in Kachemak Bay.

Using Genetic Variation to Investigate the Population Structure of Tanner Crab (*Chionoecetes bairdi*) Throughout Alaska

Genevieve Johnson
University of Alaska Fairbanks, gmjohnson7@alaska.edu
Andrés López
University of Alaska Fairbanks, jalopez@alaska.edu

Knowledge of population boundaries is an important component of the development of natural resource management policies. In marine organisms, determining these boundaries can pose a special challenge partly as a result of dispersal during pelagic larval life stages. Evidence from genetics has proven useful in refining understanding of population structure in these situations, but its application was historically limited by the genomic resources available for a particular species. However, novel and continuously refined sequencing technology offers the potential to circumvent this barrier and provide access to genomic-scale datasets of genetic variation even for species without available reference genomes. We applied these techniques to assess the population structure of Tanner crab (*Chionoecetes bairdi*) throughout Alaska. A set of 100 samples, composed of 25 individuals from four different commercially and/or subsistence harvested stocks (Southeast Alaska, Prince William Sound, Bering Sea west of 166° W, Bering Sea east of 166° W) were sequenced using a double-digest restriction site associated DNA sequencing (ddRAD) approach. The sequence data will be used to obtain a set of genotyped loci that can be used to compare genetic variation within and between each of these regions. We describe the progress of the genotyping effort and findings to date.

Allometric Relationship between Body Size and Energy Density of Juvenile Chinook (*Oncorhynchus tshawytscha*) and Chum (*O. keta*) Salmon Across a Latitudinal Gradient

Jamal Moss
NOAA Alaska Fisheries Science Center, jamal.moss@noaa.gov
James Murphy
NOAA Alaska Fisheries Science Center, jim.murphy@noaa.gov
Emily Fergusson
NOAA Alaska Fisheries Science Center, emily.fergusson@noaa.gov
Ron Heintz
NOAA Alaska Fisheries Science Center, ron.heintz@noaa.gov

Allocation of energy toward storage versus somatic growth by juvenile Pacific salmon during early marine residence is important because winter is a period when prey resources become scarcer, which increases demand on energy reserves for satisfying basic physiological demands. Energy allocation strategy differences along a latitudinal gradient may suggest counter gradient variation in energy storage for juvenile salmon, where higher latitude populations allocate more energy to storage than growth to satisfy greater energetic demands during winter in more northerly regions relative to southerly. Region-specific patterns in the relationship between energy density and body size of juvenile Chinook (*Oncorhynchus tshawytscha*) and chum (*O. keta*) salmon from rivers in Oregon, Washington, and the Yukon River were investigated to identify if latitudinal position has an influence on the allometric relationship between energy density and body size. The allometric relationship between energy density and body size increased at a greater rate for both Chinook and chum salmon inhabiting higher latitudes, where longer, more severe winters occur. Juvenile Chinook salmon had higher energy density than chum salmon across the latitudinal gradient, suggesting that energy stores may be more important for Chinook salmon than for chum salmon. Gaining a better understanding of how spatially segregated populations of the same species are adapted to localized conditions can provide insight into how variability in environmental conditions and prey fields may act to improve or hinder growth and survival.

Do Salmon Sharks Eat Chinook Salmon in Cook Inlet?

Andrew Seitz
University of Alaska Fairbanks, acseitz@alaska.edu
Michael Courtney
University of Alaska Fairbanks, mbcourtney@alaska.edu
Mark Evans
University of Alaska Fairbanks, mdevans@alaska.edu

After discovering high rates of predation by salmon sharks on large Chinook salmon in the Bering Sea, an investigation was conducted to determine whether this predator-prey relationship exists in Cook Inlet. Twenty Chinook salmon were tagged with pop-up satellite archival transmitting tags near Homer, AK in March 2016.While externally attached to the fish, the tags measured and recorded ambient light intensity, depth and temperature data. On pre-programmed dates in April and May 2016, the tags released from the fish, floated to the surface of the ocean and transmitted the recorded data to overhead satellites which were then retrieved by project investigators. Using these data, movement, depth and temperature occupation, and predation events were described. The majority of tagged Chinook salmon remained in Cook Inlet while occupying depths to ~175 m and water temperatures between 3 and 9°C in March–May. A minority of tagged Chinook salmon exited Cook Inlet to both the west and east in the Gulf of Alaska, and occupied similar water temperatures, but deeper depths to ~325 m. Based on a lack of anomalously high temperature records, there was no evidence of predation on Chinook salmon by salmon sharks in Cook Inlet and the Gulf of Alaska. However, based on complete darkness and no change in ambient temperature recorded by the tags, there was evidence that at least three Chinook salmon were eaten by “cold-blooded” predators. These data provide valuable information about regional oceanic ecology of Chinook salmon, which may be used in a variety of ways, such as for improving bioenergetics and populations dynamics models, and avoiding bycatch.

Spatial and Temporal Variability of Forage Fish in Coastal Waters of Prince William Sound, Alaska

Mayumi Arimitsu
U.S. Geological Survey, Alaska Science Center, marimitsu@usgs.gov
Scott Pegau
Prince William Sound Science Center, wspegau@pwssc.org
John Piatt
U.S. Geological Survey, Alaska Science Center, jpiatt@usgs.gov
Brielle Heflin
U.S. Geological Survey, Alaska Science Center, bheflin@usgs.gov
Sarah Schoen
U.S. Geological Survey, Alaska Science Center, sschoen@usgs.gov

Small-schooling pelagic fish are key to marine food webs because they are prey for seabirds, marine mammals and predatory fish. In the wake of the *Exxon Valdez* oil spill and the subsequent crash of Pacific herring in Prince William Sound (PWS), efforts to quantify changes in the prey base have been important in understanding the recovery of injured resources in PWS. Broad-scale aerial shoreline surveys were conducted in summers (June-July) of 1995-1999 and again in 2010-2016 to count forage fish schools. The resulting school density index was used to examine spatial and temporal variability in forage fish in PWS. We also provide results of validation efforts, which suggest that aerial discrimination of herring and sand lance schools by experienced observers is possible using school characteristics such as school shape and color. Finally, as part of the Gulf Watch Alaska effort, we compared school density to concurrently measured hydroacoustic biomass from July 2014-15. We discuss forage fish variability in space and time, and also discuss the trade-offs between broad-scale aerial surveys and fine-scale hydroacoustic trawl surveys for understanding changes in forage fish abundance over time.

Seasonal Energetic Content of Northern and Dusky Rockfish in Specific Habitat Types

Tayler Jarvis
NOAA Alaska Fisheries Science Center, tayler.jarvis@noaa.gov
Christina Conrath
NOAA Alaska Fisheries Science Center, christina.conrath@noaa.gov
Ron Heintz
NOAA Alaska Fisheries Science Center, ron.heintz@noaa.gov

Since 1996, the Magnuson-Stevens Act has required NOAA to specify essential habitat for the many rockfish species (*Sebastes* sp.) in the Gulf of Alaska (GOA), but these specifications remain vaguely defined. Rockfish species in the GOA tend to have distributions that occur in rocky or high relief substrates. Many of the commercially important rockfish in the GOA are also associated with coral and sponge habitats. Because of the complexity of coral and sponge habitats, benefits may be offered to juvenile and adult rockfish such as enhanced food resources and/or increased protection from predators. We analyzed samples collected from research cruises conducted during the spring (2014), summer (2012), and winter (2014) in the central GOA off the coast of Kodiak Island. The primary focus of the surveys was to collect two commercially important rockfish species: northern rockfish, *Sebastes polyspinis*, and dusky rockfish, *Sebastes ciliatus*, in specific habitat types: low-relief (bare), high-relief rocky/boulder (boulder), and high relief coral/sponge (coral) and relate their diets and condition to those habitats and seasons. Condition was measured as length-weight residuals, and energy content. Distinct differences were observed in the prey consumption and seasonal energy densities of dusky and northern rockfish. Northern rockfish all demonstrated a pattern of peak energy density in December followed by a minimum in May, regardless of habitat type, while dusky rockfish in coral and boulder habitats failed to demonstrate a distinct seasonal pattern of energy content. In the bare habitat, dusky rockfish seemed to have the same seasonal energy density patterns as the northern rockfish. Dusky rockfish in bare habitat had less diverse diets, and their diets, like that of the northern rockfish, were dominated by euphausiids. Alternatively, dusky rockfish in coral and boulder habitats consumed a more diverse benthic diet, which permitted year round foraging. These data indicate that dusky rockfish adopt habitat specific life history strategies while northern rockfish are less plastic in their ability to adapt to local habitats. A greater understanding of the relative mobilities of these two species with respect to habitat would be invaluable for resolving their habitat requirements.

Combined Acoustic-Optical Approach to Assess Rockfish Availability to Bottom Trawl Gear in the Gulf of Alaska

Darin Jones
NOAA Alaska Fisheries Science Center, darin.jones@noaa.gov
Chris Rooper
NOAA Alaska Fisheries Science Center, chris.rooper@noaa.gov
Rachel Wilborn
NOAA Alaska Fisheries Science Center, rachel.wilborn@noaa.gov
Sarah Stienessen
NOAA Alaska Fisheries Science Center, sarah.stienessen@noaa.gov
Chris Wilson
NOAA Alaska Fisheries Science Center, chris.wilson@noaa.gov
Paul Spencer
NOAA Alaska Fisheries Science Center, paul.spencer@noaa.gov
Tom Weber
University of New Hampshire, weber@ccom.unh.edu
Dana Hanselman
NOAA Alaska Fisheries Science Center, dana.hanselman@noaa.gov
Jon Heifetz
NOAA Alaska Fisheries Science Center, jon.heifetz@noaa.gov

Rockfishes in the Gulf of Alaska (GOA) are often associated with high relief habitats. Extrapolating fish density estimates from low relief trawlable habitat into high relief untrawlable habitat results in both bias and imprecision to assessment survey abundance estimates when fish densities differ between these habitat types. To accurately assess rockfish populations, reliable estimates are needed for the extent of trawlable (T) and untrawlable (UT) habitat types in the surveyed area, as well as fish densities in these two habitats. Acoustics (splitbeam and multibeam) and lowered stereo-cameras were used to: 1) map areas within 25-km^2 grid cells historically designated as T or UT based on information from the annual Alaska Fisheries Science Center (AFSC) bottom trawl survey (BTS), and then compare the original BTS trawlability designations to model-based trawlability estimates developed from multibeam data (groundtruthed with camera images), and 2) compare the abundance of rockfishes (*Sebastes* spp.) within the T/UT grid cell areas. Acoustic data were collected along uniformly spaced transects within 35 T and 30 UT grid cells throughout the GOA during summers 2013 and 2015. The lowered camera system was deployed at $\leq$ 3 stations per grid cell to 1) determine the species and size compositions of fishes attributed to the acoustic backscatter to derive acoustic-based estimates of fish abundance, and 2) ground truth the multibeam-based trawlability classifications. Backscatter attributed to rockfishes (except *S. alutus*) in BTS-classified UT cells was approximately twice that found in T cells. Preliminary trawlability designations based on camera images (multibeam data analysis currently underway) indicated 38% of *S. variegatus*, 33% of *S.*

alutus, and 10% of *S. polyspinis* were detected in UT habitat and unavailable to bottom trawl gear. The study results can ultimately be used to provide better estimates of the catchability coefficient (q), which largely reflects the availability of rockfish populations to the AFSC bottom trawl survey.

A Comparative Assessment of Resource Use by Pacific Halibut and Arrowtooth Flounder Throughout the Gulf of Alaska

Cheryl L. Barnes
University of Alaska Fairbanks, cheryl.barnes@alaska.edu
Anne H. Beaudreau
University of Alaska Fairbanks, abeaudreau@alaska.edu
Mary E. Hunsicker
NOAA Northwest Fisheries Science Center, mary.hunsicker@noaa.gov
Lorenzo Ciannelli
Oregon State University, lciannel@coas.oregonstate.edu

Pacific Halibut (*Hippoglossus stenolepis*) have supported culturally and economically important fisheries throughout the Gulf of Alaska for over a century. However, recent decreases in spawning stock biomass and size-at-age have generated concerns among those who depend upon and manage the resource. Many potential mechanisms have been proposed to explain these changes in halibut productivity, including decreases in mean size-at-age from harvesting the largest and fastest growing individuals, decreased growth due to fluctuations in the environment, and changes in energy flow because of altered community compositions and food web structure. Among the prevailing hypotheses is intensified competition with Arrowtooth Flounder (*Atheresthes stomias*), a voracious predator that has exhibited nearly five-fold increases in biomass over the past 60 years. Because of their considerable population size, Arrowtooth Flounder are hypothesized to competitively exclude Pacific Halibut from preferred habitat and/or prey, resulting in decreased growth. Evaluating this hypothesis requires evidence of opposing population trajectories, information about resource availability, and some measure of spatiotemporal and dietary overlap. As a first step toward addressing the potential for competition between Pacific Halibut and Arrowtooth Flounder, we assessed their spatial and dietary overlap (i.e., a measure of resource partitioning). Using food habits and bottom trawl survey data from the Alaska Fisheries Science Center (NOAA; 1990 to 2013), we quantified spatial and size distributions and diet compositions of Pacific Halibut and Arrowtooth Flounder from local to regional scales. We then calculated indices of spatial and dietary overlap between the two groundfish predators and used generalized additive models to explore how these indices varied as a function of bottom depth, temperature, potential competitor biomass, and biomass of important prey species (i.e., Walleye Pollock [*Gadus chalcogrammus*]). Finally, we used generalized linear models to assess the relationship between spatial and dietary overlap, elucidating the degree to which Pacific Halibut and Arrowtooth Flounder partition resources throughout the Gulf of Alaska. This study represents an initial exploration of the hypothesis that interspecific competition with Arrowtooth Flounder is responsible for decreased size-at-age of Pacific Halibut and helps identify broad-scale

environmental and ecological conditions that may limit population-level productivity of Pacific Halibut.

Assessing Inshore Habitat Loss from the 1920s to the 1990s in the Chignik Area of the Alaska Peninsula

Mark Zimmermann
NOAA Alaska Fisheries Science Center, mark.zimmermann@noaa.gov
Gregory Ruggerone
Natural Resources Consultants, Inc., gruggerone@nrccorp.com
Jeff Freymueller
University of Alaska Fairbanks, jfreymueller@alaska.edu
Nicole Kinsman
NOAA National Ocean Service, nicole.kinsman@noaa.gov

GIS (Geographic Information System) comparison of NOS (National Ocean Service) hydrographic survey data from the 1920s to the 1990s demonstrated that there has been shallowing of the seafloor in five of six bays examined in the Chignik region of the Alaska Peninsula: Castle Bay, Chignik Lagoon, Hook Bay, Kujulik Bay and Mud Bay. These five sites all lost volume as calculated from MLLW (Mean Lower Low Water) to the deepest depths and four of these sites lost volume from MHW (Mean High Water) to the deepest depths. Both calculations were made because MHW has increased (high tides have gotten higher) from the 1920s to the 1990s. This shallowing was originally reported in the Descriptive Reports of several 1990s-era NOS hydrographic surveys in the area, but no possible causes of the shallowing were given aside from changes in survey technology and methods. Deposition of ash from eruptions of nearby Veniaminof and Aniakchak volcanoes, including remobilization of ash as sediment, is the most likely cause of the shallowing in the marine environment. In Black Lake, the upper lake in the Chignik lake system, which drains into Chignik Lagoon, riverine erosion and ash deposition contributed to the geomorphic change in the lake's outlet and consequential shallowing previously noted by other researchers. Loss of shallow water marine habitat may have serious consequences for several fish, invertebrate and avian species: Mud Bay is quickly disappearing while Chignik Lagoon is being reduced to narrow channels. Anchorage Bay was the only site which got deeper over time and, despite its survey being from an earlier time (1906), we have no explanation about why our analysis shows that it deepened.

Combined Acoustic-Optical Approach to Assess Rockfish Availability to Bottom Trawl Gear in the Gulf of Alaska: The Role of Acoustics in Assessing Seafloor Trawlability

Sarah Stienessen
NOAA Alaska Fisheries Science Center, sarah.stienessen@noaa.gov
Tom Weber
University of New Hampshire, weber@ccom.unh.edu
Jodi Pirtle
NOAA Alaska Region, jodi.pirtle@noaa.gov
Chris Rooper
NOAA Alaska Fisheries Science Center, Chris.Rooper@noaa.gov
Darin Jones
NOAA Alaska Fisheries Science Center, darin.jones@noaa.gov
Chris Wilson
NOAA Alaska Fisheries Science Center, Chris.Wilson@noaa.gov

The Alaska Fisheries Science Center (AFSC) bottom trawl (BT) survey provides abundance estimates for numerous rockfish species (*Sebastes* spp.) as critical inputs to the Gulf of Alaska (GOA) stock assessment efforts. However, some rockfish species prefer high relief, untrawlable (UT) bottom habitats, which make them unavailable to the AFSC survey. Extrapolating fish density estimates from low relief trawlable (T) habitats into the high relief UT habitats results in both bias and imprecision to the survey abundance estimates when fish densities differ between these habitat types. To accurately assess rockfish populations, reliable estimates are needed for the extent of T and UT habitats in the surveyed area. Here, we describe the use of multibeam acoustic data, which are groundtruthed with camera image data, to estimate seafloor trawlability. Earlier work by Pirtle et al. (Methods in Ocean. 12(2015) 18-35) developed a model using multibeam-derived seafloor metrics to predict seafloor trawlability. The model was correct for 69% of the haul locations examined. We have expanded upon this earlier work to re-evaluate the trawlability designation of the seafloor in areas historically designated as T or UT by the BT survey. Multibeam and associated camera data were collected on nightly mini-surveys conducted opportunistically during the AFSC summer GOA-wide acoustic-trawl pollock survey in 2013 and 2015. Multibeam data were collected along parallel transects 1 nmi apart and camera data were collected at $\leq$ 3 stations for each mini-survey. Seafloor metrics were extracted from the multibeam data. The data were combined with historical data, and a Generalized Linear Model was parameterized to extract new model coefficients. The updated model was used to derive probabilities of T and UT habitat. This new information will be used to refine the proportion of the GOA sampled by the bottom trawl survey. When these seafloor trawlability estimates are considered with the acoustic-optical based rockfish density

estimates for these same areas (see AMSS presentation by Jones et al), it is possible to estimate the availability of various rockfish species to the AFSC bottom trawl survey.

Elevating the Management Tier of Commercially Important Rockfish Inhabiting the Gulf of Alaska and Aleutian Islands: Part 1 - Reproductive Biology and Estimates of Maturity

Todd Tenbrink
NOAA Alaska Fisheries Science Center, todd.tenbrink@noaa.gov
Christina Conrath
NOAA Alaska Fisheries Science Center, christina.conrath@noaa.gov
Thomas Helser
NOAA Alaska Fisheries Science Center, thomas.helser@noaa.gov

Data-poor rockfish (shortraker rockfish, redstripe rockfish, harlequin rockfish, and shortspine thornyhead) reproductive biology (this poster) and accuracy of ageing (adjacent poster) was investigated. Data were collected for initial and/or improved estimates of maturity, fecundity, seasonal development, skipped spawning, and maternal effects, including temporal variation. Each of the *Sebastes* species appear to be seasonal synchronous spawners with internal fertilization. Length at 50% maturity for Gulf of Alaska (GOA) shortraker rockfish was 49.9 cm from samples collected during the 2010 reproductive season. The proportion of mature adult shortraker rockfish that were skip spawning was 61.1%. For harlequin rockfish, parturition in both the GOA and AI appears to occur during spring months, with a cessation of reproductive activity by early summer. Harlequin rockfish in the GOA appear to mature at smaller sizes than southeast Alaska and British Columbia populations (17-18 cm vs. 23 cm), indicating latitudinal variation. Age analysis conducted thus far for GOA harlequin rockfish suggests an age at 50% maturity of less than 7 years. Harlequin rockfish collected in the AI for maturity analysis, meanwhile, have been all mature. Small (and presumably immature) specimens have not been observed from both fishery independent and dependent sources in the AI. Redstripe rockfish from the GOA showed an age range of 7 to 42 years for a limited number of specimens (n = 25). Preliminary work on redstripe rockfish fecundity suggests this species is one of the more highly fecund *Sebastes*. Field observations show that shortspine thornyheads spawn in early spring through June in both the AI and GOA. The shortspine thornyhead ovarian structure and mode of reproduction differs from *Sebastes* rockfish. Like other *Sebastolobus*, shortspines spawn a gelatinous egg mass where the eggs are released in the gelatinous material and eventually the water column. Analysis of additional field samples and the final results will be presented in the final report for this project in spring 2017.

Elevating the Management Tier of Commercially Important Rockfish Inhabiting the Gulf of Alaska and Aleutian Islands: Part 2 - Age Determination and its Accuracy

Thomas Helser
NOAA Alaska Fisheries Science Center, thomas.helser@noaa.gov
Craig Kastelle
NOAA Alaska Fisheries Science Center, craig.kastelle@noaa.gov
Todd TenBrink
NOAA Alaska Fisheries Science Center, todd.tenbrink@noaa.gov
Paul Spencer
NOAA Alaska Fisheries Science Center, paul.spencer@noaa.gov

We investigated the life history status of Tier 5 redstripe and harlequin rockfish by evaluating the precision and accuracy of the ages for these species. Life history traits (i.e. long life span, slow growth, delayed maturity) of these species may increase the risk of population declines. Ageing accuracy was determined using the bomb radiocarbon assay on otoliths from redstripe and harlequin rockfish by comparing the $\Delta^{14}C$ (validation) in these samples to the reference $\Delta^{14}C$ carbonate chronology that exist for the Gulf of Alaska. The validation sample data sets were compared to the halibut reference $\Delta^{14}C$ using a coupled-function model and were fit using Bayesian hierarchical methods because we wanted to take advantage of the posterior sample to derive a probabilistic framework. Our study showed that harlequin and redstripe rockfish are much longer-lived than previously thought; harlequin rockfish has been aged at 70+ years, while redstripe rockfish has been aged in the mid-40s. Previous known maximum ages for harlequin and redstripe rockfish, are 47 and 36 years, respectively. Moreover, for species of rockfish that live to more than 40+ years of age we also found estimated ages to be remarkably accurate. For instance, the probability density of bias (+/- *x* years) encompasses zero suggesting little evidence of ageing bias overall as the tail probability greater to or less than zero years is 75% and 25%, respectively. The MCMC posterior density also allows more explicit probability of ageing bias for a range of years; the probability that ageing bias less than or greater than one year (+/- 1 one year) is 27%, and for being bias by more than +/- two years is only 9%. New estimates of maturity at age, M, age reading precision and bias will be in incorporated into a mixed model approach to evaluate how estimation of fishing reference points such as $F_{40\%}$, which depend on estimates of growth and maturity parameters, are affected by accounting for aging error and bias.

Verification of Smooth Sheet Bathymetry for Inshore Habitat Studies in the Gulf of Alaska

Mark Zimmermann
NOAA Alaska Fisheries Science Center, mark.zimmermann@noaa.gov
Alex De Robertis
NOAA Alaska Fisheries Science Center, alex.derobertis@noaa.gov
Olav Ormseth
NOAA Alaska Fisheries Science Center, olav.ormseth@noaa.gov

Juvenile fish habitat studies in the Gulf of Alaska Integrated Ecosystem Research Program (GOA-IERP) required detailed bathymetric maps, and these were made with soundings from National Ocean Service smooth sheets, sources that are often older (frequently 1930s - 1940s) and not well-known to the fish research community. The bathymetry maps were used to describe the morphology of study sites, which are mostly bays, and characterize locations selected for collecting samples. To determine if bathymetric maps created from the smooth sheet data (1924 - 2003) corresponded to depth observations made during GOA-IERP (2011 & 2013), we compared interpolated smooth sheet bathymetry surfaces (20 m rasters) to individual single-beam soundings from GOA-IERP. Ordinary least squares linear regressions determined that the 2011/2013 soundings were highly correlated with the interpolated smooth sheet bathymetry at all sites ($R^{2=}$~0.8-0.9), although the sites with the oldest smooth sheet observations had the poorest fits. The standardized residuals from the linear regressions were relatively small and they were geographically clustered at all sites, with higher residuals often occurring in areas of rapid depth transition. We used generalized additive models to investigate the discrepancies between the smooth sheet and echosounder observations. These models indicated that that smooth-sheet depth was always a significant explanatory predictor of the residuals of the linear regressions ($p < 0.001$), while rugosity, slope and distance to the nearest smooth-sheet sounding were sometimes significant predictors of the residuals. This formal comparison served as a method of groundtruthing the smooth sheet interpolated surfaces, and thus increases confidence in the use of habitat metrics derived from the often decades-old soundings available from smooth sheets, which are the only sources of information available in Alaska nearshore environments.

Developing a Stereo Camera System to Survey Nearshore Steller Sea Lion Prey Fields in the Central and Western Aleutian Islands

Susanne McDermott
NOAA Alaska Fisheries Science Center, susanne.mcdermott@noaa.gov
Mike Levine
NOAA Alaska Fisheries Science Center, mike.levine@noaa.gov
Brian Fadely
NOAA Alaska Fisheries Science Center, brian.fadely@noaa.gov
Tom Gelatt
NOAA Alaska Fisheries Science Center, tom.gelatt@noaa.gov

Recent satellite tagging efforts indicate that endangered adult female Steller sea lions (SSL) in the central and western Aleutian Islands are likely to forage in shallow, nearshore regions. However, the availability of prey resources in these regions remains poorly understood because traditional bottom trawl surveys conducted by NOAA's Alaska Fisheries Science Center (AFSC) cannot sample the prevalent rocky, nearshore habitats and lack precision for specific localized areas such as sea lion haulouts. We attempted to overcome these sampling challenges by opportunistically deploying a towed underwater stereo camera system near SSL rookeries and haulouts during the NOAA AFSC Marine Mammal Laboratory ship-based population survey of SSL in June 2016. This low-cost system was towed from the USFWS R/V Tiglax using a winch that transmitted a live video feed, allowing an operator to keep the system near the sea floor. Within each surveyed area, we conducted 15-minute transects in three depth strata ranging from 25 – 100 m. We conducted 45 camera transects near 17 Steller sea lion rookeries and haulouts. We focused survey efforts where tagged adult female sea lions were present, using telemetry to identify their core use areas. Transects were analyzed using software developed at the NOAA AFSC which allowed for fish and associated habitat to be identified, quantified, and measured. While stereo image quality did not always allow for fish identification to the species level, it did allow for identification of many prey species (i.e. Atka mackerel, Pacific cod) and species groups (i.e. rockfish, flatfish, sculpins) that are found in summer SSL diets. Camera transects encompassed substrates ranging from sand to high-relief boulder fields, and we found that higher fish abundance was associated with rocky terrain. Substrates and associated fish abundances varied widely over small (10-100 m) spatial scales, suggesting that nearshore survey activities should be structured to account for extreme spatial variability. The low cost of our system, combined with its ability to be deployed quickly during available vessel time, make it a promising nearshore fish survey tool.

Innovative Solutions for Remotely Monitoring Bycatch

Farron Wallace
NOAA Alaska Fisheries Science Center, farron.wallace@noaa.gov

Although electronic monitoring (EM) has been shown to be an effective tool to satisfy a variety of monitoring objectives, these systems have not been shown to be an effective tool in delivering detailed data sets similar to information collected by an observer. A stereo and chute camera system developed by the Alaska Fisheries Science Center Observer program greatly improves the functionality of standard camera systems and addresses many of the issues previously identified with EM systems.

Both systems provides the ability to not only monitor fisheries with cameras, but to collect length measurements. Length is an important data component for estimating catch weight and is a necessary data element used in stock assessments. Research also includes development of machine vision algorithms to automatically capture high quality (HD) stereo images of individual catch events for efficient identification to species or species group. Because only images of catch events are be stored and reviewed, post-processing and storage costs will be lower. Reduction in the data volume resulting from this system will facilitate data transfer and management. Images will be time stamped and linked to GPS information, allowing precise location of species-specific catch. This will enable mapping of high bycatch rate areas of non-target species, improving future management strategies to lower bycatch and support the development of spatial stock assessments. Lower overall costs will extend coverage rates to a wider range of vessels types and sizes where it is impractical to place an observer. A cost effective camera based system that collects scientific data on fishery impacts will provide greater certainty for resource management and support sustainable fishing practices.

Empirically-Based Models of Oceanographic and Biological Influences on Pacific Herring Recruitment in Prince William Sound

Fletcher Sewall
University of Alaska Fairbanks, fletchersewall@noaa.gov
Brenda Norcross
University of Alaska Fairbanks, blnorcross@alaska.edu
Franz Mueter
University of Alaska Fairbanks, fmueter@alaska.edu
Ron Heintz
NOAA Alaska Fisheries Science Center, ron.heintz@noaa.gov

Small pelagic fish abundances can change dramatically over time and are difficult to forecast, partially due to variable numbers of fish that annually mature and recruit to the spawning population. Recruitment strength of age-3 herring in Prince William Sound has been estimated by managers as a function of spawning stock biomass via a Ricker spawner-recruit model. However, stock size has little influence on subsequent numbers of recruits. This study evaluates the usefulness of herring recruitment models that incorporate oceanographic and ecological variables. Results indicate herring recruitment estimates may be significantly improved by modifying the standard Ricker model to include an index of young-of-the-year Walleye Pollock (*Gadus chalcogrammus*) abundance. We suggest that synchrony of juvenile herring and pollock survival may be caused by trends in abundance of their shared zooplankton prey, or high juvenile pollock abundance may promote prey switching and satiation of their shared predators. Including sea surface temperature, primary productivity, and additional predator or competitor abundances did not improve model performance. Identifying and monitoring factors that determine juvenile herring survival remain challenging, but the association between pollock and herring reported here represents a significant step forward in understanding herring recruitment.

Winter Condition of Juvenile Herring Relative to Diet and Temperature in Prince William Sound

Fletcher Sewall
NOAA Alaska Fisheries Science Center, fletcher.sewall@noaa.gov
Ron Heintz
NOAA Alaska Fisheries Science Center, ron.heintz@noaa.gov
Johanna Vollenweider
NOAA Alaska Fisheries Science Center, johanna.vollenweider@noaa.gov

Pacific herring (*Clupea pallasii*) year-class strength may be largely determined by winter survival of young-of-the-year (YOY) herring. To survive winter food scarcity, temperate fishes metabolize stored lipids for energy. Whether lipid stores are sufficient for survival depends on environmental conditions, including water temperature and prey availability. Winter starvation and predation risks are often highest for small individuals, making winter mortality size-dependent. Variation in size, diet, and water temperature are thus expected to strongly influence winter survival of herring.

We investigated trends in YOY herring condition (% lipid), a growth index (RNA/DNA ratio), and diet in November and March collections in Prince William Sound in 2009 – 2016. Across the seven study years, herring size dictated energy allocation strategy prior to winter; individuals below a critical size of 70 – 80 mm length in November favored growth while larger individuals switched to lipid storage. Lipid depletion below 2% by March forced herring to take on greater predation risk and forage. Small herring were thus scarce by March due to growth and size-dependent winter mortality. Yearly differences in herring condition and RNA/DNA were likely due to differences in diet and temperature. Cold temperatures in 2012 likely promoted high lipid levels by slowing metabolism, while high RNA/DNA may have been needed to grow due to reduced metabolic efficiency at lower temperature. Temperature can override diet effects on herring condition: prey quantity and quality (energy density) in 2012 were low-average when herring condition was highest. Good condition of the 2012 YOY herring appeared to promote high winter survival, indicated by aerial survey observations of unusually abundant schools of age-1 herring in summer 2013. The 2012 YOY herring were expected to contribute strongly to the 2015 adult spawning stock at age 3, but low spawner abundance in 2015 made the stock age composition unclear. Further stock observations are needed to ascertain whether high winter survival yielded a strong 2012 year class.

Diver Observations of Community Structure on a Subarctic Marine Artificial Reef in Whittier, Alaska

Charlotte Levy
Alaska Pacific University, levych@oregonstate.edu
Eloise Brown
Alaska Pacific University, ejbrown@alaskapacific.edu

Increased coastal development poses a potential threat to nearshore habitats in Alaska, and artificial reefs (AR) are an increasingly popular tool for mitigating habitat loss. Although well studied in tropical and temperate locations, less is known about AR efficacy in high latitude locations. Since ARs are heavily influenced by ecological factors specific to their environment, these studies may not apply to sites in subarctic Alaska. An AR was deployed in Whittier in 2006 as part of a mitigation settlement for Alaska Marine Lines facility expansion. Surveys conducted the following year suggested AR assemblages resembled those of adjacent natural reefs (NR). However, long-term surveying of community composition is necessary to allow for the establishment of a climax community. With bi-monthly dive surveys conducted June-November 2016, this research surveyed the AR to assess how demersal fish, macroalgal and invertebrate assemblages have changed in the past decade. Assemblages were quantified at n=6 plots (30 structures per plot) with two types of AR structures: Fish Havens (n=3) and Reef Balls (n=3) for a total of 180 structures, and compared to former assemblages present in 2007 at both AR and NR sites. Demersal fish density was calculated from abundance estimated in-situ via 30 m transects (60 m^2; n=1 per plot). Macroalgal percent cover was estimated in-situ; macroalgal and invertebrate density was calculated using abundance estimated in situ with 0.25 m^2 quadrats (n≥6 per plot). Species richness was calculated as the number of species normalized per unit area. Means and standard deviations were averaged across n=6 and n=3 reef-types in 2016 and compared to 2007 data. Preliminary results indicate an increase in *Sebastes spp*. species present and a change in the dominant macroalgae *Laminaria saccharina* to *Agarum clathratum*. Macroalgae species present (n=10) increased compared to 2007 when only *Saccharina spp*. was observed (n=1). AR assemblages in 2016 appear to resemble those of NR in 2007 in terms of species composition. Multivariate analysis will further quantify changes in community composition (MANOVA across periods, reef types and years and nMDS ordination plots) and address potential environmental variability in the model.

Quantifying the Potential for Disease Impacts to Pacific Herring

Paul Hershberger
U.S. Geological Survey, Marrowstone Marine Field Station, phershberger@usgs.gov
Lucas Hart
U.S. Geological Survey, Marrowstone Marine Field Station, hartlucasm@gmail.com
Ashley MacKenzie
U.S. Geological Survey, Marrowstone Marine Field Station, amackenzie@usgs.gov
Rachel Powers
U.S. Geological Survey, Western Fisheries Research Center, rpowers@usgs.gov
Maureen Purcell
U.S. Geological Survey, Western Fisheries Research Center, mpurcell@usgs.gov

Viral hemorrhagic septicemia virus (VHSV) causes periodic disease (VHS) epizootics and resulting mortalities in populations of Pacific herring and has been associated with the decline and failed recovery of the adult herring biomass in Prince William Sound (PWS). The current age structured assessment model for forecasting herring abundance in PWS includes a disease metric that is based partly on VHSV infection prevalence. Unfortunately, the epizootiological principles governing VHSV in Pacific herring indicate that infection prevalence is an extremely poor indicator of future host mortality. Rather, knowledge of the prior exposure history of Pacific herring to VHSV would provide a reliable forecaster of future disease potential. For example, all Pacific herring are born susceptible to the disease; however individuals become refractory if they survive their initial exposure to the virus. Therefore, a diagnostic assay capable of identifying the exposure history of Pacific herring could inform the potential for future disease impacts. Here we describe the optimization of a plaque neutralization test (PNT) that is capable of assessing the exposure history of Pacific herring to VHSV. Among Pacific herring that survived laboratory exposures to VHSV, the optimized PNT detected known VHSV survivors as early as 37d post-exposure. Further, the optimized PNT successfully identified VHSV survivors for at least 345 d post exposure in all temperature treatments ranging from 6.0 - 12.0 ^{o}C. It is anticipated that this novel ability to document the exposure history of Pacific herring to VHSV will enable retrospective analyses between prior VHS exposures and year class recruitment failures. Further, the optimized PNT is expected to be employed as a forecasting tool, capable of identifying the potential for future VHS epizootics in populations of wild Pacific herring.

Larval Fish Connectivity in the Gulf of Alaska from Single Species Trajectories to Community Patterns

Esther Goldstein
NOAA Alaska Fisheries Science Center, Esther.Goldstein@noaa.gov
Janet Duffy-Anderson
NOAA Alaska Fisheries Science Center, Janet.Duffy-Anderson@noaa.gov
William Stockhausen
NOAA Alaska Fisheries Science Center, William.Stockhausen@noaa.gov

Determining the processes that affect survival and recruitment of commercially and economically important groundfish species in the Gulf of Alaska (GOA) is a major objective of the GOA-Integrated Ecosystem Research Program. For many marine fish, larval supply and early life survival regulate recruitment and population replenishment; yet larval mortality is high and advection and delivery to nursery habitats are affected by climate-mediated oceanographic variability. Despite spanning a broad geographic area composed of regional ecosystems, analyses to date demonstrate that fish larval connectivity and transport from the eastern to the western GOA via prevailing currents may affect recruitment magnitude of groundfish species. Such connectivity across broad spatial scales has the potential to influence single species survival and recruitment as well as regional species composition. To understand the processes that influence broad linkages and regional larval distributions in the GOA we utilized two years of larval fish collections and satellite-tracked drifter information to determine the potential influence of east-west transport on spatial patterns of larval fish assemblages. We then utilize a single-species biophysical individual-based model to focus on fine-scale transport pathways of an abundant predator (arrowtooth flounder: *Atheresthes stomias*) to discern the mechanisms that affect realized population connectivity. This approach provides insight into the mechanistic processes that influence regional ecosystem linkages and fish recruitment in the GOA.

Investigating the Effects of Top-Down and Bottom-Up Processes on Juvenile Pacific Ocean Perch (*Sebastes alutus*) Growth in the Gulf of Alaska

Ashwin Sreenivasan
Sitka Sound Science Center, ashwin.sreenivasan@noaa.gov
Ron Heintz
NOAA Alaska Fisheries Science Center, ron.heintz@noaa.gov
Jacek Maselko
NOAA Alaska Fisheries Science Center, jacek.maselko@noaa.gov

Resolving the relative importance of top-down and bottom-up processes on the growth of juvenile fish is important to understanding the factors constraining their survival. However, growth is difficult to measure in the field, limiting our ability to identify the driving processes. Higher nucleic acid (RNA/DNA) ratios are believed to index recent growth as they signal increased protein synthesis. Recently, laboratory studies have identified the relationship between consumption, temperature, RNA/DNA and growth in juvenile Pacific Ocean Perch (POP; *Sebastes alutus*). We used those observations to examine the influence of bottom-up and top-down processes on juvenile POP growth in the Gulf of Alaska during the summers of 2011 - 2013. We used survey data collected during the Gulf of Alaska Integrated Ecosystem Research Project in two sets of models. In the first set we employed mixed-effects models to relate environmental characteristics, including predator and competitor abundances, and chlorophyll-a concentration to the observed RNA/DNA values in the field. These models indicated the relationship to the realized growth of the fish. For the second set of models we used the laboratory data to estimate RNA/DNA values for field samples, assuming optimal feeding conditions. We calculated the difference between the estimated and observed ratios (growth depression) and related the same environmental characteristics used in the first model set to our calculated growth depression. Chlorophyll-a concentration had a significant ($p = 0.0064$) positive effect on realized growth, while abundances of both predators and competitors were not significant. We found a significant positive effect of abundances of predators ($p = 0.0203$) and competitors ($p = 0.0298$) on growth depression, but no effect of chlorophyll-a. Thus POP experience their highest growth rates in locations where chlorophyll-a is abundant and those growth rates are nearest the value expected for well-fed fish, but only when their growth is not depressed due to potential predation and competition. This study demonstrates that both top-down and bottom-up processes are significant factors influencing juvenile POP growth.

Building a Foundation of Decision-Support Tools Integrating Existing Mapping and Monitoring Information for the Benefit of Long-Term Shellfish Sustainability and Management in Kachemak Bay and Cook Inlet, Alaska

Angela Doroff
Kachemak Bay Research Reserve, adoroff@alaska.edu
E. Jamie Trammell
Alaska Center for Conservation Science, UAA, ejtrammell@alaska.edu
Syverine Abrahamson
Kachemak Bay Research Reserve, isabrahamson@alaska.edu
Steve Baird
Kachemak Bay Research Reserve, sjbaird@alaska.edu
Jessica Ryan Shepherd
Kachemak Bay Research Reserve, jaryan@alaska.edu
Marcus Geist
Alaska Center for Conservation Science, mageist@alaska.edu
Megumi Aisu
Alaska Center for Conservation Science, maisu@alaska.edu
Jeff Hetrick
Alutiiq Pride Shellfish Hatchery, jjh@seward.net

Shellfish have long been important subsistence, recreational, and commercial fisheries in the Kachemak Bay region of Alaska. Since the 1990s, native clam populations in southcentral Alaska have declined significantly so much so that fisheries are closed and harvest opportunities are lost. The goal of this project is to develop a baseline reference of habitat conditions integrated with environmental variables from which change can be measured. Researchers, decision-makers and stakeholders in Kachemak Bay and Cook Inlet are partnering to establish a framework upon which ecosystem-based management questions can be explored, and rehabilitation efforts can be built. --- By utilizing available information, we are in the process of synthesizing landscape-level information needed for the development of bivalve conservation strategies for Kachemak Bay. Specifically, we are creating a continuous physical habitat map of the Bay by harmonizing detailed intertidal zone mapping done by the Research Reserve over the past decade with high resolution subtidal characterizations from NOAA's recent Hydropalooza bathymetric and benthic sampling efforts. We are in the early stages of piloting methods for monitoring the environmental conditions and timing of bivalve spawning and recruitment in Kachemak Bay in order to explore the feasibility of native clam rehabilitation techniques. Collectively, these actions foster stewardship, harvest sustainability, and best management practices of native clams through stakeholder engagement and public education.

Ecology of Young of the Year Arrowtooth Flounder (*Atheresthes stomias*) Inhabiting the Gulf of Alaska

Casey Debenham
NOAA Alaska Fisheries Science Center, casey.debenham@noaa.gov
Jamal Moss
NOAA Alaska Fisheries Science Center, jamal.moss@noaa.gov
Ron Heintz
NOAA Alaska Fisheries Science Center, ron.heintz@noaa.gov

The Gulf of Alaska Project (GOAIERP) and the Gulf of Alaska Assessment (GOAA) surveys are integrated ecosystem studies that examine the physical and biological mechanisms, which determine the survival of commercially important young of the year (YOY) groundfish, specifically Walleye Pollock, Pacific Cod, Pacific Ocean Perch, Sablefish and Arrowtooth Flounder. The early life survival these fish are thought to be directly related to growth and energetic conditions. Here we will focus on Arrowtooth Flounder (*Atheresthes stomias*), a large, piscivorous flatfish, which presently represents the greatest biomass of a single groundfish species in the Gulf of Alaska (GOA). Although of limited commercial value arrowtooth flounder are ecologically important in the GOA food web. Despite the importance and abundance of arrowtooth flounder many basic biological aspects of its early life history are poorly understood, including knowledge of and how they respond to the diverse environmental conditions encountered in the GOA. During the summer months from 2010 to 2015 over 840 YOY arrowtooth flounder were collected from the surface waters in the GOA. Basic biological information was obtained, and a select subset of fish were assessed for diet and energetic condition. Environmental factors, such as temperature, were also concurrently collected. This study synthesized the data obtained and provided an overview of the early life history of YOY arrowtooth flounder inhabiting the GOA.

Alaska's Salmon and People in the 21st Century: A Statewide Review with Support from the National Center for Ecological Analysis and Synthesis

Peter Westley
University of Alaska Fairbanks, pwestley@alaska.edu
Ian Dutton
Nautilus Impact Investing, ian@nautilusii.com

This poster presents an overview of the recently initiated State of Alaska's Salmon and People (SASAP) project. With support from the National Center for Ecological Analysis and Synthesis at the University of California Santa Barbara, this interdisciplinary project led by a team of Alaska based researchers seeks to provide an up-to-date assessment on Alaska's salmon systems and the people who rely upon them. The overall goal is to answer three core questions: what do we know, what do we not know, and how can we better integrate and share what we know about Alaska's salmon system for more informed and equitable decision making? SASAP Working Groups (see https://alaskasalmonandpeople.org/working-groups/) will compile and analyze available data and information to provide new insights into Alaska's salmon systems and their relationships with salmon people through a collaborative, science-based and adaptive assessment process. The Working Group synthesis process deliberately emphasizes collaboration between indigenous knowledge and western science perspectives to bridge the information gap. SASAP has a dual emphasis on multidisciplinary science synthesis and on building capacity in Alaska to undertake similar processes going forward. Stakeholders will have opportunities to engage with SASAP project through meetings such as NPRB and workshops throughout the SASAP project. Products of the work are expected to be diverse, including by not limited to academic papers and reports supported by openly accessible, synthesized data, archived models and analyses, and education materials. These materials will be widely distributed to government, education, research, community and commercial interests to strengthen their understanding of salmon systems and prioritize future research, monitoring and management. There will be an initial public "rollout" of products at the 2018 Alaska Marine Science Symposium and Alaska Forum on the Environment

The Influence of Environmental Factors on the Occurrence and Density of Capelin in the Gulf of Alaska

David McGowan
University of Washigton, mcgowand@uw.edu
John Horne
University of Washigton, jhorne@uw.edu
Mark Zimmermann
NOAA Alaska Fisheries Science Center, mark.zimmermann@noaa.gov

As part of the Gulf of Alaska Integrated Ecosystem Research Program (GOAIERP), we investigated the influence of environmental factors on capelin (*Mallotus villosus*) distributions over the continental shelf east of Kodiak Island. Capelin distributions were quantified during an acoustic-trawl survey conducted in summer and fall of 2011 and 2013. Acoustic measurements and midwater trawls were sampled along parallel transects orthogonal to the coast extending across the shelf to slope waters. Oceanographic measurements were sampled at fixed stations spaced equidistant (20nmi) along transects. Capelin densities were significantly higher in 2013 compared to 2011. To quantify differences in capelin densities between years and seasons as a function of bottom depth, we used a generalized linear mixed model (GLMM) with random effects for spatial covariance among continuous samples along transects. Capelin distribution patterns were similar in summer of both years with relative densities highest over shallow submarinebanks (≥100m depth). In contrast, densities were highest within troughs (100-300m depth) in fall. Length frequency distributions indicated that the population was comprised primarily of immature age-1 and -2 capelin, with age-1s primarily concentrated over banks and age-2s within troughs. To quantify the influence of environmental predictors on variability of discrete measurements of capelin occurrence and density within a 0.5km radius of stations, we used a 2-stage generalized linear model (GLM). Bottom temperature and chlorophyll-*a* concentration had the greatest influence on the probability of occurrence in summer. Proximity to the edge of banks/troughs had the greatest influence on capelin density in summer, while surface temperature, vertical salinity gradient, and predator (*i.e.* semi-demersal piscivorous fish) density were also identified as influential predictors. Our results indicate that age-1 capelin were more likely to aggregate over shallow waters near the edges of banks that experience relatively strong mixing and high primary production in summer. Densities of age-2+ capelin were more likely to occur over deeper waters within troughs that were more stratified. Ongoing research will compare factors that influenced summer and fall distributions to assess seasonal differences. We will also examine the relationship of additional biological predictors (*i.e.* prey availability, potential competitors) with capelin distributions in summer.

Impacts of the Parasite *Ichthyophonus* (sp.) on Groundfish Growth and Condition

Sioned Sitkiewicz
Alaska Pacific University, ssitkiewicz@alaskapacific.edu

Ichthyophonus is a globally distributed, largely undescribed parasite species inhabiting fresh and saltwater aquatic systems. Documented in 140 fish species including economically important stocks (e.g. salmon and herring), it can result in reduced growth, stamina, and overall health, decreased market value, and has triggered large-scale mortality events. As changing ocean temperatures increase the potential for presence and spread of pathogens, it is important to establish baseline information for *Ichthyophonus* and its current and potential effects on Alaskan fisheries. Preliminary studies conducted at Alaska Pacific University in 2012 and 2013 found *Ichthyophonus* in 26% (n= 563) of Pacific halibut (*Gadus macrocephalus*) sampled in the port of Homer, AK. The parasite infected heart tissues but not liver, kidney, or spleen, and was more prevalent in older fish. My current thesis research (2016 & 2017) expands this initial work to assess *Ichthyophonus* prevalence in three port towns (Homer, Seward, and Whittier, AK) within three economically significant Alaskan fish species, Pacific halibut, Alaska pollock (*Gadus chalcogramma*), and Pacific cod (*Gadus macrocephalus*). The study employs a length-based sampling design, as well as bioelectric impedance analysis (BIA) and Fulton's Condition Factor (K) to assess *Ichthyophonus* impacts on fish condition. Also evaluated is size-at-age (growth), host immune response to infection (histolopathological methods), parasite load within the heart (qPCR), and parasite-induced changes in heart mass. During the summer of 2016 all field objectives were accomplished while sampling cooperatively with the ADF&G port sampling program and charter fleets. Overall *Ichthyophonus* prevalence in Pacific halibut was 57% (n=572). Additional preliminary analyses are currently ongoing, and a second field season is planned for 2017. As climate change variably impacts fish stock health, effective and adaptive management strategies will require updated information about the distribution and impact of pathogenic risk. This project lays important methodological groundwork for the expansion of groundfish condition research to the Bering Sea – Aleutian Islands and Gulf of AK.

Distributional Responses of Groundfish to Climate Variability: A Comparison across the Gulf of Alaska, and the West Coast of Canada and US

Lingbo Li
NOAA Alaska Fisheries Science Center, lingboli.fish@gmail.com
Anne Hollowed
NOAA Alaska Fisheries Science Center, anne.hollowed@noaa.gov
Steve Barbeaux
NOAA Alaska Fisheries Science Center, Steve.Barbeaux@noaa.gov
Jennifer Boldt
Fisheries and Oceans Canada, Jennifer.Boldt@dfo-mpo.gc.ca
Edward Cokelet
NOAA Pacific Marine Environmental Laboratory, Edward.Cokelet@noaa.gov
Toby Garfield
NOAA Southwest Fisheries and Science Center, toby.garfield@noaa.gov
Stéphane Gauthier
Fisheries and Oceans Canada, stephane.gauthier@dfo-mpo.gc.ca
Darin Jones
NOAA Alaska Fisheries Science Center, Darin.Jones@noaa.gov
Aimee Keller
NOAA Northwest Fisheries Science Center, Aimee.Keller@noaa.gov
Jackie King
Fisheries and Oceans Canada, Jackie.King@dfo-mpo.gc.ca
Michelle McClure
NOAA National Marine Fisheries Service, Michelle.McClure@noaa.gov
Olav Ormseth
NOAA Alaska Fisheries Science Center, Olav.Ormseth@noaa.gov
Wayne Palsson
NOAA Alaska Fisheries Science Center, Wayne.Palsson@noaa.gov
Patrick Ressler
NOAA Alaska Fisheries Science Center, Patrick.Ressler@noaa.gov
Dale Sweetnam
NOAA Southwest Fisheries and Science Center, Dale.Sweetnam@noaa.gov
Phyllis Stabeno
NOAA Alaska Fisheries Science Center, Phyllis.Stabeno@noaa.gov
Chris Wilson
NOAA Alaska Fisheries Science Center, Chris.Wilson@noaa.gov

Global warming has impacted marine organisms in many different ways, including changes in species distribution. Species have been observed to move to higher latitudes and deeper waters; however, to date, ontogenetic changes have rarely been taken into account. In this study, we test the two hypotheses by life stage for a group of commercially exploited fish species: 1). Groundfish shift their geographic ranges in

response to shifts in the water temperature. 2) Groundfish will move to deeper waters rather than shifting their geographic range when the water temperature increases. We analyzed large datasets of bottom trawl and acoustic-trawl surveys in the Gulf of Alaska, and west coast of Canada and US. We used size bins to capture ontogenetic differences in species distribution. We computed the abundance-weighted centroid location and depth for each species in each size bin and correlated them with changes in water temperature. Preliminary results show no consistent changes in geographic location in response to water temperature for walleye pollock (*Gadus chalcogrammus*) across all life stages in the Gulf of Alaska. However, large walleye pollock (≥ 400 mm) show large variability in their centroid depth in warm years while they stayed in a narrow depth layer in cold years. This suggests that other factors (such as prey) in addition to temperature may have impacts on their vertical distribution. We compare pollock with rockfish and flatfish, that rely on some specific habitats, to investigate the between species differences across the Gulf of Alaska and the west coast of North America. Finally, we summarize the sensitivity and resilience of species to environmental changes.

Investigating the Size and Scope of the 2015/2016 Die-Off of Common Murres in Alaska

Sarah Schoen
U.S. Geological Survey, Alaska Science Center, sschoen@usgs.gov
John Piatt
U.S. Geological Survey, Alaska Science Center, jpiatt@usgs.gov
Robin Corcoran
U.S. Fish and Wildlfie Service, Robin_Corcoran@fws.gov
David Irons
U.S. Fish and Wildlfie Service, dbironsak@gmail.com
Tony DeGange
U.S. Geological Survey, Alaska Science Center, tdegange@gmail.com
Robert Kaler
U.S. Fish and Wildlfie Service, robert_kaler@fws.gov
Kathy Kuletz
U.S. Fish and Wildlfie Service, kathy_kuletz@fws.gov
Heather Coletti
National Park Service, heather_coletti@nps.gov
Brielle Heflin
U.S. Geological Survey, bheflin@usgs.gov
Anne Schaefer
Prince William Sound Science Center, aschaefer@pwssc.org
Mary Anne Bishop
Prince William Sound Science Center, mbishop@pwssc.org

Unusually large numbers of Common Murres (*Uria aalge*) washed up dead on beaches across Alaska in pulses from spring of 2015 to spring of 2016. Common Murre die-offs have occurred periodically in Alaska (e.g. 1972, 1993, 1997/1998, and 2004) but the 2015/2016 die-off was set apart from others by its duration, magnitude, and geographic extent. Coincident with this die-off and past events were anomalously warm ocean temperatures in the North Pacific; in 2015 and 2016 a mass of warm water ("The Blob") stretched from California to the Aleutian Islands. In an effort to quantify the scale and scope of this recent die-off, biologists from several organizations collaborated on surveys for beach-cast murres at more than 100 beaches spanning a geographic range of over 850 km from Prince William Sound to the Alaska Peninsula, including Kodiak Island. We surveyed >330 km of beach from August 2015 to May 2016, and documented >20,000 dead murres on beach transects. The grand mean encounter rate of dead murres on beaches was 61 murres/km, with one transect exceeding a rate of 6980 murres/km. To investigate the cause of death, we conducted field necropsies on a subset of fresh beach-cast murres. The proximate cause of death appeared to be starvation: nearly all (98%) of the birds were emaciated or strongly emaciated, and 88% of stomachs were completely empty. Additionally, the majority of birds we have

examined thus far were adults and most were female (77%). Starvation was likely related to a lack of accessible prey. Young of the year walleye pollock (*Gadus chalcogrammus*), an important prey item for murres, were found in lower numbers in larval surveys in 2015 than in any other time within the last 15 years. We plan to further investigate other potential causes for this die-off, including testing for the presence of biotoxins, which may have contributed to murre mortality.

The Nosey Neighbor: Testing Different Types of Remote Camera Equipment to Spy on a Cliff-Nesting Seabird

Sarah Tanedo
Alaska SeaLife Center, saraht@alaskasealife.org
Tuula Hollmén
Alaska SeaLife Center, tuulah@alaskasealife.org

Remote camera methods are an increasingly popular form of monitoring wildlife, particularly for species inhabiting remote locations, such as seabirds. Advances in technology have resulted in cameras that are increasingly autonomous, more compact, and produce high quality images or video. With numerous options available on the market, the question of which type of equipment and method to use often comes down to cost, ease of installation, and image quality required to complete the objective of the project. To investigate the value of different types of remote cameras for monitoring cliff-nesting seabirds, we utilized multiple types of camera equipment to monitor a sub-colony of black-legged kittiwakes (*Rissa tridactyla*) over multiple years. Our objective was to identify the strengths and weaknesses of each camera type by collecting common components of biological significance, such as colony attendance throughout the breeding season, average hatch dates, or productivity. To accomplish this, we monitored a sub-colony of black-legged kittiwakes in Resurrection Bay in the northern Gulf of Alaska using a remote video system, a digital SLR camera, an unmodified trail camera, and a modified trail camera with a zoom lens. Our results indicated that the remote video system had the highest quality media as well as the most diverse use of the equipment tested at the Resurrection Bay study site. The digital SLR camera was the best value for versatility in collection of data. The unmodified trail camera had the least quality and practicality as a tool for monitoring any reproductive parameters but was a useful method for monitoring adult attendance at the colony. The modified trail camera showed potential but needs further adjustment to be suitable as a monitoring tool for the Resurrection Bay study site. The results of this investigation demonstrate the value and practicality of different types of remote camera equipment, providing a framework for identifying the type of equipment best suited for future projects monitoring cliff-nesting seabirds.

Monitoring Productivity and Seasonal Occurrence of Common Murre in Resurrection Bay, Alaska: Indicators for Large Scale Mortality Event

Sadie Ulman
Alaska SeaLife Center, sadieu@alaskasealife.org
Tuula Hollmén
Alaska SeaLife Center, tuulah@alaskasealife.org
Sarah Tanedo
Alaska SeaLife Center, saraht@alaskasealife.org

Monitoring seabird populations is important and informative, as seabirds can be indicators of marine environment health. Since 2011, we have studied the common murre (*Uria aalge*) near Resurrection Bay in south-central Alaska. Monthly numbers and distribution of birds in Resurrection Bay have been recorded via boat-based coastal seabird surveys and breeding success of common murre on Barwell Island has been determined using still-image cameras. These monitoring efforts provide data in relation to a recent common murre die-off event.

Common murre populations periodically experience large-scale die-offs that have been linked to starvation, but the recent 2015-2016 Alaskan event was geographically widespread and considered the largest in recorded history in the state. In Resurrection Bay, numerous die-offs also have been observed in the past, but not to the degree observed in 2015-2016. During the 2011-2014 year-round boat-based seabird surveys, few common murre were observed during the breeding season (May-August) and the highest count observed during the non-breeding season (Sept- April) was 102 individuals. Surveys in 2015 showed a sustained, elevated number of live murre starting in January, continuing during the breeding season with a high count of 71 individuals, and peaking at 549 in late December. In late December, we complemented our live bird surveys with foot-based beach surveys to record numbers of carcasses washed up on Resurrection Bay beaches. The peak in live bird numbers corresponded with the peak in beach survey numbers, with 907 carcasses found on three beaches near the head of Resurrection Bay in early January. We propose that our live bird survey may be used to detect early signals of future common murre die-offs. Before the die-off event, reproductive success breeding productivity from the Barwell Island colony was 70% in 2014 and 61.7% in 2015 (n=60 nests both years). Preliminary findings, however, indicates there was no attempt at nesting during the 2016 season.

While more research is needed to fully understand the environmental drivers behind these die-offs, our monitoring efforts have provided context to the Resurrection Bay common murre before, during, and after a large-scale die-off event.

The Important Role of Wildlife Rehabilitation during a Major Mortality Event

Guy Runco Jr.
Bird Treatment and Learning Center, director@birdtlc.net

Throughout Alaska during the winter of 2015-2016, Common Murres, medium-sized black and white seabirds endemic to the northern hemisphere, experienced the largest mass die-off in the state's recorded history. In response to this major mortality event, avian rehabilitators at Anchorage's Bird Treatment and Learning Center provided emergency care for hundreds of these emaciated seabirds. Over the course of two days alone, over 300 seabirds arrived at our clinic for treatment. Our total intake during the entirety of this mortality event was 414 individuals. Rescued by concerned citizens – some as far inland as Fairbanks – most were found stranded on the ground far from any body of water. Staff and volunteers worked tirelessly for weeks, receiving and tube feeding a fish slurry to each Murre several times a day. Soiled feathers were washed and if all went well, we prepared them for release back to the sea. Bird TLC also provided an important public service by fielding calls from the general public, sharing information with reporters, and providing interviews with news agencies. As this mortality event began to wind down in March, experts with the USFWS and USGS confirmed a carcass count of 36,000, but are hesitant to offer an overall death toll. Estimates from similar previous events suggest that only around 15% of birds that die at sea actually reach the shore, let alone so far inland. The cause of starvation and the reason why these seabirds left the sea en masse are still unknown. This presentation emphasizes the important role of wildlife rehabilitation during a major mortality event. The presence of experienced, licensed professionals with the expertise and capacity to take on a high volume of birds in need resulted in significantly fewer birds left to perish and decompose where they landed – a significant health risk to humans and animals. In addition, the widespread community awareness of our rehabilitation clinic reduces the instances of well-meaning, yet inexperienced members of the general public attempting rehabilitation at home, which can likewise present threats to human health and be detrimental to the bird's health, often resulting in the death of the bird.

Running Hot and Cold: Shifts in Seabird Distribution in the Northern Gulf of Alaska under Different Temperature Regimes, Based on Seward Line Surveys, 2007-2015

Kathy Kuletz
U.S. Fish and Wildlfie Service, kathy_kuletz@fws.gov
Daniel Cushing
Pole Star Ecological Research LCC, dan.cushing@gmail.com
Russell Hopcroft
University of Alaska Fairbanks, rrhopcroft@alaska.edu
Seth Danielson
University of Alaska Fairbanks, sldanielson@alaska.edu
Elizabeth Labunski
U.S. Fish and Wildlfie Service, elizabeth_labunski@fws.gov

In the northern Gulf of Alaska (GOA) conditions are dynamic, with strong seasonal and interannual variations. Recently there have been consecutive years of ‘cold’ ocean temperatures (2007-2009) and ‘warm’ years (2013-2015), with 2011 and 2012 near average. Oceanographic conditions can impact seabird foraging ability and can influence the prey base, therefore seabird distribution should respond to oceanographic changes. We examined a decade of seabird survey data to determine if broadscale shifts in distribution were evident in the GOA. We compared seabird densities observed during Seward Line surveys between seasons (May and September), between cold and warm years, and among four regions: Prince William Sound (PWS), inner shelf (IS), mid shelf (MS) and slope/oceanic (OC). Overall, seabird densities were higher during warm years, especially in fall. In warm springs, seabird densities were high in PWS and the IS, whereas in cold springs, densities were higher in the MS and OC, with particularly low densities of murrelets, murres, and kittiwakes. More ‘offshore’ groups like fulmars, storm-petrels, and albatrosses, consistently occupied the MS and OC. During fall, seabird abundance was highest in warm years, with inshore species (cormorants, kittiwakes, gulls, murrelets, murres) occupying PWS, and these along with puffins and shearwaters occupying the IS. Cold falls had the lowest densities for most species groups, with the exception of offshore groups in the MS (fulmars, albatrosses) and OC (storm-petrels, albatrosses). In general, PWS and the IS showed the greatest differences in seabird abundance between cold and warm years, particularly among inshore species groups (including murres). Shearwaters were mainly present during warm years, and shifted from the OC in spring to the IS in fall. For ‘resident’ species, PWS and the IS may be a ‘refugia’ during warm years, yet they are joined by large numbers of migrant shearwaters. These preliminary results suggest that seabirds in inshore waters, particularly PWS, are most impacted by shifts in GOA conditions. Ocean temperatures have trended warmer since the 1970s, and predictions are for increasing temperatures

in the future. This study will help describe and predict the impact such changes may have on seabird communities of the northern GOA.

Marine Mammal Monitoring In The Offshore Waters of The Gulf of Alaska Under U.S. Navy Funding 2009-2017

Chip Johnson
U.S. Navy, chip.johnson@navy.mil
Andrea Balla-Holden
U.S. Navy, andrea.ballaholden@navy.mil

The U.S. Navy continues to fund extensive marine mammal monitoring within the Gulf of Alaska. Two ship-based visual and passive acoustic surveys were conducted in April 2009 and expanded in scope during a summer 2013 survey. These two surveys covered cumulatively 5,260 km of on-effort transects and reported 898 marine mammal sightings representing 13 species. Round the clock passive acoustic monitoring from a towed array during these surveys made 428 detections of six species.

In addition to the ship surveys, from July 2011 through May 2015 up to five bottom-mounted devices (10 Hz-160 Hz) were deployed on the shelf, slope, and seamounts within the Gulf of Alaska. Over 89,000 hours of passive acoustic data were collected and analyzed through May 2015 with regular detection of up to five different baleen whale species and eight toothed whale species. Ambient ocean sound measurements were also obtained for each site.

Finally, a field test of an advanced underwater glider with passive acoustic sensors was conducted over 32 days from July to August 2015. The glider was deployed starting approximately 200 km east-southeast of Homer, Alaska and traveled southwest parallel to the continental slope within the Gulf of Alaska. The glider completed 755 km of effort with 170 discrete dives from the surface to a depth of 1,000 m. Data collection from the glider included 680 hours of passive acoustic data (15Hz-90 kHz) resulting in 315 cetacean encounters of six species, as well as concurrent measurements of water temperature profiles and surface currents. This glider (along with other new marine monitoring technologies) highlights the beginning stages of technology transition from basic research to field application, funded by three separate Navy research and monitoring programs.

Further background, additional results, and description of future efforts from 2017-2021 will be described.

2015 Gulf of Alaska Large Whale Unusual Mortality Event

Kate Savage
NOAA Alaska Region, kate.savage@noaa.gov
Kathy Burek Huntington
Alaska Veterinary Pathology Services, avps.kbh@gmail.com
Stephen Raverty
British Columbia Ministry of Agriculture, stephen.raverty@gov.bc.ca
John Moran
NOAA Alaska Fisheries Science Center, john.moran@noaa.gov
Paul Cottrel
British Columbia Ministry of Agriculture, Paul.Cottrell@dfo-mpo.gc.ca
Kate Wynne
University of Alaska Fairbanks, kate.wynne@alaska.edu
Deb Fauquier
NOAA National Marine Fisheries Service, deborah.fauquier@noaa.gov
Bree Witteveen
University of Alaska Fairbanks, bree.witteveen@alaska.edu
Mandy Migura
NOAA Alaska Region, Mandy.Migura@noaa.gov

Between May 22 and June 17 of 2015, 12 dead fin whales were reported near Kodiak Island and in the western Gulf of Alaska. The number of animals was unprecedented; over the previous 15 years an average of less than one stranded fin whale had been reported throughout the entire Alaskan region. Through the summer, coastal British Columbia also experienced an unusual intensity of large whale strandings. Consequently, in August of 2015, a large whale Unusual Mortality Event was declared and an investigative team established.

Findings of the investigative team, collected in 2015 and throughout 2016, and conclusions will be presented.

Adding Pieces to the Puzzle: Consolidating Datasets from Photo-Id, Stranding, and Genetic Studies Extends What Can Be Learned from Satellite-Tagging of Endangered Cook Inlet Beluga Whales

Tamara McGuire
LGL Alaska Research Associates, Inc., tmcguire@lgl.com
Amber Stephens
LGL Alaska Research Associates, Inc., astephens@lgl.com
Kim Shelden
NOAA Alaska Fisheries Science Center, kim.shelden@noaa.gov
Mandy Migura
NOAA Alaska Region, mandy.migura@noaa.gov
Christopher Garner
Joint Base Elmendorf and Richardson, christopher.garner.9@us.af.mil
Carrie Goertz
Alaska SeaLife Center, carrieg@alaskasealife.org
Kathy Burek Huntington
Alaska Veterinary Pathology Services, avps.kbh@gmail.com
Greg O'Corry-Crowe
Florida Atlantic University, gocorryc@fau.edu

Between 1999 and 2002, the National Marine Fisheries Service instrumented 18 Cook Inlet beluga whales (CIBWs, *Delphinapterus leucas*) with satellite tags to track their movements. Years later, the CIBW Photo-ID Project discovered several photo-identified CIBWs had scar patterns consistent with satellite-tag attachment methods and that photographic resighting of these individuals could provide post-tagging information about survival, reproduction, and movement/residency for decades beyond the original tag life (1-295 days). Four datasets were reviewed and combined to assemble life histories of satellite-tagged CIBWs. Datasets spanned 1999-2015 and included: NMFS capture/tagging/tracking data; stranding records from the Alaska Marine Mammal Stranding Network; CIBW Photo-ID Project catalog (with contributions from JBER and the public); and HBOI-FAU genetic analyses of tissue samples from captures and dead-stranded individuals. Of the 20 CIBWs captured, 18 were tagged (8 males, 10 females) and 15 of the 20 were later identified as individuals in the CIBW Photo-id catalog. Ten were photographed as recently as 2015, representing 50% of the 20 CIBWs originally captured. Three satellite-tagged whales were confirmed dead since 2002; match confirmation was provided by a flipper-band, and by genetic fingerprinting of two whales recovered dead. Photo-id records suggest a fourth whale may have died after 2007. Six photographically resighted satellite-tagged whales could be matched to their tagging photos; four were confirmed as females via genetic samples taken during tagging, and seven others are suspected to be females based on close accompaniment by calves in photographs. Five of these 14 cataloged satellite-tagged whales had signs of tag-site infection in photos, eight had signs of deformity above the tag site, and two

displayed damage to the pectoral fins from flipper bands applied during tagging. All of the 15 captured/ satellite-tagged whales in the photo-id catalog were resighted in Upper Cook Inlet's Susitna River Delta, and most were also resighted in Knik Arm and Turnagain Arm, displaying distribution and movement patterns consistent with those obtained from the transmitting tags. Combining these four datasets broadens what can be learned about these individuals and the population, extending the temporal range of the satellite tags, and adding biological data to the photo-id catalog.

Stress-Related Hormone Concentrations in Hair of Young Steller Sea Lions (*Eumetopias jubatus*)

Mandy Keogh
Alaska Department of Fish & Game, mandy.keogh@alaska.gov
John Maniscalco
Alaska SeaLife Center, johnm@alaskasealife.org
Pamela Parker
Alaska SeaLife Center, pamp@alaskasealife.org

Steller sea lions (*Eumetopias jubatus*, SSLs) within the western distinct population segment are listed as endangered with no definitive cause for their decline or slow recovery. Assessing the health and fitness in free-ranging populations is challenging and many parameters can be altered by acute stressors. Hair is increasingly being used to investigate diet, contaminants, and stress-related hormones. Hair is metabolically inert and not altered by capture and handling. Further, large-scale environmental changes and reduced food were related to cortisol concentrations in hair of terrestrial mammals and polar bears.

This study examined the utility of measuring hormones in SSL hair to assess the impacts of potential stressors. Pups (F=29,M=21) were weighed, measured and hair collected. A body condition index (axial girth/standard length*100) associated with survival was calculated. Pups were sampled in conjunction with the remote video monitoring program at the Alaska SeaLife Center allowing for the identification of mother–pup pairs and determination of ages. Pups ranged in age from 0.9 to 33.4 days. The majority of the pups (n=39) were from multiparous dams while 7 were from primiparous and 3 were unknown. There was no difference between male and female pups for mass, standard length, or axial girth whereas females had higher BCI than males (p=0.021). Pups born to primiparous dams were younger (p=0.020), smaller in mass (p=0.008) and axial girth (p=0.013). Steroid hormones were extracted from ground hair and standard methods including recovery of added mass, parallelism and dilution linearity were used to validate enzyme immunoassay kits (Arbor Assay) for cortisol. Cortisol was detectable in all samples and ranged from 2.1 to 10.9 pg/mg hair (4.7±1.8 pg/mg). There was no difference between cortisol concentration between male (4.9±2.0, 2.6-10.9 pg/mg) and females (4.6±1.8, 2.1-8.3 pg/mg), nor between pups born from primiparous (4.0±1.5, 2.1-5.9 pg/mg) or multiparous dams (4.9±2.0, 2.1-10.9 pg/mg). These preliminary findings demonstrate that stress-related hormones are measurable in SSL hair; however, larger sample sizes are needed to fully assess the utility of hair for assessing the response of SSLs to potential stressors.

Mercury in Ancient Sea Otters: Complexity in Climate Change

Amy Hirons
Nova Southeastern University, hirons@nova.edu
Lawrence Duffy
University of Alaska Fairbanks, lkduffy@alaska.edu

An increase in mobility of heavy metals, like mercury (Hg), has the potential to be one of the impacts of climate change on Arctic and sub-Arctic ecosystems. Sea level changes and flooding events in high latitude coastal ecosystems could increase the bioavailability of contaminants such as mercury. Mercury concentrations have been used as an indicator of past exposure to heavy metals in ancient fish and animal samples. Sea otters (Enhydra lutris) are present in the coastal areas of the Gulf of Alaska; and paleontological deposits of their bones have been identified as far back as the early Holocene. Stable isotope ratios are used to reconstruct ancient food webs and help identify sea otter prey which may have bioaccumulated high concentrations of the metal. Modern sea otters have $\delta^{13}C$, $\delta^{15}N$, and mercury values likely corresponding largely to a benthic diet. Conversely, higher $\delta^{15}N$ and mercury levels were found in ancient sea otter bones which may not only demonstrate higher trophic level foraging but also an almost 6 fold increase in the bioavailability of mercury in the coastal ecosystem. One possible explanation being explored to explain these large increases may be associated with rising sea level following the glacial maximum. Paleontological remains of sea otters have been used to place present day predicted climatic perturbations, like sea level rise, in a historical context, testing the hypothesis that bioaccumulation of mercury occurred due to coastal flooding of Beringia during the Holocene.

Importance of Marine Resources to Brown Bears on the Katmai Coast: Evidence from Multiple Data Streams

Grant Hilderbrand
U.S. Geological Survey, Alaska Science Center, ghilderbrand@usgs.gov
Joy Erlenbach
Washington State University, jerlenbach@wsu.edu
David Gustine
National Park Service, david_gustine@nps.gov
Buck Mangipane
National Park Service, buck_mangipane@nps.gov
Heather Colett
National Park Service, heather_coletti@nps.gov
Dan Monson
U.S. Geological Survey, Alaska Science Center, dmonson@usgs.gov
Troy Cambier
Chena River Aviation, tcambier@alaska.net

In 2015, we initiated a study of the intertidal and coastal ecosystems in Katmai National Park with particular focus on the distribution and abundance of marine invertebrates and their importance to resident brown bears (*Ursus arctos*). These ecosystems and their physical and nutrient linkages can potentially be affected by ocean acidification, oil spills, and human visitation. We have investigated the nutritional ecology and energetics of brown bears on the Katmai coast using a variety of techniques including GPS and video collars, direct observation, stable isotope analyses, changes in body composition throughout the growing season, remote cameras, and local knowledge. Early results indicate a wide range of important food resources, both seasonally and annually, including sedges, salmon, flounder, clams, as well as scavenged and predated marine mammals. The dietary breadth seen in brown bears on the Katmai coast is in large part due to individual specialization made possible by the high quality and availability of diverse food resources throughout the year. Katmai brown bears differ from not only interior bear populations in their seasonal energetics and body mass dynamics, but from other coastal populations as well, likely due to the availability of high quality spring food resources.

The National Marine Mammal Tissue Bank and AMMTAP

Jennifer Trevillian
National Institute of Standards and Technology, jennifer.trevillian@nist.gov
Amanda Moors
National Institute of Standards and Technology, amanda.moors@noaa.gov
Jennifer Ness
National Institute of Standards and Technology, jennifer.ness@noaa.gov
Debra Ellisor
National Institute of Standards and Technology, debra.ellisor@noaa.gov
Rebecca Pugh
National Institute of Standards and Technology, rebecca.pugh@noaa.gov
Teri Rowles
NOAA National Marine Fisheries Service, teri.rowles@noaa.gov

The National Marine Mammal Tissue Bank (NMMTB) was developed in 1989 by the National Marine Fisheries Service, Office of Protected Resources (NMFS/OPR) in collaboration with the National Institute of Standards and Technology (NIST), and was formally established by Federal legislation in 1992 (PL 102-587). Its purpose is to provide long-term cryogenic archival of systematically collected marine mammal tissues, enabling researchers to investigate environmental trends through retrospective analyses, thereby providing valuable baseline data on contaminant levels in marine mammals. Protocols developed by NIST for the collection and archival of target tissues are designed to minimize contamination during sampling, ensure sample integrity, and provide sufficient material for multiple analyses. In addition, NIST ensures long-term sample stability through cryogenic techniques and tracks and maintains records of sample histories. Tissues for Alaska are collected for the NMMTB through the Alaska Marine Mammal Tissue Archival Program (AMMTAP), which was established in 1987. Tissues include blubber, kidney and liver and are primarily collected through subsistence harvests in collaboration with local Native Americans, but also include animals taken incidentally in fishing operations and single-animal strandings. Once collected, a portion of each tissue is archived for long-term storage and a portion is processed and sub-sampled into 20-25 aliquots for various analyses. Currently there are over 13,000 sample aliquots that have been collected from over 1,900 animals representing 19 species, including whales, seals, sea lion, walrus, and polar bear. Samples are located at and maintained by NIST's Marine Environmental Specimen Bank (Marine ESB) at the Hollings Marine Laboratory in Charleston, South Carolina. The scientific community can request tissues from the NMMTB for research purposes through a formal tissue access policy accessible through the NMFS/OPR website. Past research includes temporal and spatial trends of emerging, persistent organic, and organometallic contaminants, as well as animal nutrition studies and evaluating trophic transfer of pollutants.

Asphyxiation of an Endangered Cook Inlet Beluga Whale, *Delphinapterus leucas*

Natalie Rouse
Alaska SeaLife Center, natalier@alaskasealife.org
Kathy Burek-Huntington
Alaska Veterinary Pathology Services, avps.kbh@gmail.com
Kim Shelden
NOAA Alaska Fisheries Science Center, Kim.Shelden@noaa.gov

Cook Inlet beluga whales, Delphinapterus leucas, are a critically endangered cetacean population residing year-round in a semi-enclosed tidal estuary in southcentral Alaska. Because of this, stranding events and causes of mortality are closely monitored. A beluga was reported stranded in Turnagain Arm, Cook Inlet, in October 2013. The National Marine Fisheries Service authorized necropsy of the carcass. Gross examination revealed the animal to be a healthy, robust male, and subsequent analysis of the teeth determined he was about 40 years old (assuming annual deposition). A starry flounder, *Platichthys stellatus*, was found lodged in the pharynx at the goosebeak, dislocating the larynx. Most cases of asphyxiation by prey have been reported in wild bottlenose dolphins, *Tursiops truncatus* and *T*. aduncus, with a few cases reported for other wild cetacean species such as pilot whales, *Globicephala melas*, harbor porpoise, *Phocoena*, Pacific white-sided dolphins, *Lagenorhynchus obliquidens*, short-beaked common dolphin, *Delphinus delphis*, Atlantic spotted dolphin, *Stenella frontalis*, whitebeak dolphin, *L. albirostris*, and minke whale, *Balaenoptera acutorostrata*. Prey anatomy such as spines, body shape, and backbone density may be risk factors for choking in beluga whales and other cetaceans. Starry flounder may have been the preferred prey of this individual whale during the fall (when it died) following the end of anadromous fish runs in the inlet. We know little about available prey for this population of whales during seasons other than summer. As this is the only stranded animal examined by necropsy with this cause of death determination in the last 18 years (n=49), we do not consider choking incidents to be a significant threat to the Cook Inlet beluga population as a whole. However, it is important to monitor and document any unusual sources of mortality given the status of this endangered population.

Histology and Morphology of Phocid Whiskers in Relation to Cortisol Concentrations

Shawna Karpovich
Alaska Department of Fish & Game, shawna.karpovich@alaska.gov
Mandy Keogh
Alaska Department of Fish & Game, mandy.keogh@alaska.gov
Leroy Brown
Histology Consultation Services, Inc., rhbrown@histocs.com
Lawrence Kunz
BioGenetics Research Laboratories, Inc., kunzll@whidbey.com

Cortisol is deposited into whiskers during growth. Therefore, analysis of cortisol in serial sections of whiskers may provide retrospective information about circulating concentrations of cortisol over time. Previously, spring-collected harbor seal whiskers showed cortisol concentrations were highest at the root and decreased curvilinearly to minimal levels at the tip. To investigate potential drivers of this pattern, harbor seal whiskers collected during different seasons were examined for dissimilarities in morphology (n=154), histology (n=16), and cortisol concentrations (n=14). Three distinct root morphologies were identified that correlated with timing of whisker molt. Closed-root whiskers were associated with pre-molt, open-root with post-molt, and intermediate-root with time in-between. Darkened spots, believed to contain blood or lipids, were found in 8% of closed-root, 74% of intermediate-root, and 89% of open-root whiskers. Pre-molt whiskers (≈full length, n=8) were 41 mms longer than post-molt whiskers (<full length, n=6). Consequently, we hypothesized that cortisol concentrations would be lower at the roots of post-molt compared to pre-molt whiskers because material closest to the root was most recently deposited and post-molt whiskers were less than full length (i.e. lacking ~41 mms of material at the root). However, cortisol concentrations from the root area of pre- and post-molt whiskers were not different (p=0.20). This may have been caused by three post-molt whiskers that had substantial darkened spots and significantly higher cortisol concentrations at the root area than two post-molt whisker roots without spots (p=0.02). If these spots contain blood incorporated during whisker collection, circulating cortisol associated with capture stress could be included. Longitudinally sectioned whiskers were used for histological examination of pre- (n=7) and post-molt (n=9) whiskers and showed that cortisol was incorporated diffusely in the cortex or in discrete spots in the cortex or medulla of whiskers, and did not vary with differing proportions of medulla and cortex. These findings suggest that root morphology can be useful to estimate the growth status of whiskers, darkened spots may confound results when using information stored in whiskers, and further investigations are necessary to verify the stability of cortisol in whiskers.

Gulf of Alaska - Mammals

The Costs and Benefits of Whale Watching in Juneau, AK

Alicia Rinaldi
University of Alaska Fairbanks, akrinaldi@alaska.edu
Heidi Pearson
University of Alaska Southeast, hcpearson@alaska.edu

As many whale populations around the globe increase in number, the whale watch industry is also growing and becoming increasingly lucrative. Whale watching is an important source of income for many Southeast Alaskan communities, including Juneau. As the number of whale watch vessels increases, there is rising concern that whale watching could lead to negative short-term and long-term effects that are inadvertently jeopardizing the health of the resource on which the industry relies. The objectives of this study were to 1) identify costs by determining if whale movement and behavioral patterns are affected by whale watch vessel presence; 2) determine how these costs are related to the number, type, and proximity of vessels to whales, and whale group size, group type, and residency; and 3) identify benefits by measuring the educational and conservation value of whale watching. A surveyor's instrument, or theodolite, used to observe changes to humpback whale (*Megaptera novaeangliae*) and killer whale (*Orcinus orca*) behavior according to whale watch vessel presence. Passenger surveys were administered to passengers before and/or after whale watch trips to assess knowledge, attitudes, values, intentions, and behaviors. During June-October 2016, 187 humpback whale groups and 15 killer whale groups were observed. Additionally, 275 "before" and 523 "after" surveys were collected from passengers of two whale watch companies. Data analysis is on-going and field work and data collection will commence again in May 2017. Data from this two-year study will then be used to create a quantitative assessment of the effect of commercial whale watch vessels on whale behavior and movement patterns and will provide an analysis of the educational and conservation benefits of whale watching.

Avoiding Injury to Marine Mammal Hearing from Underwater Construction Noise

Suzann Speckman
HDR, Inc., suzann.speckman@hdrinc.com
James Reyff
Illingworth & Rodkin, Inc., jreyff@illingworthrodkin.com
Nathan Jones
HDR, Inc., Nathan.Jones@hdrinc.com
Bonnie Easley-Appleyard
HDR, Inc., Bonnie.EasleyAppleyard@hdrinc.com

Construction and other industrial activities in the marine environment can cause elevated underwater noise levels with potential to disturb or injure marine mammals. Effects of anthropogenic noise may be especially harmful for species that use echolocation for navigating and feeding, such as Cook Inlet beluga whales. The range of the Cook Inlet beluga whale, a distinct population segment listed as endangered under the Endangered Species Act, overlaps with Alaska's largest concentration of human population and marine industrial projects. Reducing the threat of anthropogenic noise in Cook Inlet has been identified by the National Marine Fisheries Service (NMFS) as one of its priority actions for protecting and fostering recovery of the Cook Inlet beluga whale, which numbers fewer than 350 individuals. In recognition of growing global concern about the effects of noise on marine mammals, NMFS has developed new Technical Guidance for assessing the effects of underwater anthropogenic noise on the hearing of marine mammals for species under its management authority. Released in July 2016, the Technical Guidance will be implemented under the Marine Mammal Protection Act. The Technical Guidance identifies the received sound levels, or acoustic thresholds, at which marine mammals are predicted to experience permanent or temporary threshold shifts that correspond to Level A injury levels for five different functional hearing groups: Low-, Mid-, and High- Frequency Cetaceans, and Phocid and Otariid Pinnipeds. This study modeled the acoustic thresholds for hypothetical marine construction projects in Cook Inlet using NMFS' previous methods, including the Practical Spreading Loss Equation, and compared those results with the new NMFS Technical Guidance, which applies auditory weighting functions. Example projects include pile driving and seismic surveys, activities that occur in Cook Inlet and produce some of the highest sound source levels measured in marine construction. The conservation benefit to marine mammals of each approach, and assessment of the potential costs and benefits to project proponents, are addressed.

Partnership for Success: Steller Sea Lion Disentanglement, Post-Release Monitoring, and Global Collaboration

Kimberly Raum-Suryan
NOAA Alaska Region, kim.raum-suryan@noaa.gov
Lauri Jemison
Alaska Department of Fish & Game, lauri.jemison@alaska.gov
Kate Savage
NOAA Alaska Region, kate.savage@noaa.gov
Michael Rehberg
Alaska Department of Fish & Game, michael.rehberg@alaska.gov

Human activities that have negative consequences to marine mammals are of increasing global concern. Steller sea lions in Alaska are especially vulnerable to becoming entangled in floating plastic debris, and interacting with and ingesting fishing gear. From 2000-2016, we photo-documented ~350 live Steller sea lions with neck entanglements (e.g., plastic packing bands, rubber bands) and > 400 live Steller sea lions that had ingested fishing gear in Southeast Alaska. Until recently, disentanglement of Steller sea lions was limited due to animal size and the lack of appropriate agents for chemical restraint. However, in 2013 the Alaska Department of Fish and Game and National Marine Fisheries Service initiated a collaborative effort to disentangle Steller sea lions using a recently developed chemical cocktail of midazolam, butorphanol, and medetomidine which allows for immobilization on land and in water without respiratory compromise. Our objectives were to dart specific, entangled Steller sea lions, capture and remove entangling or ingested materials, and attach flipper tags and/or satellite tags to monitor post-capture survival. From 2013-2016, we darted 12 Steller sea lions of which seven were successfully sedated, restrained, disentangled, and released, and one was sedated and restrained but not disentangled. The remaining four individuals were darted but not fully sedated so not restrained. Moreover, for the first time ever in Alaska, four subadult male Steller sea lions were outfitted with satellite transmitters to monitor post-release survival. As we continue to refine and improve upon these capture techniques, we share our methods and simultaneously continue our “Lose the Loop” outreach and educational efforts through our multi-stakeholder Pinniped Entanglement Group, which has grown to 45 members in five countries.

Mortality Trends in Steller Sea Lion Stranding Incidents (1990-2015)

Janessa Esquible
University of Alaska Fairbanks, jaesquible@alaska.edu
Shannon Atkinson
University of Alaska Fairbanks, shannon.atkinson@alaska.edu

Steller sea lion (SSL) (*Eumetopias jubatus)* as sentinel species, and whose populations have faced severe fluctuations over the last 5 decades. By identifying long-term mortality trends in both SSL stocks, we can develop a better understanding of cause-specific spatial and temporal trends affecting SSL population dynamics. In this study, we characterized spatial and temporal trends in SSL strandings occurring in Alaska, Oregon and Washington. Temporal trends were assessed by identifying seasonality trends across all years (1990-2015) in addition to analyzing sex, age class, body length, body condition and cause of death (if determined). Spatial trends were identified through mapping of SSL stranding incidents, separated by into two regions: West coast and Alaska. The stranding reports obtained for the purpose of this study came from the Alaska and West Coast Region Marine Mammal Stranding Network, as well as Alaska Department of Fish & Game.

An apparent increase in stranding incidences was found, likely a result of increased effort following 2000, due to an increase in federal grant award and concerted effort of scientists involved with SSL studies around that time. Adult males were the most frequently stranded sex and age class across both regions. In Alaska, the southeast region had the highest concentration of stranding occurrences, with very few cases reported in Western Alaska. In the Northwest Region, Oregon had the highest overall number of stranding occurrences. Clear seasonality trends were illustrated in the Northwest region, with summer having the highest number of reported stranding occurrences. Both spring and summer appear to be times of higher stranding occurrences in Alaska. Initial condition of carcass varied by region. Cause of death in both regions for the majority of cases was unknown, which may be a result of initial condition upon the stranded sighting. Although these datasets have provided insight into spatial and temporal SSL mortality trends, these data do not account for effort, and may not be representative of stranding occurrences for the 25-year time period in Alaska. This study hopes to encourage continued and improved stranding surveillance programs while taking into consideration the quality of data collected.

Spatial and Temporal Trends in Juvenile Steller Sea Lion (*Eumetopias jubatus*) Utilization Distributions in the Gulf of Alaska: 2000-2014

Amanda Bishop
Alaska SeaLife Center, amybi@alaskasealife.org
Leigh Torres
Oregon State University, leigh.torres@oregonstate.edu
Michael Rehberg
Alaska Department of Fish & Game, michael.rehberg@alaska.gov
Markus Horning
Alaska SeaLife Center, markush@alaskasealife.org

The Western Distinct Population Segment (W-DPS) of the Steller sea lion (SSL, *Eumetopias jubatus*) has declined to approximately 20% of levels encountered 40 years ago. At the height of the decline, juvenile survival appeared to be depressed. While some regions of the W-DPS seem to be stable or slightly increasing, it has been suggested that the continued decline in the western Aleutian Islands and the lack of recovery for the W-DPS as a whole might be driven by killer whale predation or inadequate food resources. The spatial distribution and habitat utilization of upper trophic level predators is assumed to be primarily driven by foraging opportunities and predation avoidance, but the latter is rarely included in models due to lack of data. By integrating data from satellite tracking (distribution) and Life History Transmitters (LHX tags; predation) we have the unique opportunity to generate a juvenile SSL habitat model that incorporates both elements of pinniped distribution ecology. In this initial step, we examined geospatial tracking data from juvenile sea lions tagged between 2000 and 2014 (n=105) in the Prince William Sound and Kenai Fjords regions. A Bayesian Switching State-Space Model (SSSM) was used to estimate animal movement locations, and to assign each location a behavioral state of either transit (directed movement) or area-restricted searching (a proxy for foraging). Using the locations derived from the SSSM, we derived utilization distributions (UD) for juvenile SSLs. Core areas were defined as locations with UD ≤50%. Changes in core area distribution (distance to coast, distance to haul-out) and core size (area) were evaluated seasonally and annually over the 14 year period with respect to age and sex. These results will later be utilized to develop a species distribution model that incorporates physical and biological habitat characteristics, and for the first time, predation risk (as derived from actual predation event locations determined from the LHX tags). Juveniles constitute one of the most vulnerable life history stages for SSLs, and the characterization of biologically relevant habitat and its use is therefore vital information to management and promoting recovery of the species.

Can we use Stable Carbon and Nitrogen Isotope Analysis to Determine the Contribution of Hatchery Salmon to Humpback Whale Diet?

Madison Kosma
University of Alaska Fairbanks, mmkosma@alaska.edu
Megan McPhee
University of Alaska Fairbanks, mvmcphee@alaska.edu
Jan Straley
University of Alaska Southeast, jmstraley@uas.alaska.edu
Matthew Wooller
University of Alaska Fairbanks, mjwooller@alaska.edu

Since the end of commercial whaling, the population of humpback whales returning to feed each year in Southeast Alaska and northern British Columbia is increasing annually, changing the seascape for local communities in many ways. Their feeding habits are of increasing concern to fishermen and managers of aquaculture operations because of overlapping interests for the same target species. However, the feeding ecology of marine mammals is difficult to observe. Stomach content analysis provides only a snapshot of the last few meals and is impractical for large animals such as whales. Stable carbon and nitrogen isotope analyses of animal tissues can represent a longer-term integrated proxy of animal diets. Used together with isotopic analyses of potential prey items, these techniques can be used to estimate the proportional contribution of different diet items. We are using stable carbon and nitrogen isotope analyses of humpback whales (*Megaptera novaeangliae*) and their potential diet items in Southeast Alaska to determine the proportional contribution of hatchery salmon versus wild prey in their diets. Stable isotope analysis is an effective method of diet depiction when prey types have different stable isotope signatures. Our preliminary data show that hatchery salmon have a different isotope signature compared with wild diet items. We obtained tissue samples from the same humpback whale individuals, that repeatedly fed on juvenile released hatchery salmon, over the 2016 season in order to examine potential changes in tropic position and to determine whether the isotope signature of hatchery salmon prey persists through the season. Using stable isotopes to determine the proportional contribution of hatchery salmon to the diet of humpback whales will help determine the role of humpback whales in the early marine mortality of hatchery salmon. Based on results from our proposed study, the hatchery industry will have a better understanding of the economic effects whale predation is having on their production. In the future, this method could be used for studies of other predators upon hatchery salmon. This information will help guide aquaculture managers in addressing concerns regarding hatchery production and returning adults.

Preliminary Results on Reproductive and Metabolic Endocrine Profiles in Blue Whales from the Eastern North Pacific

Valentina Melica
University of Alaska Fairbanks, vmelica@alaska.edu
Shannon Atkinson
University of Alaska Fairbanks, shannon.atkinson@alaska.edu
John Calambokidis
Cascadia Research Collective, calambokidis@cascadiaresearch.org

The goal of this project is to define reproductive parameters and assess interaction between reproduction and stress responses in blue whales *(Balaenoptera musculus)* from the Eastern North Pacific Ocean. This population is showing signs of recovery after being severely depleted by commercial whaling, with a recent estimate of 2500 individuals. The habitat range for this stock extends as far South as Costa Rica Dome and as far North as the Gulf of Alaska, with the largest aggregations off California, a summer feeding ground and off La Baja California, Mexico, the winter breeding area. Photo-identification is an important tool used to estimate population abundance and movement; however, physiological parameters regarding reproduction and stress levels are fundamental for describing population dynamics and defining growth. In this study, we use steroid hormones combined with sighting history as a tool to determine pregnancy in female blue whales and to create baseline data for metabolic status, as a biomarker for measuring response to naturally occurring or human-induced stressors. Concentrations of progesterone and cortisol were measured in 23 biopsies collected between 2005 and 2013 by Cascadia Research Collective in Southern California waters. Three additional samples from ship-struck whales ware included in the pool and further analyzed for blubber depth studies. Preliminary results support the hypothesis that high concentrations of progesterone ($\geq$ 81 ng/g) are indicative of an ongoing pregnancy; observational data confirmed pregnancy status for two out of four adult female whales, as they were seen with calves the following year and for one of stranded individuals, as it was carrying a fetus at time of necropsy. Cortisol appears to be statistically higher in females (< 0.05) and to vary both across blubber depths and body areas. Further steps include a larger sample size, comparison between breeding and feeding grounds and measurement of aldosterone concentration as an additional indicator of a stress response.

Tooth and Consequences: Tooth Position, Growth Layer Groups, and Age-Length Curves for the Endangered Belugas in Cook Inlet, Alaska

Kim Shelden
NOAA Alaska Fisheries Science Center, kim.shelden@noaa.gov
Daniel Vos
Alaska Ecological Research, djvbam@acsalaska.net
Nancy Friday
NOAA Alaska Fisheries Science Center, nancy.friday@noaa.gov
Barbara Mahoney
NOAA Alaska Region, barbara.mahoney@noaa.gov

The Cook Inlet beluga whale (*Delphinapterus leucas*) population is currently listed as endangered under the U.S. Endangered Species Act. Teeth from hunted and stranded whales, collected from 1992 to 2015, were used to estimate growth layer group (GLG)-length curves for females and males. A total of 1,028 teeth from 124 whales were cut and analyzed. Of the 124 whales, tooth position was documented for 102 whales (947 teeth). Teeth from matching left and right jaws were compared and found to give statistically equivalent values. Tooth position in the jaw affected wear with maximum GLG counts occurring in teeth from the posterior of the jaw. Tooth position 9 had the highest average count, followed by 8 and 7. Neonatal cap presence ranged from 15% at tooth 8 (10%, 12%, and 14% for tooth 6, 7, and 9, respectively) to 4%-6% for teeth 1-5. Because tooth 9 was rarely represented in the sample (n = 36 vs. n = 88 for tooth 8 and n = 107 for tooth 7), and tooth 8 had the highest average GLG in combination with neonatal cap presence, regression equations were developed to adjust GLGs for each tooth position based on the maximum value reflected in tooth 8. Growth curves were calculated from a sample of 100 known length belugas (45 females and 55 males). Sexual dimorphism was evident with male lengths longer than females.

Using Fasting Status to Evaluate the Nutritional Stress Hypothesis in Steller Sea Lion Pups

Stephanie Crawford
University of Alaska Fairbanks, sgcrawford@alaska.edu
Lorrie Rea
University of Alaska Fairbanks, ldrea@alaska.edu
Robert Coker
University of Alaska Fairbanks, rcoker@alaska.edu

From the 1970's through the 1990's, significant population declines of numerous species of piscivorous apex predators were well documented in the subarctic Pacific Ocean. Nutritional stress hypotheses have been proposed as a proximal cause of the decline and lack of recovery of the Steller sea lion (*Eumetopias jubatus*) within the western portion of their range. Steller sea lions' offshore foraging range is limited by essential ties to land for resting, breeding, and pupping; consequently, they are vulnerable to changes within the coastal marine ecosystem. Dams alternate between nursing pups onshore and foraging at-sea, resulting in a fasting interval for the pup. Previous studies demonstrate that pinnipeds extend foraging trips when resources are limited. During extended maternal absences, pups show a distinctive blood chemistry profile indicating entry into advanced phases of fasting, systematically depleting stored resources. Using measurements of the relative concentrations of blood urea nitrogen and β–hydroxybutyrate, I will differentiate between pups that were recently fed, in Phase II of fasting (lipid stores primarily support energy needs), transitioning between Phase II-III, and those in Phase III (recommencing protein catabolism). Examination of pups' fasting status over a broad geographic (Russian and Alaskan rookeries) and temporal (1990-2016) range will allow us to evaluate the validity of the nutritional stress hypothesis with respect to adult females and their newborn to 2 month old pups (n≈1700). A large proportion of pups in advanced fasting phases would suggest dams are extending their foraging trip durations before returning to the rookery. Furthermore, we will investigate relationships among areas of differing population trends, as well as the influence of covariates such as body condition indices, sex, and oceanic factors. Preliminary assessments suggest a presence of nutritional stress in the region of population growth and expansion (eastern portion of range), not in the region of population decline.

Growth Rates and Hand-Rearing Guidelines of Orphaned Beluga (*Delphinapterus leucas*) and Pacific Walrus (*Odobenus rosmarus divergens*) Calves

Todd Schmitt
SeaWorld, todd.schmitt@seaworld.com
William Winhall
SeaWorld, william.winhall@seaworld.com
Steve Osborn
SeaWorld, steve.osborn@seaworld.com
Les Dalton
SeaWorld, les.dalton@seaworld.com

Orphaned marine mammals provide a unique challenge to ensure proper nutrition and behavioral socialization for optimal physical and mental development. Animals are often orphaned secondary to maternal neglect, maternal naiveté, maternal aggression, maternal loss or death, neonatal weakness or illness. In the uncommon event that a neonate marine mammal, such as a beluga (Delphinapterus leucas) or Pacific walrus (Odobenus rosmarus divergens), is found orphaned within hours to days of birth, the animal must first be examined, stabilized, and treated for any medical conditions, such as dehydration, infection, parasitism, hypoglycemia or hypothermia. Secondly, the orphaned animal should be placed in appropriate species-specific housing for swimming, hauling-out, and maintenance of water quality. Despite the small sample size of orphaned belugas and walruses that have been raised, the weight gain on average for both species is ~0.45 kg/day for the first 90 days. A review of guidelines for artificial formula composition, caloric requirements, animal handling, and behavior training of managed orphan beluga calves and wild orphaned Pacific walrus calves will be presented.

Sea Otter Harvest and Population Dynamics in Southeast Alaska

Wendel Raymond
University of Alaska Fairbanks, wraymond2@alaska.edu
Martin Tinker
University of California, Santa Cruz, ttinker@ucsc.edu
Michelle Kissling
U.S. Fish and Wildlfie Service, michelle_kissling@fws.gov
Brad Benter
U.S. Fish and Wildlfie Service, Brad_Benter@fws.gov
Verena Gill
NOAA National Marine Fisheries Service, verena.gill@noaa.gov
Ginny Eckert
University of Alaska Fairbanks, gleckert@alaska.edu

Increases in the sea otter population and legislative calls for management action have led to questions regarding sea otter harvest and population dynamics in Southeast Alaska. At last count in 2011, the sea otter population was estimated at 25,000 animals and growing at 12-14% per year. The Marine Mammal Protection Act permits only coastal Alaska Native peoples to harvest sea otters, solely for the purpose of subsistence and creating and selling authentic native handicrafts and clothing, provided that the harvest is not wasteful and is reported to the US Fish and Wildlife Service. We analyzed sea otter harvest records and combined them with a spatially structured population model to investigate 1) whether sea otter harvest pressure has changed over time and space; 2) whether hunting is focused in particular geographic areas; and 3) if hunting pressure relates to and affects sea otter population growth, either at local or regional scales. A total of 13,151 sea otters were reported harvested from 1988 to 2015, ranging from 72 to 1,494 sea otters per year. Harvest has increased through time, with annual harvest exceeding 1,000 animals since 2013. The proportion of the population harvested is stable; consistently around 4% of the population per year. Spatial analysis shows both consistent hot spots of harvest, with the greatest concentration in Sitka Sound and central Prince of Wales Island, and transient hot spots that change from year to year. Preliminary model results suggest that current levels of hunting have impacted population growth at both local and regional scales.

Preliminary Results of the Harbor Seal Biosampling Program 2015-2016: Health, Diet, and Stress of Seals in Alaska

Amanda Bishop
Alaska SeaLife Center, amy.bishop00@gmail.com
Bernadine Erickson
Alaska Native Harbor Seal Commission, bernadineerickson1@gmail.com
Anne Hoover-Miller
Alaska Native Harbor Seal Commission, anne@wiprr.com
Link Olson
University of Alaska Museum of the North, leolson@alaska.edu
Eric Bortz
University of Alaska Anchorage, ebortz@alaska.edu
Jennifer Burns
University of Alaska Anchorage, jmburns@alaska.edu
Joni Bryant
Alaska Native Harbor Seal Commission, jonibyrant@harborsealcommission.org

Harbor seals (*Phoca vitulina richardii*) play a key role in marine ecosystems as a top predator and are also an important nutritional, spiritual, and cultural resource for Alaska Natives. Consistent monitoring across the breadth of the species' range is essential for managing viable seal populations, while concurrently ensuring seals remain safe food resources for Native communities. As harbor seals are widely distributed along the Alaskan coast, this task is logistically challenging. The Alaska Native Harbor Seal Commission (ANHSC) Biosample Program, initially operated from 1995-2006, was designed to unite Alaska Native subsistence hunters and scientists in taking a proactive approach to monitoring the health of harbor seal populations in Alaska. In 2015, the program was revitalized and 33 Alaska Native hunters are now certified as biosample technicians in 11 communities. Here we present the preliminary results from the samples collected to date (n=7), from the Aleutians, Gulf of Alaska, Prince William Sound, and Southeast Alaska regions. The condition of seals from all regions were well within reported ranges for this species by sex and age class. Diet assessments were conducted at three levels: short-term (stomach content hard-parts), long-term (fatty acid profiles), and seasonal changes (whisker stable isotopes). Initial findings suggest variation in diet across region and individuals. Tissue samples collected through the fall 2016 hunting season will be screened for a suite of common and potentially emergent pathogens including influenza A, phocine distemper virus, and seal coronavirus, and the results will be presented. Finally, we will present the total mercury (THg) concentrations in the blubber for each seal. From 2015-2016, the ANHSC biosampling program successfully re-established a state-wide cooperative network between scientists, managers and subsistence hunters; including participants from some of the most remote communities in the Aleutians. In time, this framework will help promote a better

understanding of the long-term effects of natural and anthropogenic environmental perturbations on seals and the humans who rely on them.

Use of Infrared Thermal Imaging for the Comparison of Glacial and Terrestrial Harbor Seals (*Phoca vitulina*): Habitat and Physiological Analyses

Chenoa Payne
Christopher Newport University, chenoa.payne.13@cnu.edu
Annie Eckmann
Christopher Newport University, ann.eckmann.10@cnu.edu
John M. Maniscalco
Alaska SeaLife Center, johnm@alaskasealife.org
Michael Meyer
Christopher Newport University, michael.meyer@cnu.edu
Richard Sherwin
Christopher Newport University, rsherwin@cnu.edu

In Alaska, harbor seals (*Phoca vitulina*) occupy two different types of haul-out sites classified by substrate type, ice or rock. The two groups may exhibit differences in activity budgets and energy expenditure due to varying environmental pressures in these different habitats. During the summer of 2016, 100 infrared thermal images of harbor seals observed on rock and ice substrates in Kenai Fjords National Park were collected. Data were taken from distances of 25-100 m aboard a tour vessel using an infrared thermal camera with digital imaging capabilities. Images of harbor seals collected from haul-outs on rock substrate and on ice were compared using a thermal scale of 0-30°C. The physiological differences in the seals' heat distribution and thermal qualities of the surrounding habitat were compared to observe the basis for habitat association and possible preferences, as well as potential physiological differences in regards to heat retention of the two seal groups. The preliminary results of this study indicate that the substrate temperatures of the glacial habitat are consistently stable. Thermal images of glacial seals in this habitat showed little variation in heat radiation, and instead emphasized retention of core heat. Conversely, the temperature of the terrestrial habitat is more variable, depending on weather conditions. Thermal imaging showed evidence that terrestrial seals have a greater variation of heat radiating from their bodies, from core to appendages. The haul-out behavior of harbor seals has been studied, yet this compensatory trade-off between substrate and fitness requires more research. Infrared thermal imaging provides data that may reveal underlying factors influencing habitat preference and physiological differences among glacial and terrestrial harbor seals.

Seasonal Distribution of Dall’s Porpoise in Prince William Sound, Alaska

John Moran
NOAA Alaska Fisheries Science Center, john.moran@noaa.gov
Danielle Dickson
North Pacific Research Board, danielle.dickson@nprb.org
Matthew O'Dell
NOAA Alaska Fisheries Science Center, matthew.odell@noaa.gov
Janice Straley
University of Alaska Southeast (Sitka Campus), jan.straley@gmail.com
Mayumi Arimitsu
U.S. Geological Survey, Alaska Science Center, marimitsu@usgs.gov

Dall’s porpoise are a conspicuous predator in the Prince William Sound ecosystem, yet there has been little effort directed towards monitoring this species since before the Exxon Valdez Oil Spill. We used vessel-based surveys to examine the seasonal distribution of Dall’s porpoise in the waters of Prince William Sound from 2007-2015. Dall’s porpoise were found throughout the year in Prince William Sound, using a wide range of habitats, including those not considered typical of the species, such as bays, shallow water, and nearshore. The ability of Dall’s to exploit these habitats may be attributed to reduced foraging risk associated with the decline of their main predator, AT1 killer whales, following the Exxon Valdez Oil Spill. We describe the seasonal shifts in the distribution of Dall’s porpoise observations and evaluate their habitat preferences (depth, slope, and distance from shore). We identified potential Dall’s porpoise habitat within Prince William Sound using generalized additive models (GAM). Encounter rates with porpoise were lower and group size was similar to surveys conducted during the late 1970’s. While the current population of Dall's porpoise within Prince William Sound remains uncertain, their high metabolic rate and ubiquitous presence makes Dall’s porpoise one of the more important yet underestimated forage fish predators.

SPLISH - Survey of Population Level Indices for Southeast Alaskan Humpbacks

John Moran
NOAA Alaska Fisheries Science Center, john.moran@noaa.gov
Kelly Cates
University of Alaska Fairbanks, kacates@alaska.edu
Jennifer Cedarleaf
University of Alaska Southeast (Sitka Campus), jcedarleaf@gmail.com
Christine Gabriele
National Park Service, chris_gabriele@nps.gov
Aleria Jensen
NOAA Alaska Region, aleria.jensen@noaa.gov
Steve Lewis
Tenakee Springs, tenakeetwo@yahoo.com
Janet Neilson
National Park Service, Janet_Neilson@nps.gov
Matthew O'Dell
NOAA Alaska Fisheries Science Center, mbodell@alaska.edu
Heidi Pearson
University of Alaska Southeast, hcpearson@uas.alaska.edu
Janice Straley
University of Alaska Southeast (Sitka Campus), jan.straley@gmail.com
Andy Szabo
Alaska Whale Foundation, andyszabo@gmail.com

After decades of population growth since the end of commercial whaling, humpback whales are now a prominent component of coastal ecosystems in the North Pacific. In anticipation of the removal of the Hawaii Distinct Population Segment of humpback whales from listing under the Endangered Species Act, the National Marine Fisheries Service encouraged local researchers to initiate a collaborative survey of humpback whales in northern Southeast Alaska. The objectives of this study were to establish baseline conditions for indices that are slated to be monitored for the 10 year post-delisting period. We collected photographic mark-recapture data to assess trends in abundance, calf production, spatial and temporal distribution and evaluated prey composition and body condition. Seven independent research groups worked in partnership to conduct vessel-based surveys covering the waters of Lynn Canal, Icy Strait, Glacier Bay, Chatham Strait, Stephens Passage, Frederick Sound and Sitka Sound from August 1-14, 2016. Fluke photographs and distribution data will be compared with those collected during a similar period in 2004-2005 under the “SPLASH” population assessment program. Preliminary observations during this survey, such as a low number of calf sightings, “skinny” whales and shifts in distribution, suggest that whales feeding in Southeast Alaska may be ending their period of rapid population growth. In addition,

during winter 2015-2016, whale researchers on the Hawaiian wintering grounds reported a reduction in the number of adults and calves observed. However, concurrent with these observations, the Gulf of Alaska has faced several years of unusually warm conditions with many biological ramifications, and caution must be exercised in distinguishing long-term population trends from temporary climatic perturbations. The complexity of ecosystem variability under a changing climate highlights the importance of creating monitoring programs capable of reliably detecting population level changes. We recommend the use of this low cost rapid assessment tool as a measure to contribute to the successful management of both listed and recently delisted humpback whale populations. Monitoring humpback whales and understanding the mechanisms behind changes in their population parameters will also provide insight into fluctuations in the Gulf of Alaska ecosystem under varying climactic conditions.

Estimating Age-dependent Mortality Rates and Age Structure for Beluga Whales in Cook Inlet

Roderick Hobbs
NOAA Alaska Fisheries Science Center, rod.hobbs@noaa.gov
Daniel Vos
Independent Contractor, djvbam@acsalaska.net
Kim Shelden
NOAA Alaska Fisheries Science Center, kim.shelden@noaa.gov

The beluga whales (*Delphinapterus leucas*) of Cook Inlet declined from an estimated population size of 1300 animals in 1979 to 650 in 1994; the most recent estimate is 340 individuals in 2014. Prior to 1999 the decline can be attributed to an uncontrolled subsistence hunt; however the population has continued to decline, albeit at lesser rate since the hunt was limited to a few animals after 1999. Average age at death declined from 28 years in the early 90's to 18 years in 1998 and has since rebounded to 30 years. This occurred for both males and females indicating that adults of both sexes were substantially depleted. Here, we develop a population model that accounts for all ages and both sexes to estimate age- and sex-dependent mortality and vulnerability to hunting. The model is run in a Bayesian framework with likelihood of a given outcome dependent upon approximating an abundance time series from 1994 to 2014, and age at death data for over 120 individuals from 1992 to 2015. Results for age-dependent mortality rates during the unrestricted hunting and in the current period will be presented and the current depletion of age classes estimated.

Varied and Extensive Movements of Harbor Seal (*Phoca vitulina richardii*) Pups from their Natal Habitat on Glacial Ice in Disenchantment Bay, Alaska

John Jansen
NOAA Alaska Fisheries Science Center, john.jansen@noaa.gov
Jamie Womble
National Park Service, jamie_womble@nps.gov
Scott Gende
National Park Service, scott_gende@nps.gov
Peter Boveng
NOAA Alaska Fisheries Science Center, peter.boveng@noaa.gov

Harbor seals (*Phoca vitulina*) commonly travel extensively during the non-breeding months, with juveniles and pups typically ranging the furthest from natal areas. Little is known about what factors influence the range of recently weaned pups (maximum recorded: 500 km), but environmental and endogenous cues are thought to play a role. Foraging habitat near natal sites is thought to be a key factor because an important constraint is pups' ability to transition to independent foraging. In early June 2016, we deployed 45 satellite-linked GPS and time-depth recorders on maternally-dependent pups approx. 1-2 weeks of age (mass: 13-25 kg) in Disenchantment Bay, Alaska. Our aim was to examine pre-weaning haul-out behavior and post-weaning movements. By early July, 20 pups had traveled at least to the mouth of Yakutat Bay or the adjacent outer coast (approx. 50-100 km); half of these pups (10) traveled >500 km along the outer coast, to the SE (as far as Icy Straits) and to the NW (at least to Kayak I.). Four of the six pups that traveled NW entered Prince William Sound, covering a distance of about 1,000 km from Disenchantment Bay. Such distances represent a new extreme in known movements of harbor seal pups. Earlier studies have demonstrated striking contrasts in traveling ranges of weaned pups in relation to more open (oceanic; greater ranges) vs. closed (embayment; lesser ranges) marine systems. Except for nearby Icy Bay, another tidewater glacial-ice haul out, there are few known haul-out sites within 500 km likely due to the near absence of protected islets. It may be that pups move initially on larger scales to find prey concentrations and haul-out sites that are sufficiently close together, enabling winter foraging trips to be made on smaller scales.

How Costly are Social Interactions? Long Distance Movements of Resident Killer Whales in Southern Alaska may be tied to Social Needs

Dan Olsen
North Gulf Oceanic Society, waterdogdan@gmail.com
Craig Matkin
North Gulf Oceanic Society, comatkin@gmail.com
Shannon Atkinson
University of Alaska Fairbanks, shannon.atkinson@alaska.edu
Franz Mueter
University of Alaska Fairbanks, fmueter@alaska.edu

Between 2006 and 2015 we collected 1352 hours of behavioral data from resident killer whale pods in southern Alaska to assess seasonal and pod specific differences in behavioral budgets. We compared the percentage of time that these pods spent in four primary behaviors; foraging, resting, socializing, and travelling. A chi squared test was used to determine the significance in behavior budget difference between seasons and between pods, and a mixed effects model was used to determine the most important factors contributing to these behavioral percentage differences. Percentage of time socializing increased with the number of pods present. Social behavior was least for single pod encounters (5.5%), and increased with two pods present (15.3%), three pods present (21.4%), and four or more pods present (26.5%). Of the total budget, social behavior in July/August (17.7%) was higher than in May/June (13.5%), and similar to September/October (16.1%). No difference was detected in the behavioral budget between groups of different genetic haplotype, however, pods which have the Southern resident (SR) genetic haplotype travelled alone (with no other pods) in more encounters (112 of 401, 27.9%) than those with the Northern resident (NR) genetic haplotype (52 of 317, 16.4%). Additionally, pods that regularly use Kenai Fjords and Prince William Sound (more than 40 total encounters each) travelled alone in more encounters (131 of 503, 26.0%) than pods that use the region less regularly (33 of 215, 15.3%). The AF and AG pods (NR haplotype) are most frequently seen in Southeastern Alaska, but visit Kenai Fjords and Prince William Sound during most years. Since 2003, 15 of 17 visits by the AF and AG pods were in August, when a higher percentage of social behavior is observed. While in this region, AF and AG pods were alone in far fewer encounters (4.0%) than the average among all pods (22.8%). These data support the hypothesis that social behavior may the cause for regular trips (1200km) by the AF and AG pods from Southeastern Alaska to Prince William Sound and Kodiak.

Gulf of Alaska - Humans

Trends in Alaska Salmon Research 2008-2016

Katherine Schake
Nautilus Impact Investing, katherine@nautilusii.com
Ian Dutton
Nautilus Impact Investing, ian@nautilusii.com
Allison Dunbar
University of Alaska Anchorage, aldunbar7@gmail.com

Funding support for Alaskan salmon research has declined over the past decade. Because of the complex flow(s) of funding from funders to grantees, and the limited availability of details about uses of research funding, it can difficult to track and evaluate the impact of changes in grant funding flows on researchers and on specific research programs. However, overall this decline in funding availability appears to have limited opportunities for extramural and student research, for linkage of long-term monitoring and research, and for research dissemination.

This poster presentation will share preliminary details salmon research analyses and invite feedback on research trends and implications.

Youth Perceptions of Commercial Fishing and Community in Bristol Bay and Kodiak Archipelago Communities

Courtney Carothers
University of Alaska Fairbanks, clcarothers@alaska.edu
Jesse Coleman
University of Alaska Fairbanks, jmcoleman2@alaska.edu
Rachel Donkersloot
Alaska Marine Conservation Council, rachel@akmarine.org
Danielle Ringer
University of Alaska Fairbanks, djringer@alaska.edu
Paula Cullenberg
Alaska Sea Grant, pjcullenberg@alaska.edu

The Alaska's Next Generation of Fishermen study is a three-year ethnographic research project aiming to understand the dynamics contributing to the "graying of the fleet" in Alaska's commercial fishing industry. Over the past four decades, the average age of limited entry permit holders in Alaska has increased by eight years—a change driven in part by a lack of young people entering into the industry. In 2014–2015, we carried out more than 65 semi-structured interviews and surveyed more than 800 middle and high-school students in the Bristol Bay and Kodiak Archipelago regions. The school survey focused on engagement in fishing, as well as attitudes and opinions held by rural Alaska youth about the fishing industry and their communities. Survey results indicate that levels of fishing engagement vary between and within regions, with 48% and 9% of students reporting having ever worked in commercial fishing in Bristol Bay and the Kodiak Archipelago, respectively. Other topical areas covered by the survey include post-high school aspirations, importance of commercial and subsistence fishing, perceptions of availability and desirability of fishing jobs, motivations to stay or leave the community, demographic information, and attitudes about the social health of the community. In this paper we discuss key findings from the survey to promote a better understanding of youth perceptions, experiences, and ambitions to enter into commercial fishing.

Implementation of Community Based PSP Testing for Subsistence and Recreational Shellfish Harvesting in Southwestern Alaska – A Project Description

Julie A. Matweyou
Alaska Sea Grant, julie.matweyou@alaska.edu
R. Wayne Litake
NOAA National Ocean Service, wayne.litaker@noaa.gov
Steven R. Kibler
NOAA National Ocean Service, steve.kibler@noaa.gov
Bruce A. Wright
Aleutian Pribilof Islands Association, brucew@apiai.org
Donnie R. Hardison
NOAA National Ocean Service, rance.hardison@noaa.gov
Patricia A. Tester
Ocean Tester, LLC, ocean.tester@yahoo.com

Subsistence shellfish harvesters in southwest Alaska are exposed to high paralytic shellfish poisoning (PSP) risks due to their strong cultural traditions, dependency on shellfish resources, and limited accessibility to medical care. The state has a toxin-monitoring program in place for the commercial shellfish industry and samples are submitted to the Alaska Department of Environmental Conservation (ADEC) for analysis ($125/sample + shipping). Resource limitations, though, have restricted routine testing of recreational/subsistence-harvested shellfish. A recent ADEC pilot program (2012-2015) demonstrated community-based monitoring is an effective strategy to reduce PSP risks, but the project ended after three years. This study will leverage community networks from the ADEC monitoring program and the Aleutian Pribilof Islands Association (APIA) with NPRB-funded technologies (#1118) to implement subsistence shellfish testing. A new electrochemical PSP test (ECtest) is expected to offer rapid shellfish screening in remote locations. The test features a numerical readout at a cost of <$20/sample. The project will include re-testing of shellfish analyzed previously via ADEC and APIA programs and analysis of new samples collected at the Kodiak and Aleutian Island sites to validate the ECtest. The project objectives are to test commonly harvested bivalve species and implement on-site community PSP testing when the ECtest is internally validated. Shellfish collected by community samplers in the Kodiak Islands (Kodiak, Old Harbor, Ouzinkie) and Aleutian Islands (King Cove, Sand Point) will be screened with the ECtest and the results validated via HPLC analysis (a regulatory method). Outreach will include workshops to gather local knowledge about shellfish resources and cleaning methods, as well as training volunteers in on-site testing methods with the ECtest. Study results will be incorporated into a project web page and fact sheets for public dissemination. Community-based PSP screening and monitoring capacity should ease the burden on ADEC for PSP testing and improve community

awareness and information on PSP toxicity trends. The ECtest will also offer the scientific community a tool to monitor the environment for PSP toxins, which may be increasing in Alaska due to climate change.

Introducing NOAA’s Bathymetric Data Viewer

Amy Holman
NOAA, amy.holman@noaa.gov
Kris Holderied
NOAA National Ocean Service, kris.holderied@noaa.gov
Timothy Smith
NOAA National Ocean Service, timothy.m.smith@noaa.gov

Curious about what's under the sea? Need to check the bathymetry for one of your projects? Looking for a way to incorporate NOAA data in the classroom? NOAA’s online seafloor data viewer gives you an virtual tour of what’s available. This poster will guide you on how to access the viewer, choose between options, and get the source data. Live demonstrations will be available.

Evaluating Climatic, Anthropogenic, and Ecological Drivers of Salmon and Herring Populations in Prince William Sound and Copper River, Alaska

Richard Brenner
State of Alaska, richard.brenner@alaska.gov
Eric Ward
NOAA Northwest Fisheries Science Center, eric.ward@noaa.gov

The *Exxon Valdez* oil spill (EVOS) occurred in March 1989 in Prince William Sound, Alaska, and was one of the worst environmental disasters on record in the United States. Despite long-term data collection over the nearly three decades since the spill, tremendous uncertainty remains as to how significantly the spill affected fishery resources. Pacific herring (*Clupea pallasii*) and some wild Pacific salmon populations (*Oncorhynchus spp.*) in Prince William Sound declined in the early 1990s, and have not returned to the population sizes observed in the 1980s. Discerning if, or how much of, this decline resulted from the oil spill has been difficult because a number of other physical and ecological drivers are confounded temporally with the spill; some of these drivers include environmental variability or alternating climate regimes, increased production of hatchery salmon in the region, and increases in populations of potential predators, like humpback whales. Using data pre- and post-spill, we applied time-series methods to evaluate support for whether and how herring and salmon productivity has been affected by each of five drivers: (1) density dependence, or increasing population growth rate at decreasing population density (2) the EVOS event, (3) changing environmental conditions, (4) interspecific competition on juvenile fish, and (5) predation and competition from adult fish or, in the case of herring, humpback whales. Our results showed support for intraspecific density-dependent effects in herring, sockeye, and Chinook salmon, with little overall support for an oil spill effect. Of the salmon species, the largest non-EVOS driver was the negative impact of adult pink salmon returns on sockeye salmon productivity. Herring productivity was most strongly affected by changing environmental conditions; specifically, freshwater discharge into Prince William Sound was linked to a series of recruitment failures—before, during, and after EVOS. These results highlight the need to better understand long terms impacts of pink salmon on food webs, as well as the interactions between nearshore species and freshwater inputs, particularly as they relate to climate change and increasing water temperatures.

Volunteers Complete 27th Year of Annual Photo-site Visits to Rocky Intertidal Sites in Western Prince William Sound

Alan Mearns
NOAA Office of Response & Restoration, alan.mearns@noaa.gov
Rob Campbell
Prince William Sound Science Center, rcampbell@pwssc.org
David Janka
Auklet Charter Services, info@auklet.com
Scott Pegau
Oil Spill Recovery Institute, wspegau@pwssc.org
Pamela Eiting
Eshamy Bay Lodge, eshamylodge@gmail.com
Brian Robinson
U.S. Geological Survey, Alaska Science Center, brobinson@usgs.gov

During summer, 2016, volunteer scientists and citizens visited and photographed six of nine long-term intertidal monitoring sites in an effort to continue documenting interannual changes in cover of conspicuous biota (seaweeds, mussels and barnacles). This marks the 27th year of near-continuous monitoring. Sites include one rocky site in Eshamy Bay, two sites in Upper Passage, a rocky site in Herring Bay, “Mearns Rock” in inner Snug Harbor and several large boulders in Shelter Bay. All but the Eshamy Bay site was oiled in 1989. Examination of the landscape-scale photos by the senior author indicates that mussel cover has generally remained constant while Rockweed (*Fucus sp*) cover has decreased dramatically during the past two years. Summer 2016 was also marked by unusually heavy barnacle cover. During the past quarter century there have been four episodes of peak and then declining Rockweed cover and four episodes of heavy and then zero mussel cover. An effort is being made to determine the extent to which these changes relate to inter-annual ocean climate indices. Though semi-quantitative in nature, this project may represent the longest intertidal biology time-series in Prince William Sound. This basic photo-monitoring activity adds to other quantitative monitoring studies that indicate wide long-term interannual variability of biological cover at sheltered sites in western Prince William Sound, raising questions about the definition of “normal” with respect to recovery from impacts such as oil spills.

.

Variability in Intertidal Crab Populations in Relation to Climate Forcing Factors and Predation Pressures in Prince William Sound, AK

Caitlin Marsteller
Alaska Pacific University, cmarsteller@alaskapacific.edu
David Scheel
Alaska Pacific University, dscheel@alaskapacific.edu
Tania Vincent
Alaska Department of Fish & Game, vintzensius@gmail.com

Climate change will have its greatest affects in arctic and near-arctic areas, including the Gulf of Alaska. In this area, sea surface temperature (SST), and other oceanographic factors that are driven by climate, may force population changes in marine organisms. Therefore, the purpose of this research project is to assess the population fluctuations across five species of small, intertidal, non-commercial crabs (*Lophopanopeus bellus*, *Cancer oregonensis*, *Telmessus cheiragonus, Pugettia gracilis* and *Hapalogaster mertensii)*, in relation to climate forcing factors and predation pressures in Prince William Sound, Alaska. Samples of crab population trends and size-frequency distributions were obtained from 2002 to 2016 at four major sites in northeastern and southwestern Prince William Sound. Predation pressure was also collected, represented by *Enteroctopus dofleini* midden remains. Major climate trends in this period included 2014-2016 record-warm winter SST, as well as an abrupt warming of winter SST in the period 2004-2006 and 2008-2010. This work will identify correlations between crab populations and these changing environmental parameters, at each site sampled. This analysis may reveal general patterns of response to climate change among diverse life histories, similarities and differences between intertidal communities throughout Prince William Sound, and will aid in future monitoring for Gulf of Alaska intertidal communities.

Results from the 2016 Eastern Gulf of Alaska Juvenile Sablefish Gear Trials and Offshore Assessment

Wesley Strasburger
NOAA Alaska Fisheries Science Center, wes.strasburger@noaa.gov
Jamal Moss
NOAA Alaska Fisheries Science Center, jamal.moss@noaa.gov
Jim Murphy
NOAA Alaska Fisheries Science Center, jim.murphy@noaa.gov
Kristin Cieciel
NOAA Alaska Fisheries Science Center, kristin.cieciel@noaa.gov

The primary objectives of the 2016 surface trawl survey in coastal and offshore waters of the eastern Gulf of Alaska were to provide information on how species distribution and marine food webs are altered by climate, including the warm blob and El Niño. This included the collection of biological and oceanographic information pertinent to juvenile groundfishes, juvenile salmon, and forage fishes in the region, collection information about the offshore extent of age-0 rockfishes in the eastern Gulf of Alaska, and assessment of the feasibility of variable mesh gillnet deployment from a large vessel format. Preliminary results are presented here, along with some unusual species observations. Summer surface temperatures continued to hover around 13.5-15.5°C. Few wind events led to a highly stratified, low chlorophyll content surface layer, and depressed large crustacean zooplankton biomass. During the beginning of August, a number of species commonly associated with the California Current system were observed in the coastal areas off of southeast Alaska. During the second half of August, we occupied a new grid extending to 200 miles offshore. During the offshore portion of the survey, we made some preliminary observations of the association between scyphomedusae and juvenile rockfishes, and how this association may affect the predatory behavior of juvenile sablefish.

Long-Awaited Coastal Habitat Assessment for an Area along Alaska Peninsula's Remote Coast

Susan Saupe
Cook Inlet Regional Citizens Advisory Council, saupe@circac.org
Sandra Lindstrom
University of British Columbia, sandra.lindstrom@botany.ubc.ca
Allan Fukuyama
7019 157th SW, Edmonds, WA 98026, USA, akfukuyama@frontier.com
Mandy Lindeberg
NOAA Alaska Fisheries Science Center, mandy.lindeberg@noaa.gov

One of the least studied sections of Alaska's coast is along the south side of the Alaska Peninsula, west of Katmai National Park. This complex coastline is a transition area between the Gulf of Alaska and the Aleutians/Bering Sea and includes remote islands, as well as a range of habitats and physical exposures along the mainland. This remote and often overlooked section of Alaska's coast has been poorly characterized biologically and is usually categorized as part of the Gulf of Alaska marine province or the Aleutian Province, although a publication by Lindstrom 2006 placed it in its own area in a biogeographic assessment of Alaskan seaweeds. Past satellite-tracked drifter buoy releases have shown that the area is "downstream" of Cook Inlet oil industry activities, and a planned federal lease sale in lower Cook Inlet highlighted the need for better information for these habitats at-risk from potential oil spills. In May 2016, several efforts took place along this coast to describe shoreline geomorphology and biological assemblages. To document seaweeds, seagrasses, and invertebrates in the area, we coordinated efforts with aerial *ShoreZone* surveys and conducted on-the-ground surveys at 27 stations between Mitrofania Bay (56.0°N 158.8°W) in the southwest and Wide Bay (57.3°N 156.3°W) in the northeast. The survey results will be integrated with the Alaska ShoreZone Coastal Mapping and Imagery website hosted by NOAA (https://alaskafisheries.noaa.gov/shorezone). In addition to species-level taxonomic collections, geomorphologic information is also acquired, such as across-shore profiles (including width and slope) and sediment composition. Field photos are systematically recorded and also linked to the survey notes. More than 200 marine species were identified- including 2 new eastern distribution records and at least 5 new western records of marine plants.

Nearshore Assessments of Complex Rocky Reefs and Platforms in Lower Cook Inlet: A Patchwork of Marine Assemblages

Susan Saupe
Cook Inlet Regional Citizens Advisory Council, saupe@circac.org
Heather Coletti
National Park Service, heather_coletti@nps.gov
Katrin Iken
University of Alaska Fairbanks, kbiken@alaska.edu
Tahzay Jones
National Park Service, tahzay_jones@nps.gov
Brenda Konar
University of Alaska Fairbanks, bhkonar@alaska.edu
Mandy Lindeberg
NOAA Alaska Fisheries Science Center, mandy.lindeberg@noaa.gov
Benjamin Pister
National Park Service, benjamin_pister@nps.gov
Sarah Venator
National Park Service, sarah_venator@nps.gov

Assessments of nearshore areas along western and lower Cook Inlet's coast were conducted in 2015 and 2016 as part of a larger multi-year effort to provide information about the area's physical and biological environments. These areas include portions of the Lake Clark and Katmai NPP coastlines and are adjacent to, or downstream of, the Cook Inlet Planning Area, one of the Bureau of Ocean Energy Management's (BOEM) proposed Final Outer Continental Shelf Oil & Gas Leasing Program 2012-2017 lease sales. Field work in 2015 and 2016 focused on intertidal and shallow subtidal rocky communities, and included sites in the very southern areas Cook Inlet where there were a lack of historical data, primarily due to the difficulty in sampling these exposed reef systems. These areas support diverse assemblages of invertebrates, seaweeds, and seagrasses which, in turn, provide habitat and food for resident and migrating organisms, such as spawning herring. Both subtidal and intertidal sampling in 2016 was repeated at a subset of the 2015 sites to provide information on temporal variability. Additional sites, including at the massive Douglas Reef system, were sampled in 2016. To access the intertidal portion of these reefs, a combination of boat- and helicopter-based operations were applied to test options for capturing the variability across intertidal polygons with surface areas that can be > 20 km^2. For all sites, tidal zonation on the wide low-angle reefs or platforms is difficult to establish, therefore we again employed Real-time Kinetic (RTK) survey methods to provide high resolution positional and tidal-height data for each intertidal site, enabling correlation of elevation with species presence and abundance. Surveys of subtidal invertebrate and algal communities were conducted visually (% cover) by divers, and quadrat collections provided additional biomass and abundance data. As with sites sampled farther north in

2015, subtidal community assemblages continue to exhibit a general north to south pattern along the study area. Understanding these zonation and geographic patterns in community structure will aid in risk assessments, oil spill planning and response, and other analyses required for future exploration or production activities associated with the lease sale.

Environmental Heterogeneity and Conserved Community Architecture Drive Spatial Patterns of Diversity Across the Gulf of Alaska Large Marine Ecosystem

Anne Hollowed
NOAA Alaska Fisheries Science Center, Anne.Hollowed@noaa.gov
Mary Hunsicker
NOAA Northwest Fisheries Science Center, Mary.Hunsicker@noaa.gov
Andrew Shelton
NOAA Northwest Fisheries Science Center, Ole.Shelton@noaa.gov
Rachael Blake
National Center for Ecological Analysis and Synthesis, blake@nceas.ucsb.edu
Colette Ward
National Center for Ecological Analysis and Synthesis, ward@nceas.ucsb.edu

The processes underlying species co-existence remain one of the more fascinating questions of ecological study. While numerous theories have been advanced to explain species co-existence within regions, no single unifying construct seems adequate to explain observed patterns of co-existence across multiple regions. Recent literature has suggested that redundancy in species function within marine ecosystems (the portfolio effect) can lead to improved stability. The constructs of the portfolio concept intersect with species co-existence through the attributes of species functional redundancy, the complexity of ecosystem structure, and the species interaction terms. We hypothesize that if redundancy in species functions within an ecosystem does provide a stabilizing effect on marine systems, then species diversity would be preserved across space (ecoregions) within large marine ecosystems that have similar large scale environmental forcing. We further hypothesize that if portfolios are preserved across space within large marine ecosystems with similar environmental exposure, then similar suites of species would be found within ecoregions. The shelf region of the Gulf of Alaska was divided into 9 shelf ecoregions. Estimates of alpha diversity, beta diversity and species richness were calculated for each ecoregion. Results show remarkable stability across ecoregions throughout the Gulf of Alaska suggesting conservation of community architecture in the region.

Lower Trophic Level Variability near the Aleutian Islands and the Influence of Pink Salmon

Sonia Batten
Sir Alister Hardy Foundation for Ocean Science, soba@sahfos.ac.uk

Continuous Plankton Recorders have been towed behind commercial ships on their transit from the north American west coast to Asia, a great circle route which transits through the Aleutian Islands. The ship almost always enters through Unimak Pass, with the western exit being more variable but usually around Agattu or Attu Islands. Sampling began in 2000 and since 2002 has sampled spring, summer and fall each year and the data collected provide taxonomically resolved abundance information on the base of the food chain, specifically hard-shelled phytoplankton and robust zooplankton.

Analysis of community composition showed regional and seasonal differences in the plankton communities. Most striking, however, was the odd-even year pattern of high and low diatom and copepod abundances which suggest an influence by pink salmon in parts of the region. Years with high pink salmon abundance had low numbers of large copepods and high numbers of diatoms, with the reverse being true in years with low pink salmon. This suggests that grazing pressure on phytoplankton by copepods is determined by pink salmon predation on the copepods, i.e. top down control.

Analysis is ongoing to fully describe the trophic interactions and this presentation will highlight the results to date.

Metabolic Biomarkers for *Calanus* Copepod Species in the Eastern Bering Sea

Ann Tarrant
Woods Hole Oceanographic Institution, atarrant@whoi.edu
Lisa Eisner
NOAA National Marine Fisheries Service, lisa.eisner@noaa.gov
Mark Baumgartner
Woods Hole Oceanographic Institution, mbaumgartner@whoi.edu
Corey Fugate
NOAA National Marine Fisheries Service, corey.fugate@noaa.gov
Ron Heintz
NOAA National Marine Fisheries Service, ron.heintz@noaa.gov

Copepods are important grazers of phytoplankton in marine ecosystems, providing an abundant and energetically rich food source to larval fish, baleen whales, and other predators. For example, in the eastern Bering Sea, *Calanus* spp. can account for a majority of the diet of juvenile walleye pollock during the summer. Feeding and lipid storage by juvenile copepods in summer and early fall is critical to their survival over the winter, reproductive output in early spring, and food value to predators. It is not yet clear how and to what extent natural patchiness in food resources affects copepod metabolic condition and ultimately impacts populations. Metabolic condition of juvenile copepods can be inferred from the size and distribution of their lipid stores, with the small and dynamic triglyceride pool indicative of recent feeding, and wax esters indicative of long-term lipid storage. Through this project, we seek to develop molecular biomarkers that indicate copepod feeding history and lipid dynamics. We sampled juvenile (C5 stage) *Calanus* spp. from 5 sites on the eastern Bering Sea middle shelf domain during a Sept-Oct 2015 cruise aboard the NOAA Ship Oscar Dyson. In addition, shipboard experiments were conducted during which copepods were either fed a natural algal assemblage or starved for up to 10 days. Copepods were individually photographed and preserved for lipid measurements or genetic/molecular analyses. Genetic analysis (16S marker) indicated that the vast majority of copepods sampled were *C. glacialis* (104 of 106 sequences, 2 of 106 *C. marshallae*). Assays have been developed to measure the expression of several genes involved in lipid storage and utilization, with analyses ongoing. While we did not observe a substantial change in oil sac volume in response to the starvation treatments, we anticipate that triglyceride stores will be depleted. Matching gene expression patterns and lipid profiles within an experimental context and in field-collected samples will enable greater understanding of how copepods respond to patchy and changing environmental conditions in this region.

The Fat's Where It's At: New Approaches to Track Intact Phospholipids and Triglycerides in Euphausiids via Tandem LC-MS

Rachel Pleuthner
Old Dominion University, rpleu001@odu.edu
Rodger Harvey
Old Dominion University, rharvey@odu.edu

In the eastern Bering Sea and Chukchi Sea, *Thysanoessa raschii* are the most abundant krill species and a keystone trophic component that serves as both an important grazer and link to upper level consumers, including whales. In these waters, krill experience large variation in food resources annually during ice advance and retreat, and store multiple lipid classes for both reproduction and growth. Two shipboard feeding experiments tested the lipid retention in adult *T. raschii* and examined the fluctuation of specific lipid biomarkers under food-limited conditions. Intact phospholipids (IPLs) represent the major structural and storage lipids; retention of IPL's, as well as other glycerides (i.e. di- and triglycerides; DG and TG), were followed over 19- and 31-day experiments using tandem liquid chromatography mass spectrometry (LC-MS) on an LTQ Orbitrap XL. A complex suite of intact lipids were observed. IPL's comprised the majority of intact lipids present; most had phosphatidylcholine (PC) headgroups, but smaller contributions were made by phosphatidylethanolamine (PE) and phosphatidylserine (PS)-contaning IPL's. The fatty acids were largely represented by seven compounds – C14:0n, C16:0n, C16:1(n-7), C18:1(n-7), C18:1(n-9), C20:5(n-3), C22:6(n-3) – and were typically present as mixed acyl groups within each intact lipid class. Concentrations over time (µmole/g wet weight) of IPL's and other glyceride lipids showed a decrease of 21% and 26%, respectively, from initial values, suggesting that both are mobilized in times of food scarcity and during overwintering. Structures containing 16:1 decreased most for IPL's, reflecting the lack of input from the 16:1(n-7) dietary algal fatty acid. This powerful set of analytical and software tools allows determination of the suite of intact lipids within euphausiids to provide a more comprehensive picture of krill structural and storage lipids, and their retention during times of varied food availability.

How Many Krill are there in the Bering Sea and Gulf of Alaska? Preliminary Field Observations from Summer 2016 and Implications for Ecosystem-Wide Measurements

Joseph Warren
Stony Brook University, joe.warren@stonybrook.edu
Patrick Ressler
NOAA Alaska Fisheries Science Center, patrick.ressler@noaa.gov
Rodger Harvey
Old Dominion University, rharvey@odu.edu
Georgina Gibson
University of Alaska Fairbanks, ggibson@iarc.uaf.edu
Brandyn Lucca
Stony Brook University, brandyn.lucca@stonybrook.edu

Multiple frequency acoustic backscatter data are regularly collected by fisheries surveys conducted by AFSC-NMFS-NOAA in the Bering Sea and Gulf of Alaska. These data are used to estimate the stock size of commercially important fish species, primarily walleye pollock (*Gadus chalcogrammus*). However, these data can also be used to measure other trophic levels in the ecosystem, specifically euphausiids (or 'krill', principally *Thysanoessa* spp.). It is fairly straightforward to identify the scattering in the water column which comes from aggregations of euphausiids. But the conversion of acoustic data to biologically-meaningful parameters (e.g. # of krill / m^3) depends upon an accurate estimate of the backscatter from a single animal, or Target Strength (TS, dB re 1 m^2). Models of TS require detailed information about animal morphology, physical properties (i.e. density and sound speed of the krill), and *in situ* behavior (orientation in the water column). Currently, acoustic estimates of krill abundance in the Bering Sea are much larger than those from traditional net tow sampling and ecosystem models. To refine krill TS models and better quantify the uncertainties in conversions of acoustic survey data to estimates of krill abundance and distribution, we sampled krill with nets and acoustics during the summer 2016 pollock survey aboard the NOAA Ship *Oscar Dyson*. Net tow data were used to ground-truth acoustic estimates of animal density, assess the effect of strobe lights on krill catchability, and to provide live specimens for shipboard measurements, including a variety of morphological (length, body shape) and material (density, sound speed) properties. Live animals were also tethered in a large aquaria on board the ship for measurements of individual krill TS at several frequencies. In addition, animals were frozen for post-cruise measurement of lipid content, as previous work in the Bering Sea suggests that animal state (in terms of health or food availability) may also affect their backscattering properties. Finally, vertical profiles of the water column using a stereo video camera provided key data on the *in situ* orientation of individual krill. Preliminary results from the 2016 field season will be presented.

Distribution Models for Skate Nursery Areas in the Eastern Bering Sea

Chris Rooper
NOAA Alaska Fisheries Science Center, chris.rooper@noaa.gov
Jerry Hoff
NOAA Alaska Fisheries Science Center, jerry.hoff@noaa.gov
Duane Stevenson
NOAA Alaska Fisheries Science Center, duane.stevenson@noaa.gov
Jay Orr
NOAA Alaska Fisheries Science Center, james.orr@noaa.gov
Ingrid Spies
NOAA Alaska Fisheries Science Center, ingrid.spies@noaa.gov

Alaskan skate species lay eggs in large aggregations along the eastern Bering Sea slope and shelf break. These aggregations persist from year to year, but to date very few have been discovered. The objective of this analysis was to use species distribution models to predict the potential distribution of skate nursery areas along the eastern Bering Sea slope and outer shelf using habitat variables collected from various sources. Skate nursery locations for 15 nurseries were identified from bottom trawl survey catches and underwater camera surveys for three of the most common skate species in the eastern Bering Sea. These species are the most vulnerable to fisheries interactions due to their abundance, depth availability and nursery grounds in fishing areas. Position data for each nursery site was chosen as the midpoint of the trawl or the closest position if identified from video transect. For model development 11 variables were used. These variables were all extrapolated to rasters of 1 km by 1 km grids and used in maximum entropy (MaxEnt) models which use presence points to predict the probability of suitable habitat in unsampled areas. The MaxEnt model fit the presence data very well (AUC = 0.97). Depth was the most important variable contributing to the model, followed by current speed, aspect and oxygen. The remaining variables (except sediment sorting which had a contribution of 0) all had relatively small contributions to the model. When the model was tested against the full dataset (presence points and background absence points from the 2014 camera survey), it also performed well (AUC = 0.91). The diagnostics were not atypical for a model that predicted relatively rare nursery areas with a lot of absences. Most of the high probability nursery habitat for skates was predicted to occur in Bering Canyon, the southern arm of Pribilof Canyon, in Zhemchug Canyon and in Pervenets Canyon in a relatively narrow band at about 300-600 m depth on the upper slope.

Co-deployment of a Zooplankton Imaging System and Sonar Imaging System for Forage Species

Hongsheng Bi
University of Maryland, hbi@umces.edu
Kevin Boswell
Florida International University, kevin.boswell@fiu.edu

Forage fish, including small schooling fish like herring and euphausiids play a major role in the marine food web in the Bering Sea ecosystem. They are a crucial food source for larger predators like whales, and seabirds. Despite their importance in the marine food web, the lack of basic information like their distribution and abundance hinders our ability to understand and manage the Bering Sea Marine ecosystem. However, sampling forage species remains problematic because of gear selection and avoidance. To overcome the problem, we propose to deploy a zooplankton imaging system, PlanktonScope, and the adaptive resolution imaging sonar, ARIS to investigate the spatial distributions of forage species and estimate their abundance. Two systems have been tested separately in Chesapeake Bay. The PlanktonScope is capable of imaging organisms ranging 100 μm to 7 cm and the ARIS system is capable of imaging most forage species > 1cm including Atlantic menhaden and mysid swarm (similar sizes to herring and euphausiids). The preliminary results are promising and the co-deployment of two systems in the Bering Sea is scheduled for August 2017.

Increased Temperatures and Juvenile Chinook Abundance in the Northern Bering Sea

Jeanette Gann
NOAA Alaska Fisheries Science Center, jeanette.gann@noaa.gov
Jordan Watson
NOAA Alaska Fisheries Science Center, jordan.watson@noaa.gov
Jim Murphy
NOAA Alaska Fisheries Science Center, jim.murphy@noaa.gov

The northern Bering Sea supports many important commercial and subsistence fisheries including Chinook salmon. Chinook returns have declined over time, with significant restrictions placed on harvest (including subsistence harvests) in the most recent years. The early marine period for juvenile Chinook is known to be critical to their marine survival. Juvenile Chinook abundance estimates during August-October in the northern Bering Sea are correlated with adult returns, which emphasize the importance of initial marine habitat conditions in the marine survival of Chinook salmon. Generalized additive models (GAMs) were used to examine habitat associations of juvenile Chinook salmon over the northeastern Bering Sea shelf. GAM models indicated a positive relationship with temperature up to about 7 - 10 degrees C. This upper threshold is generally less than optimal temperature ranges found for their lower latitude cousins where 10.8° is considered the midpoint of temperature growth ranges for juvenile Chinook. It is, however, logical that these northern Chinook would acclimate to lower temperatures considering their far north environment. Norton Sound is one of the nearshore habitats that the out-migrating juveniles will first encounter once they leave the Yukon River. Temperatures in Norton Sound are generally warmer than the northeastern Bering Sea shelf, and the water column is usually very well mixed. It is possible that environmental factors here, such as temperature, could influence survival rates of these out-migrating Chinook. Mean August sea surface temperatures over the northeastern Bering Sea shelf from 1982-2014 increased approximately 1 degree C, over the past decade or so, while mean temperatures over Norton Sound increased an average of ~ 4 degrees C beginning in the early 1990's. These SST and other oceanographic changes will be further investigated for associations with juvenile abundance and returns, hoping to fill gaps in our knowledge of juvenile Chinook mortality rates.

Automated Measurement of Bycaught Halibut from Realtime Video

Peter Brodsky
University of Washigton, pmb@uw.edu

Halibut are among the most valuable fish in the North Pacific fishery. Unfortunately, they are often caught inadvertently by catcher/processor vessels because of the spatial overlap of targeted flatfish and halibut and the quantities of flatfish that the fleet harvests. Regulations and observer protocols require that all halibut must be removed from the net and placed in a tank below deck to allow for observer sampling and weighing of catch. Paradoxically, this process extends the time period that halibut remain out of the water prior to their release, thereby increases mortality. To mitigate this, efforts are underway under an Exempted Fishing Permit (EFP) that would authorize certain vessels to sort halibut on deck, enabling them to be returned to the sea faster. However, the requirement to measure the fish remains, and this measurement process extends the time the fish are out of water.

To speed the measurements and thereby reduce mortality, we have developed an automated camera-based system for determining fish size quickly, in-situ, and without human intervention. It uses a very inexpensive off-the-shelf security camera, exploiting its built-in video feed. No additional triggering mechanism is required. Custom machine vision software, developed by the University of Washington's Information Processing Lab, runs on a ruggedized but otherwise standard computer. It detects, segments, and measures individual fish as they pass through the vessel's discard chute. Human handling of the fish is minimized. Resulting lengths and captured images of the measured fish are automatically stored in a standard relational database. A waterproof monitor displays the camera view and resulting measurements right at the sorting site. In addition, a web-based application enables realtime remote viewing from any computer on the vessel with a LAN connection. Results to date suggest a typical error rate of 2-3% RMS in length; using the Clark power law relationship between length and weight for halibut, this corresponds to weight errors between 7-10% RMS. Since the errors show a consistent overestimation bias, we believe we can apply an empirical correction factor which would bring the weight error down to less than 5% RMS.

A Stock Assessment Method for North Pacific Fish and Invertebrate Stocks Which Allows for Age and Size Dynamics

Andre Punt
University of Washigton, aepunt@uw.edu
Caitlin Allen Akselrud
University of Washigton, ciat2@uw.edu
Lee Cronin-Fine
University of Washigton, lcf46@uw.edu

Fishery stock assessments are frequently based on age-structured population dynamics models for fish, and size-structured population dynamics models for invertebrates. We have developed and implemented a new modeling framework to account for both age and size dynamics for an individual fishery. An age-size assessment model is unique in its ability to capture the dynamics of fishing and natural mortality on fished populations, which are functions of both length and age. The new modeling framework can make use of a broad range of data types, including time-series of catches, bycatches, indices of absolute and relative abundance, size- and age-compositions, conditional age-at-length data, and information on growth from tagging. The modeling framework is applied for illustrative purposes to data for three stocks managed by the North Pacific Fishery Management Council: Eastern Bering Sea Tanner crab (*Chionoecetes bairdi*), Pribilof Islands blue king crab (*Paralithodes platypus*) and Eastern Being Sea Pacific cod (*Gadus macrocephalus*). The ability of a new stock assessment method to provide reliable estimates of quantities important to management needs to be evaluated before it is used. We therefore used a simulation study to explore several key questions related to conducting stock assessments for North Pacific fish and invertebrate stocks. These simulations identified that 1) purely age-based approaches lead to bias due to model mis-specification when the population dynamics are age- and size-based, 2) model selection methods have the potential to improve the accuracy of quantities of importance to management, and 3) estimation performance is improved by estimating time-varying selectivity, even when selectivity is actually time-invariant. The developments on which the new modelling framework are based have fed into other stock assessments frameworks, including the General Modeling for Alaska Crab Stocks package.

Assessing Environmenal DNA (eDNA) Methods for Use in Fisheries Surveys

Mike Canino
NOAA Alaska Fisheries Science Center, mike.canino@noaa.gov
Anna Elz
NOAA Northwest Fisheries Science Center, anna.elz@noaa.gov
Linda Park
NOAA Northwest Fisheries Science Center, linda.park@noaa.gov

Fisheries surveys are an integral component in NOAA Fisheries' mission to assess fish distribution and abundance for management and conservation purposes. Historically, fish surveys have been conducted using various types of trawling gear and, more recently, augmented with hydroacoustic survey data. The cost of conducting surveys is considerable, representing approximately 75% of the total operating budget at the Alaska Fisheries Science Center. Here we report on initial development of molecular methods to assess environmental DNA (eDNA; collected from water rather than from the organism) as a potential means of surveying marine fishes, both in terms of presence/absence in a sample and in relative abundance. Comparing the eDNA results with trawl and hydroacoustic data provides some empirical evaluation of the potential for cost-effective use in contemporary sampling designs.

We developed species-specific quantitative PCR (qPCR) probes to detect and quantify walleye pollock (*Gadus chalcogrammus*) and capelin (*Millotus villosus*) eDNA which do not amplify other species of gadids and osmerids. eDNA sampling was conducted during a Midwater Assessment and Conservation Engineering (MACE) hydroacoustic survey in summer, 2016. Three 1 L replicate samples of seawater were collected at two depths from three survey locations where both acoustic and trawl data were available. Seawater samples were filtered at sea and filters were then frozen until DNA extractions were performed in the laboratory.

Initial laboratory testing indicates that the qPCR probes have sufficient sensitivity to detect eDNA concentrations of fishes within the ranges commonly reported in the literature (give range). Preliminary trials of the probes with eDNA samples are being completed. In addition, we plan to conduct next-generation sequencing (NGS) of eDNA to compare with qPCR and trawl data. The NGS approach provides information on eDNA present from all fish species, not just those targeted by the qPCR probes. By contrasting both qPCR and NGS methods of screening eDNA with the available trawl/hydroacoustics data, we hope to determine the best approach for potential use in future surveys.

Measuring the Growth Rate of Walleye Pollock (*Gadus chalcogrammus*) Larvae using Flow Cytometry

Steven Porter
NOAA Alaska Fisheries Science Center, steve.porter@noaa.gov
Annette Dougherty
NOAA Alaska Fisheries Science Center, annette.dougherty@noaa.gov

Accurate growth measurements of fish larvae will lead to a better understanding of the relationship between environmental variability and early life survival. Otoliths are typically analyzed to determine the growth of field-collected fish larvae, but compression of daily increments due to slow growth makes otolith reading difficult. Preliminary results of an alternative method for measuring the growth rate of Walleye Pollock (*Gadus chalcogrammus*) larvae using cell-cycle analysis of muscle tissue measured with flow cytometry are presented here. Walleye Pollock larvae were reared in the laboratory at 1.5°, 3°, and 6°C and sampled for cell-cycle analysis. Sampled fish were lengthed, and then stored at -80°C prior to being analyzed. A generalized additive model (GAM) to predict growth rate (mm/d) during the period of time from first feeding to when a larva was sampled was formulated with the covariates temperature, standard length (SL), proportion of cells in the S phase of the cell cycle, proportion of cells in the G2 and mitosis phases, and the ratio of the number of S phase nuclei to the number G1 phase nuclei with high RNA content ($r^2 = 0.82$). The model was tested by using an independent set of 6°C larvae ranging in size from 7.40 to 8.63 mm SL (n = 15). Model predictions were compared to actual growth rates (from laboratory age and SL), and otolith based growth calculated from the number of daily increments from the day of first feeding to the otolith edge, and SL from that set of larvae. GAM mean predicted growth rate was 0.13 mm/d ± 0.01, actual growth rate was 0.15 ± 0.03, and otolith based growth was 0.17 ± 0.03. Predicted growth was significantly less than both the actual growth rate and otolith growth, but it was within the range of published growth rates for Walleye Pollock larvae reared in the laboratory at 6°C (0.09 to 0.14 mm/d). Predicted growth rate was correlated with the distance between the increment at first feeding and the otolith edge (a proxy for somatic growth; r = 0.81), indicating that the model tracked larval growth reasonably well.

A Numerical Method for Allowing Individual Variation in Both Growth Parameters (k and L∞) in Size-Structured Models

Lee Cronin-Fine
University of Washigton, lcf46@uw.edu
Andre Punt
University of Washigton, aepunt@uw.edu

Stock assessment methods for many invertebrate stocks, include stocks of crabs in the Bering Sea and Aleutian Islands region of Alaska, are based on size-structured population dynamics models. A key component of these models is the size-transition matrix, which specifies the probability of growing from one size-class to another after a certain period of time. Size-transition matrices can be defined using three parameters, the growth rate (k), the asymptotic height (L_∞), and the variability in the size increment. Stock assessments can either set the size-transition matrix by analyzing mark-recapture data prior to conducting the stock assessment or the estimation of the size-transition matrix can be integrated into the stock assessment. The latter approach will better allow uncertainty in model outputs to be characterized, but can substantially increase the complexity of the assessment. Consequently, most assessments that integrate mark-recapture data into stock assessments, assume that all individuals followed the same growth curve. However, not accounting for individual variation in growth can result in biased estimators of growth parameters and it is unrealistic to assume that every individual has the same k or L_∞. Unfortunately, to date, the only way to compute the size-transition matrix when allowance is made for individual variation in growth is using simulation, which is both computationally very intensive and non-differentiable. This paper outlines an approach that uses a numerical integration technique that allows k and L_∞ to vary among individuals, and evaluates it by comparing the results with a simulation-based estimation scheme.

Methodological Development and Evaluation of Thin Sections from Potential Age Structures for Commercially Important Crustaceans in Alaska

Joel Webb
Alaska Department of Fish & Game, joel.webb@alaska.gov
April Rebert
Alaska Department of Fish & Game, april.rebert@alaska.gov
Kevin McNeel
Alaska Department of Fish & Game, kevin.mcneel@alaska.gov
Gordon Kruse
University of Alaska Fairbanks, ghkruse@alaska.edu

Age data can drastically improve stock assessments, estimates of biological reference points, and sustainable harvest limits. While standard methods are available to produce age data for many fish and invertebrate species, none have been established for commercially important crustaceans. Recent research evokes an age determination method for decapod crustaceans based on banding in the endocuticle layer of the exoskeleton. Banding, potentially indicative of age, has been observed in the gastric mill ossicles and eyestalks of red king crab (*Paralithodes camtschaticus*) and southern Tanner crab (*Chionoecetes bairdi*). However, the exact structures to target for age determination and efficient, cost-effective processing methodologies have yet to be established. Our goal is to describe optimal species-specific methods for producing and evaluating band counts for red king and Tanner crab. To do this, eyestalks and gastric mill ossicles (mesocardiac, zygocardiac, and pterocardiac) were cleaned, embedded in resin, and comprehensively thin-sectioned across both structures and with different orientations. Sections were evaluated for readability to suggest the preferred structure(s), location(s) within structure, cut orientation and section thickness for presence and clarity of bands. Initial analysis of the thin sections indicates the highest proportions of readable sections within a given structure were found in the zygocardiac (14% for red king crab, 20% for Tanner crab) and the mesocardiac (11% for red king crab, 35% for Tanner crab). In both species, the zygocardiac ossicles contained sections with the best readability. This suggests that ongoing research on red king and Tanner crab age determination can target the zygocardiac as a step towards standardization. Further work will evaluate whether bands within this structure are related to chronological age.

Competition among Western Alaska Chum Salmon and Asian Pink and Chum Salmon in the Bering Sea?

Tessa Minicucci
University of Alaska Fairbanks, tjminicucci@alaska.edu
Megan V. McPhee
University of Alaska Fairbanks, mvmcphee@alaska.edu
Ellen M. Yasumiishi
NOAA Alaska Fisheries Science Center, ellen.yasumiishi@noaa.gov

Increased hatchery production as well as favorable ocean conditions for survival have resulted in historically high abundances of Pacific salmon (*Oncorhynchus* spp.) in the North Pacific Ocean. Although many salmon populations in the North Pacific increased in abundance following the 1976-77 regime shift, there have been reductions in chum salmon (*O. keta*) growth and body size and increases in age at maturity throughout their range. In western Alaska, Yukon River subsistence fall chum salmon harvests decreased by 89% between 1990 and 2000 and Kuskokwim River chum salmon subsistence harvests fell by 63.3% between 1989 and 2007. The Alaska Board of Fisheries has since labeled numerous stocks as stocks of yield concern, with important implications for rural Alaskans who rely on salmon for food. The mechanisms underlying these changes in chum salmon body size are not well understood, although density-dependent effects, specifically competition with abundant Asian pink (*O. gorbuscha*) and chum salmon in the Bering Sea, is a primary hypothesis. Here, we synthesize existing diet and distribution data to address the potential for negative interactions between these competing salmon populations. Asian pink and chum salmon and western Alaska chum salmon exhibit similar ocean migration patterns after the first year at sea and migrate between their summer feeding grounds in the Bering Sea and overwintering grounds in the Gulf of Alaska. During years of high pink salmon abundance, chum salmon have been observed to alter their ocean distribution and rely more heavily on gelatinous zooplankton species as a primary food source, which can have adverse effects on growth rate and fecundity due to decreased lipid reserves. Based on this synthesis, we then describe our on-going research on the impacts of this competition on chum salmon from western Alaska.

Evaluation of Preparation Techniques to Enhance Banding Patterns in Tanner Crab Gastric Mill Ossicles

Katy Price
American Fisheries Society, Hutton Scholar Program, soopydoo@gmail.com
Joel Webb
Alaska Department of Fish & Game, joel.webb@alaska.gov
April Rebert
Alaska Department of Fish & Game, april.rebert@alaska.gov
Kevin McNeel
Alaska Department of Fish & Game, kevin.mcneel@alaska.gov

The lack of a reliable direct age determination method for commercially important crabs contributes to uncertainty in assessment and management. Bands potentially indicative of seasonal growth variability have been described in the endocuticle layer of the cuticle of decapod crustaceans including the gastric mill ossicles of king and Tanner crabs in Alaska. The complexities of banding pattern interpretation in age determination of fishes are well-recognized and a variety of species-specific otolith preparation methods have been developed to enhance the precision and accuracy of band counts. This pilot study evaluated whether chemical staining with alizarin red or aniline blue, acid etching (1% HCl), or viewing with (wet) or without (dry) water applied topically would improve band clarity or count precision/bias in thin-sections of the paired zygocardiac ossicles of Tanner crab, *Chionoecetes bairdi*. Thin sections of the right zygocardiac were stained while thin-sections of the left zygocardiac of the same individual were used as controls. Band counts and subjective clarity codes were assigned to each section by two observers independently. Anecdotally, acid etching alone did not improve band clarity but etching prior to staining resulted in improved stain performance. Alizarin red was more effective with respect to evenness of absorption and stain intensity than aniline blue. Band clarity in unstained sections was similar to that of stained sections for both stains and when viewed dry versus wet. Band counts were similar between paired control and stained sections in the alizarin red group but tended to be higher in sections viewed wet than dry in the aniline blue group. Staining and viewing both wet and dry were particularly helpful for visualizing and interpreting bands in thin sections with simultaneously prominent fine and large banding patterns. These results suggest that viewing sections both wet and dry should be part of standard procedures for reading thin sections for Tanner crab. However, acid-etching and staining with Alizarin red is a useful secondary step for sections with complex banding patterns.

Calcein as a Tool to Validate Ages of Alaska Crustaceans: a Pilot Study

Quinn Smith
Alaska Department of Fish & Game, quinn.smith@alaska.gov
Joel Webb
Alaska Department of Fish & Game, joel.webb@alaska.gov
Kevin McNeel
Alaska Department of Fish & Game, kevin.mcneel@alaska.gov

Validation prior to application is a key principle in the development of new age determination techniques for fishery assessment and management. We conducted a controlled pilot experiment to evaluate the effectiveness of *in vivo* exposure to calcein, an autofluorescent, calcium-binding stain, to create reference marks to validate an age determination method being developed for Alaska crustaceans. Red king crab (RKC) were treated with calcein at three levels (0 mg/L, 250 mg/L or 500 mg/L for 24h) prior to molting and sampled after molt. Tanner crab (TC) and spot shrimp (SS) were marked at two concentrations (0 mg/L and 250 mg/L for 24h) and sampled without molting. The zygocardiac ossicles of TC and RKC and eyestalks of SS were removed, cleaned, embedded in resin, and thin-sectioned. Calcein marks on thin-sections were evaluated using images taken during confocal laser microscopy and by subsampling image pixel values. Green channel pixel intensities values were pooled among individuals to detect differences across treatments. RKC zygocardiac intensity increased significantly (Kruskal-Wallis, $p<0.05$) with increasing calcein concentration; differing by a factor 0.54 between the control and 500 mg/L groups. Similarly, intensity increased significantly (Mann-Whitney U, $p<0.05$) by a factor of 1.36 for SS and 0.46 for TC in calcein treated individuals versus controls. As expected, calcein exposure increased the average green channel intensity (brightness) of the structure for all species, including post-molt RKC. However, reliable formation of a bright reference mark, relative to controls, at the "growth edge" of the endocuticle, needed for age validation, was not observed in any species. Improved understanding of the calcification/decalcification processes and possible digestion-resynthesis of the endocuticle in the gastric mill ossicles and eyestalks during molting is needed for development of chemical marking validation methods for crustaceans.

Influence of Environmental Factors and Density Dependence on Variability in Body Condition of Atka Mackerel (*Pleurogrammus monopterygius*)

Susanne McDermott
NOAA Alaska Fisheries Science Center, susanne.mcdermott@noaa.gov
Morgan Arrington
NOAA Alaska Fisheries Science Center, morgan.arrington@noaa.gov

We examined variability of length-weight relationships and body condition for Atka mackerel at Seguam pass in the Aleutian Islands, Alaska from 1999 until 2015. Female Atka mackerel fecundity has been shown to be strongly correlated to weight. Therefore, the variability of fish condition will be used as a proxy for potential variability in reproductive output. Fish condition and length-weight relationships for Atka mackerel are highly variable over time. We will examine the influence of environmental factors such as temperature and chlorophyll, as well as density-dependent factors such as year class strength on the variability of these parameters. In addition, we will examine the seasonal aspect of fish condition and discuss how seasonal and between year variability of length-weight relationships and condition factor can influence biomass estimates in the stock assessments.

Evaluation of Otolith Sampling Strategies for Pacific Cod in the Eastern Bering Sea

Patricia Puerta
Oregon State University, Ppuerta@Coas.Oregonstate.Edu
Bethany Johnson
Sonoma State University, Swimmerbethany@Gmail.Com
Lorenzo Ciannelli
Oregon State University, Lciannel@Coas.Oregonstate.Edu

Most of the contemporary stock assessments are based on estimates of age structure of fish population using size at age relationships. These relationships are derived from otolith analysis of a subsample of the fish caught during surveys. However, spatio-temporal structuring of populations life history traits is a very important consideration to design sampling strategies, and is rarely accounted for in fishing surveys. Pacific cod from the Eastern Bering Sea (EBS) shows clear spatial patterns in size-at-age relationships from inner to outer shelf. We investigated how different sampling strategy used during the Alaska Fisheries Science Center (AFSC) groundfish surveys capture the spatio-temporal patterns of Pacific cod age distribution. Pacific cod is one of the most important species for commercial fishing in Alaska and therefore, accurate representation of population age structure is pivotal for management. We approached this question by using both a simulation study and parallel field surveys with two samplings strategies for otolith collection, including the current length stratified and an alternative random strategy. For the simulations, we reproduced sampling on a virtual population with the same statistical characteristics observed in EBS Pacific cod in terms of spatial distribution, length frequency and age structure. Random and length stratified samplings for otolith collection were simulated multiple times over the virtual population, following the same protocol used in the AFSC surveys. The analyses of field collections and sampling strategy evaluations showed that the length stratified sampling can result in biased spatial patterns and age structure in the Pacific cod population, typically consisting of an underestimation of the size at age of younger individuals. Our investigations highlight the need of evaluate and consider alternative sampling strategies in spatially structured populations for a variety of marine commercial species to improve stock assessment and management.

Effects of Ocean Acidification on Respiration, Feeding, and Growth of Juvenile Red and Blue King Crabs (*Paralithodes camtschaticus* and *P. platypus*)

W. Christopher Long
NOAA Alaska Fisheries Science Center, chris.long@noaa.gov
Paige Pruisner
NOAA Alaska Fisheries Science Center, paige.pruisner@colorado.edu
Katherine Swiney
NOAA Alaska Fisheries Science Center, Katherine.Swiney@noaa.gov
Robert Foy
NOAA Alaska Fisheries Science Center, robert.foy@noaa.gov

Ocean acidification is a decrease in pH caused by dissolution of anthropogenic CO_2 in the oceans. The chemical changes, including a decrease in the saturation states of calcium carbonate, can have physiological effects on marine organisms. Juvenile red and blue king crabs (*Paralithodes camtschaticus* and *P. platypus*) both exhibit increased mortality and decreased growth in acidified waters with red king crabs being more sensitive to decreased pH than blue king crab. Reduced survival and growth could have a substantial negative effect on the populations and fisheries for both species. In this study, we determine how ocean acidification affects metabolism (oxygen consumption), feeding rates, and growth in both species. Juvenile crabs were exposed to three pH levels: ambient (pH 8.1), pH 7.8, and pH 7.5 for three weeks. Oxygen consumption and feeding ration (both normalized to crab mass) were determined immediately after exposure to treatment water and again after three weeks exposure. Growth was calculated as a change in wet mass. Red king crab exhibited an initial increase in metabolism at the lowest pH but not after 3 weeks. Feeding ration did not change with pH or over time. On the other hand, blue king crab did not exhibit a change in either metabolism or feeding ration with pH either initially or after 3 weeks. Growth data were limited, but red king crabs that molted had a bigger growth increment in ambient water than in pH 7.5 whereas blue king crab showed no effect. The initial increase in red king crab metabolism at pH 7.5 suggest the crabs expended more energy in osmo/iono-regulation. However, without a commensurate increase in feeding ration it is likely the crabs went into a caloric deficit explaining the reduced growth and increased mortality seen in this and other studies. In contrast, blue king crabs did not change either their overall metabolism or their feeding under any pH condition suggesting a calorie-neutral response. These differences may partially explain the higher sensitivity of red king crab to ocean acidification. Future work should examine osmo/iono-regulation in both species to identify specific physiological responses to ocean acidification.

How Many Chinook Salmon might Salmon Sharks be Consuming in the Bering Sea?

Kaitlyn Manishin
University of Alaska Fairbanks, KManishin@alaska.edu
Peter Westley
University of Alaska Fairbanks, pwestley@alaska.edu
Curry J. Cunningham
University of Alaska Fairbanks, cunninghamcurry@gmail.com
Kenneth J. Goldman
Alaska Department of Fish & Game, ken.goldman@alaska.gov
Andrew Seitz
University of Alaska Fairbanks, acseitz@alaska.edu

Chinook salmon (*Oncorhynchus tshawytscha)* survival and abundance in the Arctic-Yukon-Kuskokwim region has declined markedly during the past decade, resulting in considerable hardships for salmon-dependent communities. The concurrent decline of Chinook stocks over large geographic regions coupled with the maintenance of relatively intact freshwater habitat suggest that the marine environment plays an important role in Chinook salmon productivity and abundance. However, there is not a comprehensive understanding of the sources and timing of marine mortality. A recent tagging experiment provided direct evidence that salmon sharks (*Lamna ditropis*) in the Bering Sea consume large sub-adult Chinook salmon and thus represent a previously undocumented source of mortality. The goal of this study is to examine the potential level of impact salmon sharks may be having on the productivity of Chinook salmon runs in western Alaska. To accomplish this, we will first estimate the total annual consumption of Chinook salmon by salmon sharks using bioenergetics modeling. Next, we will examine the potential impact of salmon shark predation on the productivity of Chinook salmon stocks, using population dynamics models. Productivity of Chinook salmon will be examined at the scale of discrete river systems and at larger scales across river basins to attempt to identify the potential effects of predation on both regional and sub-basin populations. The range of potential impacts will be compared to those of other sources of freshwater and marine mortality. Results from this project will provide insight into a potentially important source of marine mortality of older, larger Chinook salmon.

Simulating the Impacts of Bycatch and Changing Demography on Yukon River Chinook Production in the Face of Environmentally-Driven Survival Variation

Curry Cunningham
University of Alaska Fairbanks, cunninghamcurry@gmail.com
Peter Westley
University of Alaska Fairbanks, pwestley@alaska.edu
Milo Adkison
University of Alaska Fairbanks, mdadkison@alaska.edu

Recent declines in the abundance of Yukon River Chinook salmon have resulted in limitations to commercial and subsistence fisheries with profound economic, social and cultural implications for local communities. Furthermore, the risk of Chinook bycatch in Bering Sea and Aleutian Islands trawl fisheries has resulted in limitations to fishing opportunity for pollock and other commercially valuable species. Previous analyses of Yukon Chinook population dynamics have focused on either the marine or freshwater portion of the life cycle, natural or anthropogenic factors in isolation, and have not incorporated all available sources of data. To understand the critical drivers of Yukon River Chinook survival we created a stage-structured statistical model that utilizes all available abundance, age composition, and bycatch data to estimate impacts of environmental covariates. Bayesian model selection methods were used to identify a set of key environmental factors, primarily acting during the marine portion of the life cycle, which explain much of the observed variation in abundance and escapement age composition. We build upon these results to simulate retrospective survival and abundance trajectories under alternative, climate patterns, bycatch histories, and maturation schedules, while incorporating uncertainty in demographic parameters from the previous Bayesian analyses. This research provides insights about the importance of bycatch and changing demography, relative to environmentally-driver variation in Chinook survival.

The National Institute of Standards and Technology's Seabird Tissue Archival and Monitoring Project

Amanda Moors
National Institute of Standards and Technology, amanda.moors@nist.gov
Stacy Vander Pol
National Institute of Standards and Technology, stacy.vanderpol@nist.gov
Debra Ellisor
National Institute of Standards and Technology, debra.ellisor@nist.gov
Jennifer Ness
National Institute of Standards and Technology, jennifer.ness@nist.gov
Jennifer Trevillian
National Institute of Standards and Technology, jen.trevillian@nist.gov
Rebecca Pugh
National Institute of Standards and Technology, rebecca.pugh@noaa.gov

Seabird tissues, particularly eggs, have played an important role in environmental monitoring in Europe and Canada, where analyses of eggs have successfully documented temporal changes in persistent organic pollutants (POPs). The International Arctic Monitoring and Assessment Programme (AMAP) recommends using eggs from alcids for circumpolar monitoring of POPs as many alcids, including murres (*Uria* spp.), feed at the top of the marine food web and have potential for accumulating these contaminants. More than 95% of the seabirds breeding in the continental US nest at colonies in the Bering and Chukchi seas and Gulf of Alaska, and about 80% of these birds are found on Alaska Maritime National Wildlife Refuge (AMNWR) lands. Little was known about the accumulation of POPs and other contaminants in these nesting populations. To fill this important information gap, the US Geological Survey Biological Resources Division (USGS-BRD), US Fish and Wildlife Service (USFWS), Bureau of Indian Affairs (BIA), and National Institute of Standards and Technology (NIST) have been conducting the Seabird Tissue Archival and Monitoring Project (STAMP) since 1999. STAMP was designed and implemented to serve as a systematic, long-term program to identify and track anthropogenic contaminants in Alaskan seabirds over multiple decades. Protocols for collecting and banking eggs were designed to: (1) provide sufficient material for multiple analyses, (2) minimize the possibility of sample change and/or loss during storage, (3) ensure sample integrity by minimizing potential contamination during collecting and processing, (4) protect long-term sample stability by using cryogenic techniques, and (5) keep and maintain records of sample histories. Eggs are sent to the UFWS AMNWR Center in Homer, AK, where the contents are separated from the shells and frozen in clean containers. The dried shells are shipped to the University of Alaska Fairbanks (UAF) Museum in Fairbanks, Alaska, and the frozen contents are sent to NIST in Charleston, South Carolina for cryogenic banking and selected aliquots are analyzed for POPs and inorganic contaminants. The specimen banking is provided by NIST at the Marine ESB in the Hollings Marine Laboratory, Charleston, SC. Protocols, processing, colony locations, as well as the current STAMP inventory will be presented.

You Can't Go Home: Time-Lapse Imagery Documents Crested and Least Auklet Colony Abandonment Following Volcanic Disturbance

Gary Drew
U.S. Geological Survey, Alaska Science Center, gdrew@usgs.gov
John Piatt
U.S. Geological Survey, Alaska Science Center, jpiatt@usgs.gov

The 7 August 2008 Kasatochi eruption transformed a lush Central Aleutian island with well-developed communities into a barren landscape of ash covered slopes. By burying the existing nesting areas on the island this eruption provided us the opportunity to assess the limits of nesting site fidelity for crested and least auklets. Following the eruption we set up a time-lapse camera in Tundering Cove, the site of the largest nesting area on the island prior to the eruption. Images were collected every 15 minutes during the nesting season. We assessed attendance by overlaying a 4 x 6 grid on these images and assigned presence or absence for each 50 m^2 cell. A total of 3803 useable images were collected between June 19th and July 15th in 2010, 2012 and 2013. A Kruskal-Wallis rank sum test indicated differences between years (d.f.=2, $P<0.001$). Plotting annual auklet attendance with 95% confidence limits indicated that there were differences between all three years sampled, decreasing annually from a high of 6.7% in 2010 to a low of 0.17% in 2013. In addition to a general decline in attendance at the old colony site, the C.V. increased with time suggesting more erratic use of the site. Although crested and least auklets have been shown to have high levels of nest site fidelity, our findings suggest that these populations on Kasatochi may be more plastic than anticipated, with virtually all birds abandoning this site within 4-5 years.

Changes in Red-Legged Kittiwake Migration Behavior in Response to Winter Sea-Ice Conditions

Rachael Orben
Oregon State University, raorben@gmail.com
Nobuo Kokubun
National Institute of Polar Research, Tachikawa, Tokyo 190-8518, Japan, kokubun@nipr.ac.jp
Abram Fleishman
San Jose State University, abfleishman@gmail.com
Alexis Will
University of Alaska Fairbanks, awill4@alaska.edu
Takashi Yamamoto
National Institute of Polar Research, Tachikawa, Tokyo 190-8518, Japan, ytaka615@gmail.com
Scott Shaffer
San Jose State University, scott.shaffer@sjsu.edu
Rosana Parades
Oregon State University, rparedes.insley@gmail.com
Akinori Takahashi
National Institute of Polar Research, Tachikawa, Tokyo 190-8518, Japan, atak@nipr.ac.jp
Alexander Kitaysky
University of Alaska Fairbanks, askitaysky@alaska.edu

Environmental conditions experienced during the non-breeding period can carry over to the next breeding period and influence performance, fitness and survival. Red-legged kittiwakes spend a large part of their winter non-breeding period in the Bering Sea, and use sea ice associated habitats in the northern Bering Sea and along the eastern coast of Kamchatka. Yet, winter ice conditions in the Bering Sea are annually variable and how individuals adjust wintering strategies to those changing ice conditions is not well understood. Here we compare winter migrations of red-legged kittiwakes during two years with relatively high sea ice extent (2010/11 (n=19), 2013/14 (n=16)) to two years of lesser sea ice extent (2014/15 (n=13), 2015/16 (n=21)). We sampled head feathers that are grown in the early spring as part of the pre-nuptial plumage to assess relative nutritional stress (via corticosterone concentrations) incurred by birds in relation to wintering location, ice extent, and trophic level (via stable isotope analysis). We will test if sea ice extent influences spatial distribution of RLKIs overwintering in the Bering Sea, if activity and trophic level differs between years, and if the stress incurred during migration is associated with ice extent. We predict that advancing sea ice will influence migratory timing by forcing RLKIs to leave the northern Bering Sea earlier, leading to larger wintering ranges and higher stress levels.

Sex Differences in Mercury Loads of Red-Legged Kittiwakes During the Breeding and Non-Breeding Seasons

Abram Fleishman
San Jose State University, abfleishman@gmail.com
Rachael Orben
Oregon State University, raorben@gmail.com
Alexis Will
University of Alaska Fairbanks, awill4@alaska.edu
Rosana Paredes
Oregon State University, rparedes.insley@gmail.com
Alexander Kitaysky
University of Alaska Fairbanks, askitaysky@alaska.edu
Josh Ackerman
U.S. Geological Survey, jackerman@usgs.gov
Scott Shaffer
San Jose State University, scott.shaffer@sjsu.edu

Animals that live at high latitudes are exposed to increasing mercury levels due to the pole-ward transport of mercury from anthropogenic sources. Mercury is a neurotoxin ingested by seabirds in contaminated food, and it can lead to altered behavior, reproductive failure, and increased mortality of affected individuals. Accumulation of mercury loads is likely to be sex-dependent: females (but not males) eliminate mercury annually by dumping it into their eggs. Thus exposure to mercury is expected to be higher in males than in females. We investigate mercury exposure for the Bering Sea endemic red-legged kittiwake (*Rissa brevirostris*), an IUCN listed vulnerable seabird. During the breeding season red-legged kittiwakes forage on deep-water lanternfish (*Myctophidae*), a mesopelagic prey rich in lipids, which may facilitate accumulation of high mercury levels. Additionally, mesopelagic prey species have been shown to have up to 400% more mercury than their shallow water counterparts. We hypothesize that: 1) during the non-breeding period mercury loads would be similar between the sexes due to consistency in wintering range and diets; and 2) during the breeding period there would be a sex difference because females eliminate mercury by depositing it into their eggs. We measured total mercury from whole blood and nuptial plumage sampled from breeding red-legged kittiwakes on St. George Island, Alaska in 2015 and 2016. The samples represent two distinct periods of the year: the breeding season (blood) and late winter/spring (feathers). Preliminary data from 2015 show birds had moderate mercury loads (mean ± SD, winter: 4.82 ± 0.96 µg/g dry weight (dw), summer: 0.65 ± 0.07 wet weight (ww)) above some known thresholds for impairment in other bird species. Contrary to our prediction, winter mercury loads were higher in females (5.34 ± 1.23 µg/g dw, n=22) than males (4.52 ± 0.61 µg/g dw, n=38), while there was no difference in loads during the breeding season. We will investigate this sex difference further through the analysis of samples from 2016, stable isotope analysis of feathers, and winter ranges

derived from GLS tracking. Additionally, future research will address whether mercury affects reproductive performance, including egg size, laying, hatching, and fledging success.

Aleutian Tern Migratory and Breeding Biology in Aleutians and Gulf of Alaska

Shiway Wang
University of Alaska Anchorage, shiway@gmail.com
Douglas Causey
University of Alaska Anchorage, dcausey@alaska
Veronica Padula
University of Alaska Anchorage, vmpadula@alaska.edu
Sanjay Pyare
University of Alaska Southeast, spyare@alaska.edu

The Aleutian Tern (*Onychoprionaleutica*)is a colonial nesting seabird of coastal Alaska that is very poorly understood. This species is cryptic and highly migratory and therefore almost nothing is known about its ecology outside of the brief period when it appears at coastal breeding colonies in the Aleutians and coastal Alaska. The global population of approximately 32,000 individuals is believed to breed exclusively in Alaska and eastern Siberia. The Alaska population has been crudely estimated at 9,500 or 1/3rd of the global population estimate. Colonies of a few to many hundred individuals appear to be broadly distributed along the coasts of the Chukchi Sea, Seward Peninsula, the Yukon-Kuskokwim River delta, the Alaska Peninsula, the Aleutian Islands, Kodiak Archipelago, and Kenai Peninsula. However, most individuals can be found in just a few large colonies of several thousand individuals, namely on the Copper River Delta and in the Yakutat area of northern Southeast Alaska. We report on the initial results of research utilizing stable isotope analysis of tissue collected from Yakutat, Aleutians, and from historic museum specimens to estimate diet, foraging behavior, and migration patterns. These data are being compared in context with geolocator data from transmitters, visual sightings, and colony-based observations. This study identifies the importance and need of accurate, updated population estimates to better conserve and manage for the persistence of summer breeding colonies of Aleutian Terns in Alaska.

Stomach Contents of Male Steller Sea Lions (*Eumetopias jubatus*) Collected During the Non-Breeding Season over the southeastern Bering Sea Shelf

Elizabeth Sinclair
NOAA Alaska Fisheries Science Center, beth.sinclair@noaa.gov
William Walker
NOAA Alaska Fisheries Science Center, mindwalk@msn.com
Patrick Gearin
NOAA Alaska Fisheries Science Center, pat.gearin@noaa.gov

Diet is described from the stomach contents of male Steller sea lions (*Eumetopias jubatus*) shot in the southeastern Bering Sea off the ice (n=13) in late March 1985 and off St. Paul Island (n=9) in September-October, 1985 and 1986. The four top ranked species ≥5% of total prey in both frequency (PFO) and number of individuals (PN) were walleye pollock (*Gadus chalcogrammus)* PFO 69, PN 25, mean fork length 17 cm), Pacific herring (*Clupea pallasii* PFO 62, PN 24, mean length 26 cm), shorthorn sculpin (*Myoexocephalus scorpius* PFO 39, PN 12) and Pacific giant octopus (*Enteroctopus dofleini* PFO 39, PN 11, mean wt 31 kg) in spring and; northern rock sole (*Lepidopsetta polyxystra* PFO 78, PN 47, mean fork length 35cm), Pacific cod (*Gadus macrocephalus*; PFO 56, PN 12, mean fork length 62 cm), walleye pollock (PFO 44, PN 7, mean fork length 49 cm) and red Irish Lord, *Hemilepidotus hemilepidotus* (PFO 11; PN 9) in fall. Prey species varied, but members of the Cottidae and Gadidae dominated in both collections. Clupeidae and Cryptacanthidae were the only families ≥5% that were exclusive to a single collection area (spring ice). Similar to scat-based studies of adult female western stock SSLs, males forage on demersal and semi-demersal prey that aggregate seasonally along frontal boundaries of the continental shelf.

Cetaceans in the Region Retkyn Spit, Chukotka

Natalia Kryukova
Russian Federal Research Institute of Fisheries and Oceanography (VNIRO), nkryukova@gmail.com
Andrey Pereverzev
Pacific Research Institute of Fisheries and Oceanography, anyuta0708@mail.ru

Investigations were realizing out from July to September 2004, 2007 and 2008 in Retkyn Spit region (near coastal haulout of the Pacific walrus) in Anadyr Gulf, Bering Sea. Observations were carrying out from the spit (width of 900 m) in both directions – the Rudder Bay and the sea. Additionally we observed in the village Enmelen region that is situated in 60 km to the south (from spit). It was totally 187 days of observations (2004: 50 days, 2007: 60 days, 2008: 77 days) from these days there were 36 days in the Enmelen region. In all 124 gray whales *(Eschrichtius robustus)* (GW) have been registered (2004: 28 GW, 2007: 35 GW, 2008: 61 GW). From these whales 55 GW were in the Enmelen region. In sum 34 killer whales (*Orcinus orca*) (KW) have been registered (2004: 6 KW, 2007: 7 KW, 2008: 21 KW). From these whales 5 KW were in the Enmelen region. In the first half of August, 2008 11 humpback whales (*Megaptera novaeangliae*) have been appeared near the Retkyn Spit. The greatest number of GW and KW was in 2008 that is probably connected with longer observations. Generally, GW were observed more in July, than in September. Calling at GW and KW into the Rudder bay were noted. There were a few KW. Probably, it was due lack of walruses on a haulout where they regularly come to hunt. KW were approached a haulout on distance to 100 meters. Hunting of KW on walruses has been registered only once (in 2008). Once a walrus, the male is aged more than 15 years, wounded by KW (big lacerations), came to a haulout on September, 12th. Next day he was died. Thus, the main cetaceans observed in east part of Anadyr Bay during July-September were GW, KW, and humpback whales.

Distant Relatives: Comparing Stable Carbon and Nitrogen Isotope Values and Trophic Niche from Two Pacific Harbor Seal (*Phoca vitulina richardii*) Populations in the North Pacific

Sheanna Steingass
Oregon State University, steingas@oregonstate.edu
Markus Horning
Alaska SeaLife Center, markush@alaskasealife.org
Lorrie Rea
University of Alaska Fairbanks, ldrea@alaska.edu

Between September 2014 to September 2015, 24 adult male Pacific harbor seals (*Phoca vitulina richardii*) were tagged post-cranially with Wildlife Computers SPOT5© satellite tags at two locations on the Oregon coast. Tags individually transmitted for a maximum of 324 days (μ=130.25±82.16), and one whisker (vibrissa) per animal was collected at the time of tagging for stable isotope analysis. $\delta^{13}C$ and $\delta^{15}N$ ratios in the vibrissae were analyzed in an effort to determine whether diet can be used as a predictive variable of *P. vitulina* spatial foraging behavior, and if this predictive capacity holds true between regions. Vibrissae were processed and analyzed at the University of Fairbanks (Fairbanks, AK) in collaboration with the Marine Ecotoxicology and Trophic Assessment Laboratory (METAL).

Vibrissae and satellite tracking data were also collected from Pacific harbor seals in the Aleutian Islands, AK in 2014-15. Samples from this region will be prepared and analyzed with the same laboratory standards as Oregon samples in order to compare trophic differences between Pacific harbor seals in two geographically-distinct regions of the North Pacific. Base food web values will be established using T2 (primary) consumers for both regions. Samples from 19 species of harbor seal prey in Oregon including flatfish, rockfish and greenlings were collected, and Oregon seal diet will be estimated using established trophic discrimination rates for harbor seals.

T-tests revealed that $\delta^{13}C$ differed significantly between Oregon animals (p= >>0.05, μ= -14.20), as did $\delta^{15}N$ (p= >>0.05, μ= 16.80). $\delta^{15}N$ was positively correlated with body mass in Oregon seals (p= 0.000259), suggesting higher trophic level foraging for larger animals, but $\delta^{13}C$ was not (p= 0.07). Minimum convex polygon (MCP) area alone did not predict $\delta^{13}C$ or $\delta^{15}N$ values (p= 0.192, 0.735). Generalized linear mixed models (GLMMs) will be used to correlate isotope values with multiple spatial characteristics, including distance from shore, bathymetry, and bottom substrate (sand, mud or rock). These methods will determine whether three available data sources (satellite telemetry, isotope values, and prey data) can be combined to create a comparative picture of spatial habitat use and ecological niche of Pacific harbor seals in two distinct regions of the North Pacific.

The Modern Status of Sea Otter (*Enhydra lutris* L.) Population on Commander I.

Evgeny Mamaev
Comandorsky State Nature and Bioshere Reserve, eumetopias@mail.ru

Sea otter (*Enhydra lutris* L.) population in the waters of the Aleutian I. has reduced considerably since the beginning of the XXI century. The population has recently reduced near the Kuril I. as well. Sea otter population near the Commander I. was thought to be stable, but census made in 2015 showed some continuous decrease in the population near the Commander Islands. During the census 1815 sea otters, including 313 cubs, were found off Bering, Toporkov and Arii Kamen I. 1444 sea otters were found off Medny I., 137 of which were cubs. Total population was estimated at 3259 sea otters, including 450 cubs. Average sea otter population density in preferred habitats off Bering, Toporkov and Arii Kamen I. is 1.78 animal per square kilometer (maximum rate is 10 animals per square kilometer). Near Medny I. its average population density reached 3.92 animals per square kilometer (maximum rate is 19.7 animals per square kilometer). In the period from 2007 to 2015 population numbers off Bering, Toporkov and Arii Kamen I. were decreasing annually for nearly one third (up to 27.5%). Average reduction rate was 8.9%. Modern population is 43.2% of population in 2007 and 40.3% of population in 1990. In 2007 the maximum population rate of the species off Medny I. was 2745 to 2813 individuals. Today sea otter population rate there is 51.3% out of absolute registered maximum. Near Bering, Toporkov and Arii Kamen I. ecosystem consisting of sea otters and feeding benthos is still shaping, while off Medny I. it is quite stable. Modern population rates in the waters of the Commander I. is 46.5% of maximum level reached in 2007. The tendency of population rates reduction near the Commander I. was registered in the 90s of the XX century, which was the time of population rates depression along the whole Aleutian Chain.

Are Some Eastern North Pacific Right Whales (*Eubalaena japonica*) Wintering in the Northern Bering Sea?

Dana Wright
Marine Mammal Commission, Dana.Wright@noaa.gov
Catherine Berchok
NOAA Alaska Fisheries Science Center, Catherine.Berchok@noaa.gov
Jessica Crance
NOAA Alaska Fisheries Science Center, Jessica.Crance@noaa.gov

Passive acoustic monitoring (PAM) has been used since 2001 to study the spatio-temporal trends of the most critically endangered baleen whale on earth, the eastern North Pacific right whale (hereafter NPRW; *Eubalaena japonica*). However, similarity of call characteristics and overlap in spatial distribution among mysticetes in the Bering Sea makes accurate identification of NPRWs via PAM challenging. Little is known about current and historical NPRW winter distribution, and changes in species composition, abundance, and distribution are expected as a result of climate change, making identification based on historical ranges risky. Eight BOEM-funded long-term acoustic recorders deployed by the AFSC Marine Mammal Lab in the Aleutian Passes, Bering, and southern Chukchi Seas (2008 – 2016), were manually reviewed (100%) for the presence of NPRW, gunshot call, bowhead (*Balaena mysticetus)*, humpback (*Megaptera novaeangliae*), and gray whale (*Eschrichtius robustus*), walrus (*Odobenus rosmarus*), and vessel noise. NPRW were positively identified using the 80-160 Hz up-call. NPRW up-calls were detected at very low rates (n < 5) at Unimak Pass (Aleutian Passes) across years in winter (December – February), supporting the theory that this passage is part of a migration route. Surprisingly, up-calls with characteristics matching the NPRW 'yes' criterion were observed at northern Bering and southern Chukchi Seas moorings in winter (December – March). Thus, NPRW up-calls occurred in both the Aleutian Passes and northern Bering and southern Chukchi Seas during winter months. Possible explanations of this finding include migration of some individuals of the NPRW population to lower latitudes in winter or the use of the up-call by other species. The Bering and Chukchi Sea winter up-calls were observed during bowhead whale song and heavy ice cover. Many of the up-calls occurred in pattern with bowhead song, and thus, were attributed to bowhead whale. However, up-calls still occurred that did not appear to coincide with bowhead song. This result adds further complexity to species identification using PAM during times of species distribution overlap in arctic and subarctic regions. Increased confidence in accurate identification of NPRWs via PAM remains a crucial component of understanding the basic life history of this critically endangered species.

Assessing Abundance of Beluga Whales in Bristol Bay using Genetic Mark-Recapture Methods

John Citta
Alaska Department of Fish & Game, john.citta@alaska.gov
Lori Quakenbush
Alaska Department of Fish & Game, lori.quakenbush@alaska.gov
Gregory O'Corry-Crowe
Florida Atlantic University, gocorryc@hboi.fau.edu
Roderick Hobbs
NOAA Alaska Fisheries Science Center, rod.hobbs@noaa.gov
Myra Olsen
Bristol Bay Native Association, no_email@gmail.com
Tatiana Ferrer
Florida Atlantic University, tferrer2@fau.edu

The Bristol Bay stock of beluga whales (*Delphinapterus leucas*) is one of five stocks commonly recognized in Alaskan waters. Bristol Bay belugas are genetically distinct from other stocks and tagging studies show they reside in Bristol Bay year-round. Bristol Bay belugas are harvested by Alaska Natives and periodic assessments of population abundance and trend are necessary for harvest management and population conservation. Aerial surveys flown in 2005 indicated this stock was increasing and thought to number ~3000 animals. However, counts from aerial surveys must be adjusted to correct for sightability and availability biases. As examples, while mature belugas are white and readily visible when at the surface, young whales are gray and easily missed (i.e., sightability bias). Also, only whales at the surface are available to be counted in the silty water found in the bays (i.e., availability bias). Unfortunately, such correction factors do not currently exist for Bristol Bay. An alternative technique for estimating abundance of belugas involves genetically identifying individuals using molecular markers from skin samples. With repeated sampling, we can analyze genetic "recaptures" within a mark-recapture framework. We are currently using this approach to estimate abundance and will then use the mark-recapture estimate to develop a correction factor for aerial surveys. Skin samples from Bristol Bay belugas were collected between 2002 and 2011; to date we have identified 668 unique belugas in greater Bristol Bay; 609 initially sampled in Kvichak Bay and 56 initially sampled in Nushagak Bay. Of 668 unique belugas, 83 were recaptured, resulting in a current population estimate of 3,009 belugas (95% CI 2,491–3,674). Based upon the movement of genetic marks and satellite tagged belugas, we think this estimate applies to the entire Bristol Bay beluga population. We are currently in the process of genotyping and matching the remaining 72 samples from 2011 and expect project completion early in 2017.

Validation of a Novel Method using Whiskers to Track the Reproductive Histories of Steller Sea Lions

Mandy Keogh
Alaska Department of Fish & Game, mandy.keogh@alaska.gov
Patrick Charapata
University of Alaska Fairbanks, pmcharapata@alaska.edu
Shawna Karpovich
Alaska Department of Fish & Game, shawna.karpovich@alaska.gov
Brian Fadely
NOAA Alaska Fisheries Science Center, brian.fadely@noaa.gov
Renae Sattler
Alaska SeaLife Center, renaes@alaskasealife.org
Russ Andrews
Alaska SeaLife Center, russa@alaskasealife.org
Jason Waite
University of Alaska Fairbanks, jason.waite@alaska.gov
Vladimir Burkanov
NOAA Alaska Fisheries Science Center, vladimir.burkanov@noaa.gov
Lori Polasek
Alaska SeaLife Center, lori.polasek1@gmail.com

Keratinized tissues including whiskers have proven ideal for acquiring a record of physiological parameters, such as dietary stable isotope signatures. Unlike other tissues that provide a snapshot of progesterone, a steroid hormone used to determine reproductive status, whiskers may track reproductive histories for multiple years if progesterone is incorporated as whiskers grow and concentrations vary with reproductive status. Female Steller sea lion whiskers were obtained from three sources: the captive breeding program at the Alaska SeaLife Center, live-captured animals during field research, and bio-sampled carcasses. Whiskers were sectioned with a hand chisel and ground in a mixer mill. Powdered sections were combined with methanol and slowly rotated for 24 hrs at room temperature. Standard methods including recovery of added mass, parallelism and dilution linearity were used to validate enzyme immunoassay kits (Arbor Assay) for progesterone and estradiol. Progesterone was measurable in whisker sections weighing from 2.2 to 21.4 mg (0.5-4.5 cm) while estradiol was measureable in sections weighing from 10.3 to 28.6 mg (0.5-4 cm). Whiskers become thinner towards the tip requiring distal sections to be longer. Progesterone detection required less whisker mass compared to estradiol. Therefore, whiskers were sectioned and hormones extracted based on the mass requirement for progesterone and the methanol extract from multiple sections were combined to measure estradiol. Whiskers collected from adult females with known reproductive histories were used to compare hormone concentrations during reproductive events including full-term pregnancy (pup produced) and estrous without pregnancy. Adult

female whiskers showed cyclical patterns in progesterone concentrations (range 3.3-136.9 pg/mg whisker) along the length of the whisker which appear to signify previous pregnancies or luteal phases. However, estradiol concentrations (range 0.25-0.77 pg/mg whisker) did not show the expected patterns and may not be as informative as progesterone. These results indicate pinniped whiskers retain reproductive hormones, progesterone and estradiol, throughout the length of the whisker and possibly give insights into multi-year reproductive histories of female Steller sea lions.

What Do Walrus Teeth and Tree Rings Have in Common?

Alexander Thornton
University of Alaska Fairbanks, aethornton@alaska.edu
Lara Horstmann
University of Alaska Fairbanks, lara.horstmann@alaska.edu
Nicole Misarti
University of Alaska Fairbanks, nmisarti@alaska.edu

Like tree rings, Pacific walruses (*Odobenus rosmarus divergens*) lay down seasonal/annual growth layers in their teeth. Obtained from these layers, stable isotopes can provide insight into the plasticity of foraging history throughout the lifetime of an individual walrus. Key ecological relationships of walruses, e.g., annual diet variability, or variability by age and sex, are still poorly understood. Pacific walruses are iconic sentinels of Arctic climate change and an important subsistence species for many Native communities. Due to habitat loss (i.e., reduced sea ice), they were listed as a candidate under the Endangered Species Act. Creating a dietary baseline over the lifetime of walruses by sex, age, and across a temporal scale helps fill gaps in existing knowledge.

To determine if cementum growth layers in walrus teeth can reflect temporal, sex, or age related dietary shifts, we selected teeth with ancillary data (e.g., sex, location) from specimens collected in partnership with museum collections, archaeological digs, and Alaska Native subsistence users. Teeth from two adult male and female walruses were each chosen per decade from 1880-present. This timeline encompasses impacts of the Industrial Revolution reaching the Alaskan Arctic. During known regime shifts (e.g., 1976-1978) or other periods of potentially high diet and ecosystem variability, sampling occurred at an increased frequency.

Samples from annual growth layers of walrus teeth were extracted using a MicroMill attached to a microscope. Collagen was isolated from tooth powder through a process of lipid extraction, demineralization, then gelatinization, and are being analyzed for stable carbon and nitrogen isotope ratios. We discuss the degree to which we can infer whether walruses are generalist or specialist predators, and what that means for the population given environmental changes impacting prey assemblages. We expect to observe annual fluctuations for $d^{13}C$ and $d^{15}N$ values that vary by sex, age, and across time. High variability in diet may indicate that walruses are more generalist predators than previously believed, rendering these pinnipeds more resilient to ecological changes.

Does Mercury Exposure Drive Differences in Gene Expression in Steller Sea Lions (*Eumetopias jubatus*) from the Western Aleutian Islands, Alaska?

John Harley
University of Alaska Fairbanks, john.r.harley@gmail.com
Lorrie Rea
University of Alaska Fairbanks, ldrea@alaska.edu
James MacDonald
University of Washigton, jmacdon@uw.edu
Theo Bammler
University of Washigton, tbammler@u.washington.edu
Todd O'Hara
University of Alaska Fairbanks, tmohara@alaska.edu

Steller sea lion (*Eumetopias jubatus*) populations sharply declined in the 1980s with some segments of the population failing to recover. Some rookeries of the western distinct population segment (DPS), especially the western Aleutian Islands (WAI), have not recovered with some continuing to decline. Recent studies indicated pups from WAI rookeries have higher total mercury concentrations ([THg]) in blood than pups from other parts of the western DPS. Although it is challenging to relate population level effects to the ***presence*** of a toxicant, one of the earliest responses of an organism to significant concentrations of contaminants can be changes in gene expression. Changes in gene expression are indicative of a normal physiological response with respect to general and specific response elements, while induction of systems involving antioxidant components can indicate a response occurred to defend the host from potential toxicosis. It is difficult to relate [THg] thresholds of concern from model organisms (domestic and laboratory animals) to wildlife, however we note various studies and agencies have reported toxic effect [THg] thresholds to be on the order of 50-100µg/L in whole blood. This preliminary study (proof of principle) evaluates differences in gene expression in peripheral blood mononuclear cells (PBMCs) of Steller sea lion pups from Agattu Island, Alaska. Twelve animals were chosen for RNA-seq analysis on an Illumina Hi-Seq, six animals with blood [THg] greater than 100µg/L and six animals with concentrations less than 100µg/L. The transcriptome was assembled *de novo* using the Trinity assembler, the reads were then aligned to the transcriptome using the salmon aligner, and comparisons of gene expression was conducted using the Bioconductor tximport and edgeR packages. We emphasize the influence of sex and blood chemistry as potential confounding variables. While examining changes in gene expression in remote populations of wildlife presents unique challenges, it has value in the characterization of responses to environmental contaminants.

Field Sedation of Arctic and Sub-Arctic Phocids: Additional Tools to Improve Marine Mammal Field Research

Shawn Johnson
The Marine Mammal Center, johnsons@tmmc.org
Claire Simeone
The Marine Mammal Center, simeonec@tmmc.org
Tracey Goldstein
University of California, Davis, tgoldstein@ucdavis.edu
Michelle Barbieri
NOAA Pacific Islands Fisheries Science Center, Michelle.Barbieri@noaa.gov
Josh London
NOAA Alaska Fisheries Science Center, josh.london@noaa.gov
Heather Ziel
NOAA Alaska Fisheries Science Center, heather.ziel@noaa.gov
Peter Boveng
NOAA Alaska Fisheries Science Center, peter.boveng@noaa.gov

Wildlife field studies provide valuable information about animal behavior, natural history, and health. However, capture techniques and the procedures associated with tagging and sample collection have the potential to cause temporary pain and distress. In addition to the risks to the animals, the animals themselves carry risks of injury to handlers. Mitigation of these stress-related physiological alterations through sedation and handling techniques is of high practical importance when working with animals in the field setting. The purpose of this paper is to describe safe and efficient handling and sedation techniques used in arctic and sub-arctic phocid species in order to collect biological samples and apply tracking instruments. From 2007-2014, 99 seals were captured as part of a variety of field projects. Thirty-eight ribbon (*Histiophoca fasciata*) and 14 spotted seals (*Phoca largha*), were captured in the Bering Sea, 40 harbor seals (*Phoca vitulina*) were captured in the Aleutian Islands, and seven bearded seals (*Erignathus barbatus*) were captured in Kotzebue Sound, Alaska. Diazepam (mean initial dose of 0.12 mg/kg) was administered intravenously for ribbon and spotted seals due to the rapidity and predictability of effects and because animal size and handling practices enabled consistent IV access. Bearded seals received midazolam at a mean dose of 0.16 mg/kg, IM. Harbor seals were initially administered midazolam at a mean dose of 0.2 mg/kg IM. Bearded seals and harbor seals were often given a second IV dose of either diazepam or midazolam (0.15 mg/kg) in order to complete the procedure. Sedation was reversed with flumazenil administered a dose of 0.005 - 0.01 mg/kg. Diazepam and midazolam provided safe and reliable sedation for free-ranging Arctic and sub-Arctic Alaskan phocids, and allowed the scientific team to safely collect data in a way that minimizes animal distress.

Tissue Distribution of Total Mercury, Monomethylmercury, and Selenium in Alaskan Steller Sea Lions

J. Margaret Castellini
University of Alaska Fairbanks, jcastellini@alaska.edu
Julie Avery
University of Alaska Fairbanks, jpavery@alaska.edu
Todd O'Hara
University of Alaska Fairbanks, tmohara@alaska.edu
Timothy Bouta
University of Alaska Fairbanks, tsbouta@alaska.edu
Lorrie Rea
University of Alaska Fairbanks, ldrea@alaska.edu

Mercury (Hg) is a global environmental contaminant of particular significance to piscivorous predators such as Steller sea lions (SSL). Monomethylmercury ($MeHg^+$) is a neurotoxicant that is easily absorbed via the gastrointestinal tract and readily crosses the placenta and the blood-brain barrier. Selenium, an essential element available in marine diets, likely ameliorates the adverse effects of $MeHg^+$ via antioxidant activities and demethylation. We previously reported regional differences in whole blood total mercury (THg) and total selenium (TSe) in SSLs. Several western Aleutian Islands (WAI) SSLs had whole blood (and hair) THg concentrations ([THg]) above thresholds of concern. Pup body burden studies indicated tissue [THg] was high enough in some tissues from a WAI pup (Agattu) that [TSe] may have been inadequate (based on molar ratios of TSe:THg < 1). We update these studies, reporting [THg], [$MeHg^+$], [TSe], and TSe:THg molar ratios in liver, kidney, and muscle of Alaskan SSLs (fetal to adult carcasses from 2003-13), to provide context to observations of high tissue [THg] in some SSLs. Liver had the highest median [THg] and widest range of [THg] (8.96µg/g; 0.288-56.3µg/g, wet weight). Kidney and muscle median [THg] were 0.754 and 0.291µg/g, respectively. Similarly, median [TSe] was greatest in liver (2.85µg/g) and lower in kidney and muscle (1.39 and 0.291µg/g, respectively), although the sample size for kidney and muscle was small. The molar ratio of TSe:THg was >2.5 for all kidney and muscle samples. In contrast, median value for TSe:THg in liver was 0.93 (n=15), with 5 individuals (1 juvenile male, 1 adult male and 3 adult females) <0.85. In each case where TSe:THg was <0.85, both liver [THg] and [TSe] were above the median concentration for that element, reflecting bioaccumulation but also indicating the possibility that in these cases high [THg] overwhelmed [TSe] availability. The proportion of THg that was present as $MeHg^+$ (%$MeHg^+$) varied by tissue with liver (median = 10%) < kidney (median = 41%) < muscle (median = 89%), resulting in smaller differences in [$MeHg^+$] between tissues than suggested by [THg], although liver still had consistently higher [$MeHg^+$] than kidney and muscle in matched samples.

Testing Time-Lapse Cameras for Surveillance of Marine Mammal By-Catch in Pollock and Herring Trawl Fisheries in Russia

Ivan Usatov
Kamchatka Branch of the Pacific Geographical Institute FEB RAS, usatov.ivan.alex@gmail.com
Vladimir Burkanov
Kamchatka Branch of the Pacific Geographical Institute FEB RAS, vburkanov@gmail.com

Interactions between commercial trawl fisheries and marine mammals (MM) are poorly studied in many countries including Russia. Under contract with the Pollock Catchers Association (Russia), we tested two types of time-lapse cameras (TLC) for surveillance of MM bycatch in the pollock trawl fishery in the Sea of Okhotsk in January-March 2015. Three observers worked for 81, 78, and 31 days on three large factory vessels that were fishing around the clock. Observers visually monitored MM activity and bycatch and simultaneously tested two off-the-shelf game cameras (PlotWatcher Pro and Bushnell 436) to monitor the fishing deck. One to three cameras were installed on each boat, continuously taking images at different preset intervals. All 522 trawl tows made by the boats were recorded with TLC; 334 (64%) were also monitored visually. Only one juvenile ribbon seal was caught during this time. It was found dead by the fishing crew but was not detected by the observer or on the TLC images, likely because the volume of fish transferred from trawl to the factory was so large and size of the animal was relatively small. After the pollock fishing season closed one boat fished for herring. From April 1 to 18 the boat made 43 tows for herring, 25 (58%) of which were monitored visually and all with TLC. One large Steller sea lion male was accidentally caught. That bycatch was detected by the observer and in the TLC images. PlotWatcher PRO was the better TLC for this project. The image archive allowed us to accurately quantify fishing effort in 100% of the trawl tows. Five-second time intervals between shots stored on a 32 GB SD card permitted continuous operation for up to three weeks without changing batteries. Small modification of the camera could make it possible to automatically monitor fishing activity for several months without any maintenance. In combination with archival GPS the PlotWatcher PRO camera could be an inexpensive and powerful tool to obtain critically important information on medium and large size MM bycatch in any trawl fishery in the world if fishermen allowed its installation on their boats.

Movements and Dive Behavior of Spotted Seals in the Western Bering Sea

Dmitriy Glazov
A.N. Severtsov Institute of Ecology and Evolution, dglazov@yandex.ru
Maria Solovyeva
A.N. Severtsov Institute of Ecology and Evolution, solovjova.m@gmail.com
Daria Kuznetsova
A.N. Severtsov Institute of Ecology and Evolution, datakuz@mail.ru
Vladimir Burkanov
NOAA Alaska Fisheries Science Center, vburkanov@gmail.com
Vyacheslav Rozhnov
A.N. Severtsov Institute of Ecology and Evolution, rozhnov.v@gmail.com
Peter Boveng
NOAA Alaska Fisheries Science Center, peter.boveng@noaa.gov
Josh London
NOAA Alaska Fisheries Science Center, josh.london@noaa.gov

In June 2015, we installed satellite tags on five spotted seals in Karaginsky Gulf. Four of five tags have sensors that detect the depth and duration of the dive. We received data from the tags over periods ranging from 98 to 300 days.

In summer, the animals moved along the coast from Karaginskiy Gulf to the Gulf of Anadyr. In autumn, they returned south to the tagging area, stopping along the way in the mouths of various rivers. In January the seals' locations formed two clusters that persisted until the April when the tags fell off or stopped working, in the southern parts of Korfa Bay and Olyutorsky Bay. These are known whelping locations for spotted seals from late March to mid-May in the northeast Kamchatka region. Although data ceased from the tags in the first half of April, spotted seals typically remain in their breeding areas for about 3 months, so it is likely that this area was the breeding habitat for our tagged seals.

We obtained and analyzed data from 74,430 dives; none exceeded 200 m in depth, and most of the dives lasted less than 10 minutes.

From June to mid-January, two females of spotted seals typically dived to depths of 60 - 80 m (85% of all dives), and used the entire water column in waters up to 100 m depth. This pattern was also observed from mid-March until the end of the data records. From mid-January to mid-March females dived to depths up to 200 m in waters with depths of over 1,000 m. During this period, the females made relatively little use of the 50-100 m depths (10.1% of dives), preferring other depths: 4 - 50 m (50.7%), 100-150 m (21.6%) and 150-200 m (17.6%).The male's foraging strategy seemed to be different: from tagging until mid-December he dived typically to a depths of 50-100 m in waters up to 100 m depth, and after - dived to 120 – 140 m in water depths up to 300 m.

A Single Record of Steller Sea Lion (*Eumetopias jubatus*) Emigration from the Western Aleutian Islands to the Commander Islands of Russia

Natasha Laskina
Moscow State University, lask.natalia@gmail.com
Vladimir Burkanov
NOAA Alaska Fisheries Science Center, vladimir.burkanov@noaa.gov
Tom Gelatt
NOAA Alaska Fisheries Science Center, tom.gelatt@noaa.gov

Yugo-Vostochny rookery at Medny Island, Russia is the major Steller sea lion (SSL) breeding site on the Commander Islands (CI). Annual observations during the breeding season at this rookery have occurred regularly since 1991. Surveys include regular counts by sex and age groups, pup births and mortalities, and daily recording of all sighted branded animals. Observations are conducted from fixed points located at a height of 25-30 meters above the SSLs without disturbing the rookery. Medny Island is approximately 440 km northwest of Agattu Island in the western Aleutian Islands (WAI) of Alaska where SSL abundance has continued to decline since the 1980's. This decline has occurred in contrast to most other regions of Alaska and Russia, where it has stabilized at a low level or is slightly increasing. Previous genetic work has indicated that SSL's on the Commander Islands show greater similarity to the sea lions in the western Aleutians than to those in neighboring Kamchatka. Steller sea lions were first marked in the western Aleutians in 2011. Since that time, marked animals have been sighted in the CI regularly but they were all juveniles or nonbreeding adults. In the summer of 2016 a five year old female with the brand ~35 marked as a pup on Agattu Island, Western Aleutians, gave birth to a pup on the Yugo-Vostochny rookery of Medny Island. This is the first confirmed record of a SSL female born in the WAI pupping in Russia. This female was first observed on the CI during the summer of 2014 at age 3. She was also sighted several times on the CI at different haulouts in 2015. Observations on Yugo-Vostochny rookery in 2016 were started on May 15 and ~35 was first recorded at the rookery on June 8, seven days prior to parturition. After giving birth she was present at the rookery throughout the summer until the end of observation in early August. This empirical evidence supports the genetic and population dynamics data suggesting that in the 1970s the CI rookery was likely re-established by SSL from the Aleutian Islands.

An Unexplained Decline in Steller Sea Lion Pup Production in the Kuril Islands, Russia 2015-2016

Vladimir Burkanov
NOAA Alaska Fisheries Science Center, vladimir.burkanov@noaa.gov
Tom Gelatt
NOAA Alaska Fisheries Science Center, tom.gelatt@noaa.gov

The Kuril Islands (KI) are a primary breeding area for Steller sea lions (SSL) in Russia. The population declined in the region in late 1970s and 1980s, but the trend reversed in the mid- 1990s when the population began a slow recovery at an annual rate of 3-6%. This positive trend continued until 2011 when live pup counts at the five major trend rookeries reached 2,787 pups or ~76% of the count in the mid-1960s. Pup surveys conducted in July 2015 and 2016 using similar methods as in the past indicated live pup numbers of 2,264 and 2,207 individuals respectively. The five year trend had declined at 4.7% annually. The total number of live pups decreased by 580 individuals (20.8%) between 2011 - 2016 but the decline varied among the rookeries. The greatest decrease in pup abundance was in the central part of the KI on the Raykoke (-47%) and Lovushki (-39%) rookeries, and less so (-23%) at the southern rookery of Brat Chirpoev Island. There was a steady increase at the northern-most rookery on Antsiferov Island (+12%). The mechanism of these divergent trends is not clear. Monitoring of individually marked sea lions in the KI since 1989 did not reveal any considerable re-distribution of breeding animals among the rookeries in recent years. There has been a significant increase (>50%) in the trawl squid fishery in the KI since the late 1990s potentially competing with adult sea lions for prey. However, it is not clear how this would influence sites differently. Survival of adult and juvenile sea lions could be also affected by an increase in the number of sea lions culled during the last two winters by the Japanese government near Hokkaido. However, the re-sight data suggests that a relatively small proportion of SSL from the KI winter in Japanese waters and the culling should also affect all rookeries. More comprehensive statistical analysis of survival and reproductive histories of branded SSL and recent environmental changes in the KI might help better understand the cause of SSL pup production decline in this region.

Regional Differences in Total Mercury Content of Aleutian Harbor Seal Fur

Julie Avery
University of Alaska Fairbanks, jpavery@alaska.edu
Tiffany Lamken
University of Alaska Fairbanks, talamken@alaska.edu
Todd O'Hara
University of Alaska Fairbanks, tmohara@alaska.edu
Josh London
NOAA Alaska Fisheries Science Center, josh.london@noaa.gov
Heather Ziel
NOAA Alaska Fisheries Science Center, heather.ziel@noaa.gov
Lorrie Rea
University of Alaska Fairbanks, ldrea@alaska.edu

Across Alaska, regional differences have been found in Steller sea lion (SSL) fur total mercury concentration ([THg]) with the greatest [THg] found in the Western Aleutian Islands (WAI).Within the WAI region, increased [THg] are associated with foraging at higher trophic level in Steller sea lions. The objective of this study was to examine the [THg] of harbor seal fur in the Central (CAI) and Eastern (EAI) Aleutian Islands and to examine [THg] relationship with trophic level to determine if similar trends in [THg] are observed in sympatric pinniped species. Within the Aleutian Islands both harbor seals and SSL populations have declined through the 1980’s and 1990’s. The [THg] of fur was quantified from Eastern (EAI; n=26) and Central AI (CAI; n=20) harbor seals to determine if regional differences exist. In addition, C and N stable isotope ratios were quantified to assess [THg] in a trophic level context. Adults have greater mean (± standard error) [THg] (13.77 ± 1.41 ppm) compared with young of the year (4.81 ± 4.47 ppm) and sub-adult (5.56 ± 2.41 ppm; p=0.015) harbor seals. No sex differences in [THg] were observed (p=0.448). No difference was found between fur [THg] in CAI (9.46 ± 2.81 ppm) and EAI (7.00 ± 2.09 ppm; p=0.413). Importantly, more than 15% of the harbor seals from this study had fur [THg] greater than the 20ppm threshold of concern (EAI 12%, CAI 20%), and 37% had [THg] above 10ppm (EAI 35%, CAI 40%). While no age differences were observed in $\delta^{15}N$ values (p=0.638), $\delta^{15}N$ was greater in EAI (15.66‰) compared with CAI (13.20‰; p<0.001). No correlation was observed between [THg] and trophic level (p=0.96) estimated using $\delta^{15}N$ values in either region. The range of [THg] values found in Aleutian harbor seals is similar to those observed in Steller sea lions within the same region. Further investigation of physiological mechanisms to minimize adverse effects of THg such as increased selenium concentrations is ongoing.

Diets of Walrus in Bristol Bay during Summer-Autumn, 2014 and 2015

John M. Maniscalco
Alaska SeaLife Center, johnm@alaskasealife.org
Alan M. Springer
University of Alaska Fairbanks, amspringer@alaska.edu
Katrina L. Counihan
Alaska SeaLife Center, katrinac@alaskasealife.org
Shiway W. Wang
University of Alaska Fairbanks, shiway@gmail.com
Tuula Hollmen
Alaska SeaLife Center, tuulah@alaskasealife.org
Suzanne M. Budge
Dalhousie University, Suzanne.Budge@dal.ca

Recent changes in the seasonal abundance and distribution of walrus in Bristol Bay (BB) have prompted renewed interest in determining their prey preferences in this region. We examined diets at four haulout sites, Hagemeister and Round Islands (northern BB), and Cape Seniavin and Izembek NWR (southern BB) during 2014 and 2015. Scat samples were collected opportunistically at all locations for analysis of diet using DNA composition. Native subsistence hunters provided samples from the gastrointestinal tracts of four animals taken at Hagemeister I., in addition to four full-depth blubber samples for analysis of fatty acid signatures. Blubber samples were also taken via biopsy darts from 21 walruses hauled out at Cape Seniavin. DNA was extracted from 67 prey species collected from BB for use as controls in qPCR and for primer design. Validation of qPCR was conducted using 15 DNA extractions from the scat of captive walruses with a known diet consisting of three fish species and one clam species. DNA sequences from seven broad taxa of prey have been amplified from wild scat samples using qPCR, with DNA from bivalves (clams), ascidians (sea squirts), and fish having the highest frequencies of occurrence (FO). DNA of echinoderms (sea cucumbers), gastropods (snails), decapods (shrimp, crabs), and seals was also detected at lower FO. There were apparent differences between seasons and locations in the prey types consumed. For example, bivalves were rarely observed in the diet of walrus at Hagemeister I. but were more common at other locations. Additional analyses, including qPCR and quantitative fatty acid analysis, that are underway will provide species-specific details of contemporary walrus diets in BB.

Bering Strait Acoustic Monitoring Network: An Approach to Detect and Quantify Arctic Marine Mammals in Order to Minimize Anthropogenic Impacts

Ricardo Antunes
Wildlife Conservation Society, rantunes@wcs.org
Stephanie Sardelis
Columbia University, stephanie.sardelis@gmail.com
Leigh West
Columbia University, ltw2110@columbia.edu
Martin Robards
Wildlife Conservation Society, mrobards@wcs.org
Brandon Southall
Southall Environmental Associates, Inc., brandon.southall@sea-inc.net
Kate Stafford
University of Washigton, kate2@uw.edu
Howard Rosenbaum
Wildlife Conservation Society, hrosenbaum@wcs.org

Current changes in the Arctic due to rapid climate warming and expansion of anthropogenic activities threaten this fragile ecosystem and people who depend on it. Recent studies highlighted the lack of longitudinal baseline data for many marine mammal populations in the Arctic, that are particularly sensitive to increases in ocean noise from increasing anthropogenic activities. The Bering Strait is a particularly important biological area where marine mammals gather during the spring and fall migrations. As the only passage for ships between the Bering and Chukchi Seas, especially those associated with shipping routes, E&P and mining activities, it also may represent and area of heightened potential disturbance for Arctic marine mammals. In order to better understand the degree of natural and human-generated noise confronting marine mammals, we deployed a network of sound recorders in the Northern Bering Sea. Preliminary analyses were carried out for two recorders deployed between October 2014 and June 2015 off Gambell and Savoonga, St. Lawrence Island. Spectrogram inspection of >650 h of recordings resulted in detections of bowhead, minke, beluga, and killer whales, walrus and bearded seals vocalizations. Variation in marine mammal detections were compared with remotely-sensed sea ice concentration in a 20 km radius around monitoring stations. Detections of walrus and beluga were associated with seasonal sea ice coverage, although detections in Savoonga tended to increase in areas with gaps of ice coverage. Bowhead whale detections started in October before the onset of sea ice coverage, were regularly detected in subsequent months, and mostly absent from both stations before sea ice recession in April. Bearded seal calls were detected at both stations from January until through May, coinciding with recession of seasonal sea ice. Ambient noise analysis revealed clear differences in diurnal and seasonal patterns of average noise conditions, with unique variability among

stations. Subsequent analysis will evaluate the relative contributions of natural (biological and abiotic) and anthropogenic contributions. The information provided will provide the best available science to guide recommendations concerning 'best practices' in order to minimize anthropogenic impacts to marine mammal species and their habitats in the Bering Strait region.

Bering Sea - Mammals

Freshwater Seals of Iliamna Lake – an Update

Dave Withrow
NOAA Alaska Fisheries Science Center, dave.withrow@noaa.gov
Peter Boveng
NOAA Alaska Fisheries Science Center, peter.boveng@noaa.gov
Jay VerHoef
NOAA Alaska Fisheries Science Center, jay.verhoef@noaa.gov
Josh London
NOAA Alaska Fisheries Science Center, josh.london@noaa.gov
Jennifer Burns
University of Alaska Anchorage, jmburns@uaa.alaska.edu
James Van Lanen
Alaska Department of Fish & Game, james.vanlanen@alaska.gov

Iliamna Lake is home to a unique colony of "freshwater" harbor seals that live year-round in Alaska's largest lake located approximately 225 miles southwest of Anchorage. NOAA's Marine Mammal Laboratory, along with the University of Alaska-Anchorage, Alaska Department of Fish and Game Subsistence Division, and partners from the Bristol Bay Native Association and the Newhalen Tribal Council designed a program to not only estimate the population size, but combine biological sampling and ethnographic research to better understand the seals' ecology. We've surveyed these seals almost yearly (since 2008) in August during their molt (when greatest numbers haul out), late July during pupping, and occasionally during the winter when the lake is frozen over. Our raw, unadjusted aerial counts are typically in the mid 200's with our highest counts in the mid 300's (344 and 356 seals), though winter counts are much lower, likely because most seals are obscured by ice. Pup counts are typically in the mid to high 40's. We utilized these and other historical data, including harvest information from subsistence use patterns, in a Bayesian hierarchical model and estimated that after a period of growth in the 1980's, the population has remained relatively steady at about 385 individuals (95% credible interval of 317 - 473). The annual production rate was estimated to be about 5% per year which compares closely with the annual harvest numbers from the ethnographic and subsistence use portion of our research. Future plans are to continue to monitor this population from the air and estimate the rate of exchange with seals from Bristol Bay, if any, via an ongoing genetics study. Currently there is broad community support for this research. To help protect these seals into the future, the village corporations of Iliamna and Pedro Bay agreed to conservation easements over the islands they own. Under these easements, the corporations give up the right to develop on these islands, but retain all the other rights of private ownership. The easements were spearheaded by the Bristol Bay Heritage Land Trust and The Conservation Fund.

Patterns of Energy Intake and Metabolism in Spotted Seals (*Phoca largha*) Provide Insight into Physiologically Sensitive Life-Stages

Nicole Thometz
University of California, Santa Cruz, nthometz@ucsc.edu
David Rosen
University of British Columbia, rosen@zoology.ubc.ca
Brandon Russell
Alaska SeaLife Center, brandonr@alaskasealife.org
Colleen Reichmuth
University of California, Santa Cruz, coll@ucsc.edu

Forecasting the potential impact of environmental change on ice-associated seals requires identifying critical nutritional and physiological periods. To provide fine-scale information about ontogenetic and seasonal changes in growth and caloric requirements, we evaluated two captive male spotted seals (*Phoca largha*) at the University of California Santa Cruz over a six-year period extending from early development through sexual maturity. Daily caloric intake was determined for each seal and referenced to developmental stage (age), physiological condition (body mass and length, reproductive maturity, molting status), and corresponding environmental features (air and water temperatures, photoperiod). In addition, we conducted a complimentary metabolic study with the same two spotted seals as adults at the Alaska SeaLife Center; data collection extended across molting, reproductive, non-molting, and non-reproductive periods when the seals were six years old. Data from both studies were combined and analyzed to reveal short- and long-term patterns of every intake, growth, body condition, and metabolism for this species. The seals displayed highly predictable developmental and seasonal patterns in food intake and body mass, comparable to other temperate and polar seals. Annual peaks in food consumption occurred during the annual spring molt and remained elevated during the post-molt period. Voluntary hypophagia occurred in the winter, although this decline was notably absent in a year with abnormally warm water temperatures. Seasonal cycles in food intake became more acute with age, largely due to more extreme winter hypophagia. Our data suggest that seasonal fluctuations in spotted seal prey resource requirements are strongly influenced by both physiological cycles and environmental conditions. Although the absolute amount of prey needed by captive individuals is presumably less than for wild conspecifics, the relative developmental and seasonal patterns in energy intake and metabolism described in this study are essential to understanding dynamic prey requirements of wild spotted seals.

Surgery at Sea - Hawkeye Meets Vitus Bering

Pam Tuomi
Alaska SeaLife Center, pamt@alaskasealife.org
Stacy DiRocco
SeaWorld, stacy.dirocco@seaworld.com
Renae Sattler
Alaska SeaLife Center, renaes@alaskasealife.org
Shawn Dahle
NOAA Fisheries, shawn.dahle@noaa.gov
Markus Horning
Alaska SeaLife Center, markush@alaskasealife.org

As part of the NOAA research on ecology, health, abundance and trends of Alaskan phocids, 35 harbor seals (*Phoca vitulina*) were captured in the central and western Aleutian Islands in September 2016. Ten of these seals received dual life history transmitters (LHX, Wildlife Computers, Redmond, WA). LHX tags provide data on individual animal survival, locations and causes of mortality, and in females can detect birth events. Such data can inform on seasonality and age distributions of causes of mortality and end-of-life emigration. They are surgically implanted in an animal's abdominal cavity and will transmit data via satellite after the end of the animal's life.

Seals were captured at seven haul-out sites between Adak Island and Attu Island and allowed to rest for 2 hours before processing. Surgeries were performed on the research vessel inside a specially designed portable surgical room under aseptic conditions by qualified personnel. Animals were sedated with midazolam and butorphanol, then masked for anesthesia with isoflurane and oxygen and intubated for positive pressure ventilation. Transmitters were gas-sterilized (ethylene oxide gas) and sterile surgical instruments, drapes, gloves and gowns were utilized. The abdomen was accessed via a ventral midline incision just caudal to the umbilicus and closed with monofilament antibacterial suture. Under anesthesia, the seals received a head-mounted satellite transmitter for post-release tracking up to the annual molt. A second satellite transmitter for long-term tracking was attached to the inter-digital webbing of a rear flipper. Sedation was reversed with flumazenil and naltrexone, and oxygen continued until recovery allowed extubation. Seals were monitored for 2 hours following surgery in a clean, dry enclosure and released when fully recovered from anesthesia without evidence of bleeding from the incision and with internal temperature (transmitted from LHX tags) between 36.4 to 38.4 °C. Post-release monitoring via the satellite tags indicated that all seals returned to their capture site and made typical foraging trips within a few hours after release.

Although phocid anesthesia and subcutaneous transmitter implants have been previously performed at sea, this is the first report of successful intra-abdominal surgery and successful post-release monitoring of LHX implanted harbor seals.

Increasing Shipping Traffic Through the Bering Strait and Bering Sea Region and the Risks to Endangered Whales

Laura Morse
Nova Southeastern University, laurajmorse@yahoo.com

The Arctic region is experiencing a growth in marine traffic due to longer periods of open water and vessel improvements that allow for safer transit in ice conditions. Regionally, Russia's ongoing effort to improve and expand on existing transportation infrastructure further encourages the rise in traffic along the Northern Sea Route. As a result of these and other factors, shipping traffic is increasing thru the Bering Sea and Bering Strait. Regulating traffic thru the region is far more complex than most other areas in US waters given the presence of an international strait subject to international regulation thru the IMO. The US Coast Guard has recognized the hazards of increased traffic and is moving forward with development of shipping guidelines to mitigate risk from ship traffic. Further work will be needed to translate those guidelines into domestic and international law. In addition, focus has been on impacts to the Arctic Ocean, the biological resources within, and the human residents at its margin, however potential consequences exist in the Bering Sea/Bering Strait region which tends to receive less attention. Of significance is the potential risk of increased ship strikes for endangered whales species such as fin and humpback that aggregate in large numbers in the northern Bering Sea and north Pacific right whales that aggregate in the southeastern Bering Sea. To establish appropriate international and domestic regulations that effectively mitigate ship strike risk of whales throughout the Bering Strait and Bering Sea region, a greater understanding of ship traffic patterns; marine mammal seasonality, density and behavior; and encounter risk will be necessary. Accomplishing this will require a collaborative approach among multiple stakeholders utilizing established pathways to synthesize data such as the Marine Exchange of Alaska and the Arctic Data Integration Portal (AOOS).

Can Fur Predict the Total Mercury Concentration of Muscle of Steller Seal Lions?

Jed Harding
Department of Veterinary Medicine, University of Alaska Fairbanks, jedharding@gmail.com
Julie Avery
Institute of Northern Engineering, Water and Environmental Research Center, University of Alaska Fairbanks, jpavery@alaska.edu
Todd O'Hara
Department of Veterinary Medicine, University of Alaska Fairbanks, tmohara@alaska.edu
Lorrie Rea
Institute of Northern Engineering, Water and Environmental Research Center, University of Alaska Fairbanks, ldrea@alaska.edu

Steller sea lions (*Eumetopias jubatus;* SSL) of the Western Distinct Population Segment have undergone an unexplained population decline west of Cape Suckling (144° W) since the 1970’s and are currently listed as endangered under the Endangered Species Act. Fur is collected to monitor contaminant exposure in free-ranging SSL populations. Previous analysis of fur indicates total mercury concentrations ([THg]) of Western Aleutian SSL pups above a level of concern (20µg/g) for negative health impacts. Surveillance of [THg] in species and tissues that are consumed by humans is important for OneHealth efforts. Correlations between THg content of fur and tissues that are consumed by humans have not been extensively studied. Therefore we examined the relationship between [THg] of SSL fur and skeletal muscle. SSL muzzles (n=10) were collected during necropsy, frozen and processed into clean, dry maxillaris muscle and fur samples. The paired muscle and fur samples were analyzed using a DMA-80 for [THg].Mean (± standard deviation) fur [THg] (12.0 ± 9.7 µg/g) was greater than [THg] in muscle (1.4 ± 1.1 µg/g). A significant linear relationship was observed between fur and muscle for [THg] (fur = 7.3(muscle) + 1844; $r^2 = 0.71$; $p=0.002$).Although fur [THg] is higher than muscle, given the strong linear relationship of these two matrices, fur may be a useful indicator for muscle [THg]. Further study is necessary to determine if hair can be used as a proxy for safety of muscle consumption by subsistence users and possibly used to estimate [THg] for other tissues.

The Subsistence Harvests of Ringed, Bearded, Spotted, and Ribbon Seals in Alaska are Currently Sustainable

Mark Nelson
Alaska Department of Fish & Game, mark.nelson@alaska.gov
Lori Quakenbush
Alaska Department of Fish & Game, Lori.Quakenbush@alaska.gov
John Goodwin
Ice Seal Committee, johnpearlgoodwin@gmail.com

Ice seals (ringed, bearded, spotted, and ribbon) are important subsistence resources for coastal Alaska Natives in western and northern Alaska. Concerns over how ice seals will adapt to a changing climate, especially less sea ice, have led to consideration of all four species for listing under the U.S. Endangered Species Act. Stock assessment reports and status reviews noted that the level of subsistence harvest was not a concern for any of the four species, but a lack of harvest data and reliable seal population estimates precluded a detailed evaluation. We compiled harvest data from all 55 ice seal hunting communities in Alaska between 1992 and 2012 and used the highest numbers reported to extrapolate community totals by region for regional estimates. The regional estimates were then combined for a statewide estimate of removal that included both harvested and struck-and-lost seals. The estimate of removal was then compared with the best (but known to be minimum) population estimate to determine sustainability of the harvest for each species. Annual removal estimates were all ≤3% of the minimum population estimates: 0.2% for ribbon, 1.1% for ringed, 1.7% for spotted and 2.9% for bearded seals. Harvest levels below the potential biological removal (PBR), which is 3% for phocids that mature by age six and pup annually, will allow the population to remain within the optimum sustainable population (OSP) level. However, additional harvest surveys are important for future assessment, because habitat and harvests will likely change, therefore, we recommend harvest surveys of all ice seal hunting communities in Alaska should continue with special attention on the Yukon-Kuskokwim Delta region where only six (of 19) communities were surveyed during our 21 year study period.

Winter Migration of Juvenile Northern Fur Seals (Callorhinus ursinus) from Breeding Sites across the Eastern Pacific

Tonya Zeppelin
NOAA Alaska Fisheries Science Center, Tonya.Zeppelin@noaa.gov
Jeremy Sterling
NOAA Alaska Fisheries Science Center, Jeremy.Sterling@noaa.gov
Rolf Ream
NOAA Alaska Fisheries Science Center, Rolf.Ream@noaa.gov
Noel Pelland
University of Washington, nap2@u.washington.edu

Northern fur seals (Callorhinus ursinus; NFS) have declined significantly on the Pribilof Islands, Alaska, their primary breeding site. Conversely, smaller populations within the North American range, including those on Bogoslof and San Miguel Islands, are increasing. The reasons for the decline are currently unknown, however, low juvenile survival is thought to be a possible cause. The winter is a potentially critical time for survival of juvenile NFS that are inexperienced and relatively small. Northern fur seals depart from the breeding sites in fall, undertake extensive far-ranging pelagic migrations (~ 8 mo), and do not return until the following breeding season. Recent satellite tracking studies have shown winter distribution and diving behavior of NFS pups and adults of both sexes, but no overwinter tracking information exists on juvenile NFS. We deployed satellite tags in 2006 and 2007 on 31 male and 40 female juvenile NFS from the 3 breeding sites across the North American range (Pribilof n = 55; Bogoslof n = 10; and San Miguel Islands n = 6) to examine wintertime habitat use. Dive data (6 h histograms of dive depth and duration) were collected on 36 of these animals. Satellite location and dive data were combined to examine migration departure times and routes, winter distribution, quantify time spent in different large marine ecosystems (e.g. Bering Sea Shelf, Bering Sea Basin, North Pacific Ocean, California Current and Gulf of Alaska ecosystems), and characterize diving behavior. We compared location and diving parameters among breeding sites, between sexes and years. Migratory patterns of juveniles were further compared with previous studies of adult and pup wintertime migration to examine the ontogeny of winter habitat use and foraging strategies. We found differences in juvenile migration patterns between sexes and among the different breeding sites and age classes. An understanding of wintertime habitat use and foraging by juvenile NFS will help determine the environmental and anthropogenic influences on their behavior and survival, essential information for conservation and management of this declining species.

Associations Between Commercial Fisheries and Steller Sea Lion Survival Rates at Russian Rookeries

Alexey Altukhov
University of Alaska Fairbanks, aaltukhov@gmail.com
Russ Andrews
Alaska SeaLife Center, RussA@alaskasealife.org
Tom Gelatt
NOAA Alaska Fisheries Science Center, tom.gelatt@noaa.gov
Vladimir Burkanov
NOAA Alaska Fisheries Science Center, vburkanov@gmail.com

Although Steller sea lion (SSL) populations have started to recover in many areas, SSL abundance in the Western and Central Aleutians and in the nearby Commander Islands (Russia) has continued to decline. Causes of the decline are unclear, but overlap in the fish species targeted by commercial fisheries and SSL led us to investigate associations between fishing activity and SSL vital rates in Russia. We estimated the variation in survival rates over time using Cormack-Jolly-Seber models between1996 and 2010. Survival rates varied differently over time between regions and age classes. Adult female and juvenile survival was fairly constant in the Kuril Islands, but varied significantly, and similarly, over time in two closely located areas: Medny Island (Commander Islands) and Kozlov Cape (Eastern Kamchatka coast). The two fishery regions near these rookeries are the Western Bering Sea and Eastern Kamchatka. Only juvenile SSL survival rate was highly correlated with the pollock fishery in those regions, but the sign of the relationship differed between regions. In the Western Bering Sea, modelling demonstrated that pollock catch per unit effort (CPUE) was positively correlated with survival of SSL juveniles. Perhaps some cyclical environmental factor increased pollock availability both to the fishery and SSL, resulting in coincident increases in fishery catch and SSL survival. In Eastern Kamchatka, catch levels and CPUE have been increasing since 2005. Both parameters were negatively correlated with juvenile SSL survival, and even though CPUE has been rising, models demonstrated a strong negative effect of catch density near the rookeries. SSL vital rates have varied over time in Russia, and even though our models based on long-term average vital rate estimates successfully predicted overall population trends in most areas, examining the fluctuations in vital rates over time can provide insight into the mechanisms driving the changes. Although the relationship between commercial fisheries and Steller sea lions in Far Eastern Russia is complicated, there are clearly some associations that deserve further attention.

Improvements in Large Whale Trandermal Satellite Tags from Follow-Up Studies

Alexandre Zerbini
NOAA Alaska Fisheries Science Center, alex.zerbini@noaa.gov
Jooke Robbins
Center for Coastal Studies - Provincetown, jrobbins@coastalresearch.org
Russ Andrews
University of Alaska Fairbanks, russa@alaskasealife.org
Virginia Andrews-Goff
Australian Antarctic Division, Virginia.Andrews-Goff@aad.gov.au
Mark Baumgartner
Woods Hole Oceanographic Institution, mbaumgartner@whoi.edu
John Calambokidis
Cascadia Research Collective, calambokidis@cascadiaresearch.org
Phillip Clapham
NOAA Alaska Fisheries Science Center, phillip.clapham@noaa.gov
Michael Double
Australian Antarctic Division, Mike.Double@aad.gov.au
Andreas Fahlman
Oceanographic Foundation, Valencia, Spain, afahlman@whoi.edu
Nick Gales
Australian Antarctic Division, nick.gales@aad.gov.au
Frances Gulland
The Marine Mammal Center, Gullandf@TMMC.org
Terry Hammar
Woods Hole Oceanographic Institution, thammar@whoi.edu
Melinda Holland
Wildlife Computers, melinda@wildlifecomputers.com
Amy Kennedy
NOAA Alaska Fisheries Science Center, amy.kennedy@noaa.gov
Michael Moore
Woods Hole Oceanographic Institution, mmoore@whoi.edu
Greg Schorr
Marine Ecology and Telemetry Research, gschorr@marecotel.org

Satellite telemetry has greatly improved our understanding of whale ecology and conservation. However, satellite tag duration remains highly variable and rarely exceeds the expected battery life of the transmitter. Transdermal implantable (TI) tags used on large whales have varied in design, but typically consist of an anchoring system and electronics package that is partially or fully embedded in the whale's body. The exact causes of tag failure are poorly understood, and potentially include transmitter or attachment failure, post-implantation damage, or removal/rejection. During a study to assess tag retention and health impacts on Gulf of Maine humpback whales (*Megaptera*

novaeangliae), 63 TI tags were deployed. Repeated resightings of tagged whales revealed important design flaws that could explain observed physiological reactions and the relatively short and variable tag durations. Tags with articulated anchors failed at the articulation point resulting in premature detachment of the electronics package and, in some cases (n=7 of 19 deployments), part of the anchor being left in the body of the whale. Another design limitation was found in tags with a threaded connection between the anchoring system and the electronics package resulting in bending/breakage of the tag (n=5 of 13 deployments). These flaws led to the development of reinforced/integrated tags for which breakage was rarely documented (n=1 of 27 deployments). Significant improvement (64% increase) in average tag duration was achieved once a re-design of the TI tag eliminated the articulation and the threated connection (p=0.021). This study shows that tags with such connections, which continue to be used in various tagging programs, should be discontinued to minimize tag impact and increase tag duration. Development of less invasive satellite tags should continue, but the most recent TI tags are safer and more reliable for investigating whale ecology and the effects of human activities and climate change on whales. While this study was conducted in the Atlantic Ocean, results have broad implications because tagging is a powerful tool to study these animals in remote habitats such as the Arctic, Gulf of Alaska and Bering Sea where human access is difficult.

"Seals Travel With a Fair Wind": The Influence of Marine Winds on the Migration of Newly-Weaned Northern Fur Seal Pups

Noel Pelland
NOAA Alaska Fisheries Science Center, nap2@u.washington.edu
Jeremy Sterling
NOAA Alaska Fisheries Science Center, jeremy.sterling@noaa.gov
Devin Johnson
NOAA Alaska Fisheries Science Center, devin.johnson@noaa.gov
Mary-Anne Lea
University of Tasmania Institute of Marine and Antarctic Studies, MaryAnne.Lea@utas.edu.au

Small, inexperienced, newly-weaned pups of the "depleted" Pribilof and Bogoslof Islands northern fur seal (*Callorhinus ursinus*; NFS) population migrate through the Bering Sea and North Pacific Ocean to more southerly winter foraging habitat during their first fall and winter at sea. Survival of pups during this migration is low, relative to adults, and highly variable year-to-year, for reasons that are not fully understood but may include storm conditions, prey availability, and the ability of pups to reach profitable foraging grounds. Here, we describe ongoing investigations into the effect of interannual variability in marine winds on the migratory patterns of NFS pups using satellite tagging. Satellite-telemetered movements support traditional knowledge that the timing of pup dispersal varies in years of contrasting atmospheric forcing, and that winds influence movement speed within the Bering Sea. Comparison of pup movement to reanalysis surface winds throughout the migration demonstrates that, as wind speed increases, pup movements are increasingly concentrated downwind and to the right, consistent with wind-forced surface currents. Simple correlation analyses of wind vectors and pup movements imply that winds could influence an individual pup's displacement by hundreds of kilometers during the first fall-winter migration. Of the 4 years of satellite tagging, 2 captured migrations in which a strong El Nino signal was present, showing differences in mean pup position within the Gulf of Alaska and central North Pacific Ocean that are qualitatively consistent with forcing by anomalous atmospheric patterns. The idea that anomalous winds can alter pup dispersal position is also supported by historical NFS stranding data during the 1950s and 1960s suggestive of interannual variability in the location of pups along the North American coast during some winters. We summarize ongoing work that will use novel statistical methods to quantify the mean and individual variability in the wind effect on pup movement, simulate year-to-year pup displacement over the more than 60-year reanalysis wind record, and investigate any possible effect of interannual variability in prevailing winds on pup survival and NFS demography.

Bering Strait Community Engagement in Spill Preparedness and Response

Karla Dutton
Defenders of Wildlife, kdutton@defenders.org
Allison Dunbar
Defenders of Wildlife, adunbar@defenders.org

Defenders is working with Bering Strait coastal communities and state and federal spill response and preparedness agencies and partners to increase community engagement to reduce impacts to the region's arctic marine mammals and the communities that rely on them. The newly created Bering Strait Response Teaching Tool will be used in our community engagement work.

Atka Mackerel Fisheries and Steller Sea Lions Population Decline in the Western Bering Sea and Eastern Kamchatka

Olga Belonovich
Kamchatka Research Institute of Fishery and Oceanography, aizberg@gmail.com
Sergey Fomin
Pacific Geographical Institute, Kamchatka Branch, kalan_87@mail.ru
Vladimir Burkanov
Pacific Geographical Institute, Kamchatka Branch, Vladimir.Burkanov@noaa.gov
Aleksey Altukhov
Pacific Geographical Institute, Kamchatka Branch, aaltukhov@gmail.com
Viktor Nikulin
Kamchatka Research Institute of Fishery and Oceanography, vnikulin@yandex.ru

Steller sea lions (SSL) have declined by 99% in the western part of the Bering Sea. Fisheries effects on the SSL population is one possible reason for the population decline. We investigated the direct effect of Atka mackerel fisheries on the SSL mortality in trawls interviewing fishermen, analyzing published fisheries data and surveyed SSL-fishery interactions while working on boats. There are 3 fishing sub zone in the Western Bering Sea and Eastern Kamchatka: PKZ, KZ and WBZ. The maximum total available catch (TAC) of Atka mackerel in 2004-2013 was for the PKZ sub zone with the maximum 28800 mt in 2011 and 2012. The maximum TAC in KZ sub zone was 8000t in 2009-2012 and for the WBS it was 2700 mt in 2010-2013. The total Atka mackerel catch for all zones in 2004-2013 was 179502 mt (86% in PKZ, 10% in KZ and 4% in WBZ). The primary fishing gear was trawl (83% in PKZ) and seine net (15% in PKZ). The most of the fisheries effort in PKZ was in September -December and April-May (total 11473 tows). The seine net fisheries in PKZ was all year round but most intensive in April to June and September to December (total 32789 tows). PKZ is the only region where the seine net fisheries was reported during winter time. There are 3 SSL rookeries and 10 haulouts locate in the PKZ. Although there is no complete information of SSL wintering sites, evidence on winter sights in Avacha Bay (PKZ) may suggest that majority of sea lions spent winter along Eastern Kamchatka Coast. The efforts on fishery have been dramatically increased in recent years that may potentially increase SSL mortality. More studies and especially direct observation on fishing vessels required to investigate the effect of increasing Atka mackerel fisheries on the SSL population.

The Economic Impacts of Spatial Closures: Evidence from the 2011 Steller Sea Lion Protective Measures in the North Pacific

Matt Reimer
University of Alaska Anchorage, mreimer2@alaska.edu
Alan Haynie
NOAA Alaska Fisheries Science Center, alan.haynie@noaa.gov

Spatial closures are a prominent tool for ecosystem-based management in commercial fisheries. The potential long-run benefits of spatial closures are well known; however, empirical estimates of the potential short-run costs incurred by the commercial fishing industry are relatively scarce. Spatial closures can force fishermen out of high-productivity fishing areas and potentially constrain the ability of fishermen to balance their catch compositions in accordance with annual species-specific quotas. Thus, spatial closures may have short-run costs in the form of increased operating costs and/or forgone revenues from reduced target-species catch. Evaluating the short-run costs incurred by the fishing industry relative to the potential benefits of spatial closures is an important element of evidence-based policy making for ecosystem-based fisheries management. Unfortunately, evaluating the impact of a spatial closure is complicated by the fact that spatial closures are not implemented in ways that facilitate the measurement of causal relationships between spatial closures and short-run industry costs. For instance, the implementation of spatial closures rarely generate clear “treated” and “control” groups in which one group of fishermen is not permitted to fish in an area while others are, thereby impeding estimation of the counterfactual outcomes that would have occurred in the absence of the spatial closure.

We conduct an *ex post* evaluation of the short-run industry costs associated with the 2011 spatial closures to the North Pacific groundfish fleet for the protection of the endangered Western stock of Stellar sea lions in the Aleutian Islands. Using a combination of program evaluation and structural econometric techniques, we are able to address a number of important empirical issues that have impeded *ex post* evaluations in the past and isolate the effect of the spatial closures from other confounding effects, such as changes in prices and total allowable catches. Our results indicate that the short-run industry costs 1) are relatively large in the first couple of years following the closures, 2) are primarily driven by displacing vessels from their historical fishing areas, and 3) diminish over time so that they are not statistically different from zero four years after the closure.

Integrating a Quantitative Coastal Vulnerability Index with ShoreZone

Sarah Cook
Coastal and Ocean Resources, Inc., sarah@coastalandoceans.com
Carl Schoch
Coastal and Ocean Resources, Inc., carl@coastalandoceans.com

The ShoreZone coastal habitat mapping program has been implemented over the last 30 years in Oregon, Washington State, British Columbia and the majority of Alaska. The attributes and mapping protocols have changed over time as experience, demand and technology evolved. A Coastal Vulnerability Index (CVI) was recently added that evaluates 5 shoreline attributes to calculate the vulnerability of a shoreline unit to coastal inundation. We adapted an existing CVI developed by Thieler and Hammar-Klose of the U.S. Geological Survey for use with ShoreZone. The ShoreZone CVI (SCVI) is an algorithm using categorical values of habitat attributes including erosion, flooding, geomorphology, tide range, and wave height to calculate a ranked vulnerability index. The attributes are either directly assessed from the imagery or available from local data sources. Erosion rates are based on shoreline features interpreted from the aerial imagery such as scarps and beach berms. Flooding frequency is based on the measured width of the visible flood zone using log lines or marine debris as indicators. The geomorphology is from the ShoreZone Shore Type classification. The tidal range is the maximum mean annual value from the most appropriate local tide station. Significant wave height is derived from the wave exposure categories. The SCVI is intended to meet the growing need of coastal managers for information about the vulnerability of coastlines and at the relevant spatial scales of coastal communities (100s m). Results from the Kuskokwim Bay (Bering Sea) ShoreZone mapping will be presented as the first study area where the SCVI was implemented.

The Coastal Community Ocean Observers Program

Peter Winsor
University of Alaska Fairbanks, pwinsor@alaska.edu
Seth Danielson
University of Alaska Fairbanks, sldanielson@alaska.edu
Tuula Hollmen
Alaska SeaLife Center, tuulah@alaskasealife.org
Courtney Carothers
University of Alaska Fairbanks, clcarothers@alaska.edu

The Coastal Community Ocean Observers (C2O2) is a coastal science program that seeks to build a framework for long-term community-driven monitoring of oceanic environmental variables. The C2O2 program combines cost-efficient means for communities to collect environmental data with local interest, promoting mutually beneficial partnerships and relationships for collecting and sharing information.

The C2O2 program is currently active in three communities, Kaktovik, Old Harbor, and St. Paul – and is being implemented in the neighboring communities of Cold Bay and King Cove in the Aleutians. These four communities have uniquely different climates, cultures, and local concerns, and represents different oceans and environments. Using simple-to-operate lowered conductivity-depth-salinity-fluorescence profilers, each of these communities have generated a large number of hydrographic data on weekly to months intervals which is reported in near-real time via a web interface and immediately available on the project website for community residents, scientists and stakeholders.

Here we describe our experiences with the C2O2 program, focusing on data collection, results and a build-out plan for the future, including implementation of a biological sampling component. C2O2 is interfacing with similar efforts in Canada, the Mosquito Fleet to the south and CROW project to the north, to create a linked network of ocean observations in a south-to-north framework from Vancouver to the Canadian Arctic archipelago to detect and describe climate change propagation and its impact on local ecosystems and communities.

The Arctic in the Classroom: The Savoonga School Land Steward Program

Veronica Padula
University of Alaska Anchorage, vmpadula@alaska.edu
Tracy DiPaola
Bering Strait School District (BSSD), tracy.dipaola@sva.bssd.org

The Arctic in the Classroom (TAC) is a program initiated by the Arctic Research Consortium of the United States (ARCUS) in 2016, with the aim to increase knowledge about science-rich Arctic landscapes and ecosystems, and the people that are an integral part of these places. One way in which TAC aims to accomplish this is by bringing together Alaskan scientists, educators, and community members to engage all members in successful, long-term, citizen science projects and community-based monitoring programs. Additionally, these partnerships are designed to promote communication of complex concepts that facilitate effective learning through the use of real-world Arctic science, cross subject and content areas to enhance various skills, and promote a sense of environmental stewardship through place-based learning. During the preliminary workshop in March 2016, TAC created a partnership between Padula (a graduate student from the University of Alaska Anchorage/Fairbanks) and name (a teacher from Savoonga) to initiate a land steward program with high school students. During the first phase of the project in 2016, students wrote numerous journal entries and reports considering what it meant for them to be land stewards in Savoonga, and ?for? in the rest of the world. Following this, students learned the science behind marine debris, and its impacts on the ocean environment. Further, they focused on how cleaning up marine debris, especially the debris that washes up on the shorelines of Savoonga, is one way in which they can become land stewards. These reflections and lessons were followed by field trips by students to the shoreline to collect debris that were then sorted, categorized, and counted. This information was then entered into a worldwide database called the Marine Debris Tracker. The entry from Savoonga was the first for Alaska, and students were able to see that on the website by looking at the map before and after entering their data. Here we present results of ongoing marine debris monitoring by Savoonga students, along with their reflections on what it means for them to be land stewards.

At Their Limit: Epibenthic Communities of the Aleutian Islands Continental Shelf

Aaron Bland
University of Alaska Fairbanks, asbland@alaska.edu
Brenda Konar
University of Alaska Fairbanks, bhkonar@alaska.edu
Alexandra Ravelo
University of Alaska Fairbanks, amravelo@alaska.edu

The highly productive marine communities of the Aleutian Islands are divided by a number of biogeographic breaks. However, it is unclear whether epibenthic organisms on the Aleutian continental shelf experience similar distributional limits. We collected epibenthic community data (biomass and abundance) at 18 offshore sites across six islands in the eastern and central Aleutians in the summer of 2016. Biomass and abundance of epibenthic organisms differed among islands, while only biomass differed across the Samalga Pass. Neither community richness nor evenness differed among islands. Although overall epibenthic biodiversity did not appear to differ by location, there is evidence of important distributional limits for particular benthic community members. Future work that incorporates environmental variables (temperature, salinity, depth, proximity to nearshore kelp forests, etc.) may further elucidate the relationship between the biotic community and the physical setting.

An Archipelago Divided: Differences in Kelp Forest Communities Across an Aleutian Biogeographic Break

Jacob Metzger
University of Alaska Fairbanks, jrmetzger@alaska.edu
Brenda Konar
University of Alaska Fairbanks, bhkonar@alaska.edu
Matt Edwards
San Diego State University, medwards@mail.sdsu.edu
Aaron Bland
University of Alaska Fairbanks, asbland@alaska.edu
Alexandra Ravelo
University of Alaska Fairbanks, amravelo@alaska.edu
Sarah Traiger
University of Alaska Fairbanks, sbrtraiger@alaska.edu
Benjamin Weitzman
University of Alaska Fairbanks, bpweitzman@alaska.edu

Biogeographic breaks form important ecological divisions as large shifts in community composition can occur due to multiple species reaching their range limits. Samalga Pass, in the eastern Aleutian Archipelago, has been shown to be one such biogeographic break. At Samalga Pass, species of cold-water corals, zooplankton, fish, marine mammals, and seabirds have been shown either to reach their distribution limits or exhibit dietary differences that reflect changes in predators' prey communities. While past studies have focused on offshore communities, what remains unclear is if Samalga Pass serves as a biogeographic break for other marine communities. This study compared kelp forest community structure across Samalga Pass. We surveyed kelp forest communities across the pass and collected data on fish, invertebrate and macroalgal species' abundance, biomass, and percent cover using SCUBA. We determined that Samalga Pass does indeed represent a biogeographic break for kelp forest communities along the Aleutian Archipelago and may demark the western extent of several ecologically important species.

Projecting Effects of Climate-Driven Changes in Organic Matter Supply on Benthic Food Webs in the Northern Bering Sea

James Lovvorn
Southern Illinois University, lovvorn@siu.edu
Christopher North
University of Wyoming, cnorth@uwyo.edu
Jason Kolts
Metropolitan State University of Denver, jkolts@msudenver.edu
Jacqueline Grebmeier
University of Maryland, jgrebmei@umces.edu
Lee Cooper
University of Maryland, cooper@umces.edu
Xuehua Cui
University of Tennessee, cuixuehua@gmail.com

Climate-driven changes in seasonal sea ice are expected to affect the timing, magnitude, and fate of phytoplankton production. Production may be increased by longer ice-free periods, or decreased by reduced stratification of the water column without freshwater input from melting ice. Benthic deposit-feeders may experience changes in organic matter (OM) supply owing to altered phytoplankton production, increased zooplankton grazing, or redistribution of settling phytodetritus. Where most benthic taxa subsist on a longer-term pool of sediment OM and bacteria, communities may be partially buffered against varied inputs of phytodetritus. We used network models of benthic food webs in three sectors of the northern Bering Sea to simulate effects of changes in OM supply. In the models, sediment OM content, which integrates longer-term inputs of microalgae, was gradually reduced or increased over 10 y to the lowest or highest levels observed among sampling stations. In both samples and model predictions, decreased sediment OM was linked to quite variable declines among trophic groups with effective loss of some taxa, primarily demersal fish. Increased sediment OM was coupled with moderate to dramatic increases of different taxa, sometimes with lagged peaks and declines of prey and predators. In the models, meiofauna, protists, and bacteria responded quickly while macrofauna exhibited 2-y delays, suggesting short-term but limited buffering by the sediment OM pool. Our results indicate that climate-related changes in phytodetrital inputs can lead to important shifts in benthic biomass, community structure, and functional diversity, with loss of various common taxa.

Saildrone 2016: Simultaneously Measuring the Environment, Fishes and Marine Mammals in the Bering Sea

Edward Cokelet
NOAA Pacific Marine Environmental Laboratory, edward.d.cokelet@noaa.gov
Heather Tabisola
NOAA Pacific Marine Environmental Laboratory, heather.tabisola@noaa.gov
Richard Jenkins
Saildrone Inc., richard@saildrone.com
Noah Lawrence-Slavas
NOAA Pacific Marine Environmental Laboratory, noah.lawrence-slavas@noaa.gov
Christian Meinig
NOAA Pacific Marine Environmental Laboratory, christian.meinig@noaa.gov
Alex De Robertis
NOAA Alaska Fisheries Science Center, alex.DeRobertis@noaa.gov
Ivar Wangen
Kongsberg Maritime AS/Simrad, ivar.wangen@simrad.com
Carey Kuhn
NOAA Alaska Fisheries Science Center, carey.kuhn@noaa.gov
Jessica Crance
NOAA Alaska Fisheries Science Center, jessica.crance@noaa.gov
Calvin Mordy
NOAA Pacific Marine Environmental Laboratory, calvin.w.mordy@noaa.gov
Phyllis Stabeno
NOAA Pacific Marine Environmental Laboratory, phyllis.stabeno@noaa.gov
Jessica Cross
NOAA Pacific Marine Environmental Laboratory, jessica.cross@noaa.gov

A Saildrone is a sail- and solar-powered unmanned surface vehicle (USV) developed by Saildrone Inc. in conjunction with NOAA/PMEL to make remote, season-long meteorological and oceanographic measurements at sea. It sails autonomously between user-controlled waypoints and transmits data ashore via satellite. In 2015, two Saildrones operated in the Bering Sea equipped with PAR, wind speed and direction, humidity, barometric pressure, air and water temperature, sea-surface salinity, dissolved oxygen, chlorophyll *a* and CDOM sensors, proving the capability of the vehicle to both survive and collect high-quality data in this environment. In 2016, we expanded the Saildrone's sensor suite and conducted a multi-mission cruise to make oceanographic, fisheries and marine-mammal measurements. Two Saildrones sailed out of Dutch Harbor, AK, in May 2016 and returned 101 days later, each having traveled ~6000 km, crisscrossing the eastern Bering Sea middle and outer shelf between 54˚N and 59˚N. NOAA, Saildrone Inc. and Kongsberg Maritime AS collaborated to integrate new, low-power, scientific fisheries echosounders into the vehicles. These operated almost continuously during the deployment, including two days of comparative measurements with NOAAS *Oscar Dyson*. The Saildrones also visited NOAA long-term

mooring M2 for data-quality checks. The echosounder measurements will be used to evaluate the feasibility of measuring fish abundance from an autonomous sailing vessel and to study fur-seal prey. Northern fur seals are heavily depleted in the Bering Sea and rely on walleye pollock for their primary prey. The Saildrones examined how variations in pollock availability influenced fur-seal behavior and foraging success at sea. The Saildrones mapped pollock distribution and abundance in fur-seal foraging areas while we simultaneously tracked the behavior of 30 satellite-tagged, adult female fur seals. A small autonomous acoustic recorder – an Acousonde – mounted on the keel of each Saildrone monitored for the presence of critically endangered North Pacific right whales. These instruments recorded continuously up to 3.5 kHz and will detect the vocalizations of most marine mammals in the Bering Sea. This mission demonstrated the capability of the Saildrone vehicle as an ecosystem research tool that has the potential to contribute to informed management and conservation decisions in the Bering Sea.

Comparing the Ecological Roles of Jellyfish in the Eastern Bering Sea and Other North Pacific Coastal Ecosystems

James Ruzicka
Oregon State University, jim.ruzicka@oregonstate.edu
Kristin Cieciel
NOAA Alaska Fisheries Science Center, kristin.cieciel@noaa.gov
Mary Beth Decker
Yale University, marybeth.decker@yale.edu
Richard Brodeur
NOAA Northwest Fisheries Science Center, rick.brodeur@noaa.gov

Scyphozoan jellyfish have several characteristics that place them in a potentially influential position for structuring energy flow through pelagic food webs, in that they have high rates of growth and reproduction, broad planktivorous diets, and few predators. Within the Eastern Bering Sea (EBS), the abundance of the dominant scyphozoan jellyfish, *Chrysaora melanaster*, has fluctuated widely over recent decades, and we hypothesize that so too has their impact upon the EBS ecosystem. In our NPRB-funded project, we are examining the role of jellyfish as ecosystem structuring agents through the development and application of end-to-end ecosystem models. We have updated an established ECOPATH food web model for the EBS with recent Alaska Fisheries Science Center RACE groundfish and BASIS pelagic survey observations and re-expressed the model within a physically-coupled, end-to-end format (ECOTRAN). The model is used to estimate rates of energy transfer to between functional groups via direct and indirect paths and to simulate the consequences throughout the ecosystem of changes to any part of the trophic structure. We are also applying similar models to the Coastal Gulf of Alaska (CGoA) and Northern California Current (NCC) to compare the roles of jellyfish within other North Pacific systems. Jellyfish can place a large demand upon ecosystem production. In the mid-shelf EBS ecosystem, we estimate that 4% of total ecosystem production is required to support the *Chrysaora* population. This is roughly 20-fold more energy than is used by forage fish within the EBS ecosystem. In the NCC, *Chrysaora* are similarly supported by 3% of the total ecosystem production; but in the CGoA, where jellyfish are less abundant, only 0.1% of the total ecosystem production is used by this group. In ecosystems where jellyfish are abundant, model simulations show the consequences of interannual variability in *Chrysaora* abundance. In the NCC, high jellyfish abundance has negative consequences for juvenile salmon survival and subsequent adult returns. In the EBS, models representing high (2009-2014) and low (2004-2008) jellyfish regimes show how productivity among mid and upper trophic level groups is inversely related to jellyfish abundance.

their key information needs and create new links to local observers and proposal partners. The presentation will be followed by a workshop on Friday open to all that will offer a forum for more detailed and integrative conversations to prioritize science needs. Our presentation is also linked to a set of four posters that synthesize information related to Marine, Coastal, Food Security and Community Stability that were developed with input from our workshop participants.

Improving Synthesis and Communication of Climate Impacts on Coastal Environments in Western Alaska

Amy Holman
NOAA Alaska Region, amy.holman@noaa.gov
Aaron Poe
Aleutian and Bering Sea Islands Landscape Conservation Cooperative, aaron_poe@fws.gov
Heather Stewart
Agnew::Beck, hstewart@agnewbeck.com
Karen Murphy
Western Alaska Landscape Conservation Cooperative, karen_a_murphy@fws.gov
Joel Reynolds
Western Alaska Landscape Conservation Cooperative, joel_reynolds@fws.gov
Jeremy Littell
Alaska Climate Science Center, jlittell@usgs.gov
Chris Beck
Agnew::Beck, chris@agnewbeck.com
Karen Pletnikoff
Aleutian Pribilof Islands Association, karenp@apiai.org

Coastlines provide some of Alaska's most life-filled environments. From shallow near shore waters, into tidelands, beaches and sandbars, bays and estuaries, deltas and uplands, this narrow slice of Alaska supports a disproportionately large percentage of our state's fish, bird and wildlife. This same area is also the location of the largest share of Alaska's communities and the qualities that make these coastlines so environmentally rich – the meeting of land and ocean – make these areas particularly vulnerable to the effects of climate change. One of the deliverables from the series of Promoting Coastal Resilience and Adaptation in Alaska workshops are a series of four outreach posters. They are meant to convey the current understanding and concerns of the local residents to decision-makers at the state and federal levels. This poster, the second in a set of four, synthesizes current information on the region's coastal environments, including estuaries, river systems and bluff and rocky coastlines, and key expected climate impacts on those systems. The poster targets non-specialist audiences, including western Alaska communities and local, regional, state, and national legislators. While the posters have been vetted and improved through four workshops in coastal hub communities (Nome, Kotzebue, King Salmon, and Unalaska), now we are asking AMSS participants to review and help refine the poster before final production. Come provide your perspective and learn more about these efforts promoting Coastal Resilience and Community Adaptation in western Alaska, jointly hosted by the Aleutian Pribilof Islands Association and the Aleutian Bering Sea Islands, Arctic, North Pacific, and Western Alaska Landscape Conservation Cooperatives.

Identifying Adaptation Strategies for Future Changes in Western Alaska's Coastal Environments

Karen Murphy
Western Alaska Landscape Conservation Cooperative, karen_a_murphy@fws.gov
Amy Holman
NOAA Alaska Region, amy.holman@noaa.gov
Karen Pletnikoff
Aleutian Pribilof Islands Association, karenp@apiai.org
Jeremy Littell
Alaska Climate Science Center, jlittell@usgs.gov
Heather Stewart
Agnew::Beck, hstewart@agnewbeck.com
Davin Holen
Alaska Sea Grant, dlholen@alaska.edu

Alaska's coastlines are changing rapidly though the drivers of change differ across the state. Coastal erosion, sea level rise, storm patterns, changes in land elevation, and thawing permafrost are important factors to understand when addressing local change. What adaptation strategies are already in place to help communities and resource managers adapt to change? One of the deliverables from the series of Promoting Coastal Resilience and Adaptation in Alaska workshops are a series of four outreach posters. They are meant to convey the current understanding and concerns of the local residents to decision-makers at the state and federal levels. This poster, the third in a set of four, synthesizes current information about the drivers of coastal change, the data needs that limit adaptation planning, and identifies possible adaptation strategies. The poster targets non-specialist audiences, including western Alaska communities and local, regional, state, and national legislators. While the posters were vetted and improved through four workshops in coastal hub communities (Nome, Kotzebue, King Salmon, and Unalaska), now we are asking AMSS participants to review and help refine the poster before final production. Come provide your perspective and learn more about these efforts promoting Coastal Resilience and Community Adaptation in western Alaska, jointly hosted by the Aleutian Pribilof Islands Association and the Aleutian Bering Sea Islands, Arctic, North Pacific, and Western Alaska Landscape Conservation Cooperatives.

People, Culture, Food Security, Possible Impacts and Adaptation Responses to Coastal Change in Western Alaska

Davin Holen
Alaska Sea Grant, dlholen@alaska.edu
Karen Pletnikoff
Aleutian Pribilof Islands Association, karenp@apiai.org
Karen Murphy
Western Alaska Landscape Conservation Cooperative, karen_a_murphy@fws.gov
Chris Beck
Agnew::Beck, Chris@agnewbeck.com
Aaron Poe
Aleutian and Bering Sea Islands Landscape Conservation Cooperative, Aaron_Poe@fws.gov

The diverse plants, animals and ecosystems are at the heart of the way of life in western Alaska. Climate change is altering the landscapes and water of western Alaska. Some changes are clearly negative; others, such as new game entering the region, may be positive. It is likely that these changes will continue and intensify and create new challenges and opportunities for the region. Alaska's people are incredibly adaptive and will find a way forward through these changes. To do so they will need to engage scientists and policy makers. One of the deliverables from the series of Promoting Coastal Resilience and Adaptation in Alaska workshops are a series of four outreach posters. They are meant to convey the current understanding and concerns of the local residents to decision-makers at the state and federal levels. This poster, the final in a set of four, describes how climate change is affecting people of the region. The poster targets non-specialist audiences, including western Alaska communities and local, regional, state, and national legislators. While the posters were vetted and improved through four workshops in coastal hub communities (Nome, Kotzebue, King Salmon, and Unalaska), now we are asking AMSS participants to review and help refine the poster before final production. Come provide your perspective and learn more about these efforts promoting Coastal Resilience and Community Adaptation in western Alaska, jointly hosted by the Aleutian Pribilof Islands Association, Alaska Sea Grant and the Aleutian Bering Sea Islands, Arctic, North Pacific, and Western Alaska Landscape Conservation Cooperatives.

A Qualitative Modeling Approach to Assess the Impact of Management Actions and Environmental Changes on Pribilof Island Blue King Crab (*Paralithodes platypus*)

Patrick McDonald
University of Washigton, psean@uw.edu
David Armstrong
University of Washigton, davearm@uw.edu
Janet Armstrong
University of Washigton, janeta@uw.edu
Kirstin Holsman
NOAA National Marine Fisheries Service, kirstin.holsman@noaa.gov
William Long
NOAA National Marine Fisheries Service, chris.long@noaa.gov
Jonathan Reum
NOAA National Marine Fisheries Service, Jonathan.reum@noaa.gov

The Pribilof Island blue king crab (*Paralithodes platypus*) stock, closed in 1998 and declared overfished in 2002, is the only overfished Alaskan stock. Despite no directed fishing, the stock has not improved since 2002. The reasons for the decline and lack of recovery are unknown. Our recently initiated project combines information from published studies, recovered data, and stakeholder input to develop qualitative network models (QNM) that can be used to help: 1) evaluate the strength of interacting climate, biological, and human-mediated drivers on historical decline; 2) identify management tools likely to promote stock recovery; and 3) understand how the stock and associated ecosystem might respond to perturbations, such as climate change. The models represent mathematically formalized conceptual modeling approach for linking changes in blue king crab to key ecological and environmental variables. The QNM framework will allow us to make qualitative predictions regard stock responses to potential management actions and environmental changes. The results will yield information for prioritizing data needs in future quantitative investigations. Moreover, QNM can incorporate stakeholder input and Local Ecological Knowledge (LEK), and we will engage a variety of groups in workshops to develop models, test scenarios, and evaluate outcomes. In addition to QNM results, the work will enhance ocean literacy through targeted education and outreach activities, including development of K-12 classroom education materials and senior undergraduate thesis research and training. An overview of the project is presented to solicit interested parties to contribute information and expertise to the nascent effort.

Adventures in a New Arctic frontier: Investigating the Tidal-Driven 'Winter Holes' and 'Summer Gardens' of the Kitikmeot Marine Region of the Canadian Arctic Archipelago

Seth Danielson
University of Alaska Fairbanks, sldanielson@alaska.edu
William Williams
DFO-IOS Canada, bill.Williams@dfo-mpo.gc.ca
Bodil Bluhm
The Arctic University of Norway, bodil.bluhm@uit.no
Kristina Brown
Woods Hole Oceanographic Institution, kbrown@whoi.edu
Eddy Carmack
DFO-IOS Canada, Eddy.Carmack@dfo-mpo.gc.ca
Chris Clarke
DFO-IOS Canada, Christopher.Clarke@dfo-mpo.gc.ca
Lina Rotermund
DFO-IOS Canada, Lina.Rotermund@dal.ca
Adrian Schimnowski
Arctic Research Foundation, adrian@arcticresearchfoundation.ca
Oksana Schimnowski
Polar Knowledge Canada, oksana.schimnowski@polar.gc.ca

We report preliminary results from an August 2016 expedition to the Kitikmeot Marine Region –which includes Coronation Gulf, Bathurst Inlet, Queen Maude Gulf and Chantry Inlet in the southern Canadian Arctic Archipelago - aboard the 20m RV Martin Bergmann.

The Kitikmeot Marine Region is unique in the pan-Arctic system because of its massive freshwater input relative to the area’s size, and for the shallow bounding sills to the north and west (≤30m deep). These conditions maintain an estuarine-like circulation wherein surface inflowing freshwater mixes with the deep inflowing salty oceanic waters. Strong stratification generally restricts vertical mixing and the upward fluxes of dissolved nutrients. The resulting low annual primary productivity affects the entire food web, and we speculate that this is why the region supports char and seals as top predators instead of the larger polar bears and whales that are found elsewhere. However, observations by residents, and high-resolution satellite imagery, suggest that the narrow gaps and straits between the many islands of the Kitikmeot can be prone to early icebreakup, making them dangerous places for winter travel. We thus hypothesize that these ‘winter holes’ are caused by upward mixing of subsurface heat, induced as tidal flow accelerates over sills and through narrow passes. Furthermore, the subsurface water is nutrient-rich, so the same upward mixing will also deliver nutrients to the euphotic zone year-round, creating local regions of enhanced biological productivity and

a patchwork of nearby benthic ‘gardens’ that contrast with the region’s overall very low productivity.

Such biological hotspots may form critical feeding sites for the higher trophic levels. Our preliminary results show that these sites are often characterized by high tidal current velocities and a predominance of hard bottom substrate with high proportions of suspension-feeding taxa such as feather stars and certain sea cucumbers. Currents slowed outside the narrows, where soft bottom became more prominent which were inhabited by deposit-feeding brittle stars and bristle worms. The next stages of sample analyses and data synthesis are expected to reveal a dynamic ecosystem, forced by the physical flow field and external inputs of nutrients and freshwater.

Arctic - Climate and Oceanography

Measuring Wave Forces in Ice Along Alaska's Coast

Mark Johnson
University of Alaska Fairbanks, majohnson@alaska.edu
Andy Mahoney
University of Alaska Fairbanks, armahoney@alaska.edu

Open ocean waves having periods of 15-20 seconds and less that propagate into the marginal ice zone are scattered by ice. Longer periods waves continue propagating in ice as low amplitude flexural-gravity waves. If they enter continuous ice they can cause flexing, heaving and, if the stresses are larger than the ice strength, fracturing of floes. Nearshore, such fracturing may lead to a “breakout” event in which landfast ice detaches from the coast. Breakout events represent a significant hazard to people or assets on the landfast ice and are considered by indigenous hunters to be one of the primary ice-associated risks.

A key project goal is improved ice safety and the potential for a predictive capability for the stresses that drive wave-induced landfast ice breakout events. To do this, our first-order objectives are to detect waves in the ice by directly measuring acceleration, wave period, and wave arrival time, and then use the data to derive wave velocity, displacement, and amplitude. We anticipate the project results will allow us to estimate the propagation direction of waves, determine characteristics of the ice, and identify where energy dissipation is focused that weakens the ice.

We are funded by the Bureau of Ocean Energy Management through the Coastal Marine Institute and seek to understand how wave properties affect ice strength, the evolution and shape of the ice edge, and ice detachment. Measuring waves in sea ice was an important part of scientific experiments in the 1970’s and 1980’s when camps were set up on drifting sea ice. We will measure wave induced ice motion using commercially available sensors. High-resolution inertial motion units (IMUs) will be built, tested, and then deployed on the landfast ice off Barrow. Each IMU includes 3-axis accelerometers, 3-axis gyroscopes, and 3-axis magnetometers. The IMUs will be deployed on the fast ice off Barrow for testing during phase one. Recent analysis of synthetic aperture radar interferometry (InSAR) data from Barrow suggests that infragravity waves may routinely propagate across the Arctic basin and that the region may be an ideal location for an ice-based infragravity wave monitoring site.

On Sea Ice Predictability in the US Arctic Regional Seas

Wei Cheng
University of Washigton, wei.cheng@noaa.gov
Edward Blanchard-Wrigglesworth
University of Washigton, ed@atmos.washington.edu
Cecilia Bitz
University of Washigton, bitz@atmos.washington.edu
Carol Ladd
NOAA Pacific Marine Environmental Laboratory, carol.ladd@noaa.gov
Phyllis Stabeno
NOAA Pacific Marine Environmental Laboratory, phyllis.stabeno@noaa.gov

This study assesses sea ice predictability in the US Arctic regional (Bering, Chukchi, and Beaufort) seas with a purpose of understanding regional differences from the pan-Arctic perspective and how predictability might change under changing climate. Lagged correlation is derived using existing output from the CESM Large Ensemble (CESM-LE), Pan-Arctic Ice Ocean Modeling and Assimilation System (PIOMAS), and NOAA Coupled Forecast System Reanalysis (CFSR) models. While qualitatively similar, quantitative differences exist in Arctic ice area lagged correlation in models with or without data assimilation. On regional scales, modeled ice area lagged correlations are strongly location- and season-dependent. Both CESM-LE and PIOMAS show that pan-Arctic ice thickness correlation's e-folding time scale is a few months to a year (depending on the initialization month), longer than that of ice area correlation. A robust feature in the CESM-LE is that the melt-to-freeze season ice area memory intensifies whereas the freeze-to-melt season memory weakens as climate warms.

Arctic - Climate and Oceanography

Development of an Autonomous Profiling Carbon Glider

Claudine Hauri
University of Alaska Fairbanks, chauri@alaska.edu
Brita Irving
University of Alaska Fairbanks, bkirving@alaska.edu
Andrew McDonnell
University of Alaska Fairbanks, amcdonnell@alaska.edu
Hank Statscewich
University of Alaska Fairbanks, hstatscewich@alaska.edu
Peter Winsor
University of Alaska Fairbanks, pwinsor@alaska.edu

The waters around Alaska are undergoing unprecedented environmental change that includes warming temperatures, extensive sea-ice losses, increases in storm frequency/magnitude, freshening, elevated rates of coastal erosion, increasing inputs of terrestrial organic matter, and ocean acidification, all of which could impact cycling of carbon in the Arctic at a fast pace. New autonomous observational capabilities are needed because traditional ship based observations are operationally expensive. They are also insufficient to provide the type of spatial and temporal coverage of dissolved CO_2 measurements required for an improved conceptual understanding and quantitative assessment of the region's carbon cycle. In a novel technological development in the observation of ocean inorganic carbon chemistry and ocean acidification, our team recently developed and integrated a customized carbon dioxide sensor with a Slocum glider. While the carbon glider is still in its development phase as we refine its capabilities, our Carbon Glider is the first to enable the autonomous mapping of CO_2 levels throughout the water column and may take inorganic carbon chemistry research to a new level.

Air-Sea CO_2 Flux along a Sub-Arctic to Arctic Transect with In-Situ Marine Boundary Layer and Seawater Measurements

Eric Klein
University of Alaska Anchorage, esklein@alaska.edu
Jeffrey Welker
University of Alaska Anchorage, jmwelker@alaska.edu

The oceanic carbon (C) cycle is an important biogeochemical connection between the hydrosphere, biosphere, and atmosphere. Impacts of rising atmospheric CO_2 on high latitude oceans include changes in productivity and acidification, but high temporal and spatial resolution patterns of CO_2 fluxes and associated $\delta^{13}C$ fractionation in the marine boundary layer remain uncertain. To help better articulate the marine C cycle, we present continuous, *in-situ* coupled oceanic and atmospheric data collected during summer sub-Arctic (Gulf of Alaska, Bering Sea) and Arctic (Chukchi Sea) research cruises. In the sub-Arctic, surface seawater partial pressure (*p*CO2) had higher variability than in the Arctic and was generally undersaturated relative to atmospheric *p*CO2.These patterns correlated with higher sea surface temperatures and chlorophyll levels, both of which decreased as seawater *p*CO2 in the Arctic increased and fluctuated around equilibrium with atmospheric *p*CO2.Accompanying these trends were isotope $\delta^{13}CO_2$ data that showed increased enrichment in the sub-Arctic consistent with diurnal photosynthetic patterns. Additionally, sea ice covered Arctic waters had more enriched isotope $\delta^{13}CO_2$ values than open Arctic waters. These high resolution data provide evidence for heterogeneity in oceanic C flux and demonstrate the need for continuous measurements with mobile (ship) and place-based (buoy) devices to fully understand the existing and changing nature of the marine C cycle.

Arctic - Climate and Oceanography

Geologic Controls on Arctic Coastal Erosion

Sasha Peterson
University of Alaska Anchorage, speterson.ak@gmail.com
Tom Ravens
University of Alaska Anchorage, tmravens@alaska.edu

Arctic coastal erosion rates are high and accelerating due to climate warming. However, our understanding of the mechanisms responsible for the erosion is not well-developed. In this paper, we identify two erosion mechanisms that are affecting the high bluffs on the north coast of Alaska: (1) niche erosion / block collapse and (2) bluff face thaw / slump. Further, we identify a geological parameter - coarse sediment areal density (CSAD) – that appears to control which of these erosion mechanisms is dominant. In this project, we analyzed over 100 aerial photos of the coastal zone and attributed the erosion at those locations to either niche erosion / block collapse (NEBC) or bluff face thaw / slump (BFTS). Also, we analyzed sediment data from 22 soil cores proximal to the erosion sites (11 from NEBC sites and 11 from BFTS sites). On average, the sites subject to NEBC had a much lower coarse sediment density (45.89 g/cm2) relative to the density at the BFTS sites (175.27 g/cm2). Thus, it appears that the type and amount of sediments in the coastal bluffs has a degree of control over the erosion mechanism. In addition, we examined the average erosion rate (for the 1950-2000 period) for sites subject to the two mechanisms finding that NEBC sites had an average erosion rate of 1.696 m/yr, while the erosion rate at the BFTS sites was only 0.588 m/yr. Thus, coarse sediment aerial density not only enabled a prediction of the dominant erosion mechanism, but also the erosion rate. There is an interest in the forecasting of coastal erosion rates in the Arctic. Based on this study, we can conclude that accounting for the sediment character will enable a more reliable coastal erosion forecast.

Optimized Drifter Observations: An Efficient and Cheap Way for Operational Hindcast of the Circulation in the Chukchi Sea

Oceana Francis
University of Hawaii, oceanaf@hawaii.edu
Gleb Panteleev
University of Alaska Fairbanks, gleb@iarc.uaf.edu
Max Yaremchuk
Naval Research Laboratory, Stennis Space Center, MS, max.yaremchuk@nrlssc.navy.mil

Circulation in the Chukchi Sea has persistent northward flow due to difference in Sea Surface Height between the Arctic and Pacific Oceans. This allows drifters released in the southern part of the Chukchi Sea (e.g. in the Bering Strait) to gradually drift northward providing velocity and temperature in the surface layer every 3-6 hours. If drifters are gradually released in the Bering Strait and the Chukchi Sea near Point Hope every 7-10 days, in a matter of 1-1.5 months the drifters will be uniformly distributed along the two major pathways of the Pacific Water towards the Herald and Barrow canyons. These drifter velocity observations could be assimilated into the ocean model which will allow for operational reconstruction of the circulation of the entire Chukchi Sea. Using the 4Dvar data assimilation ocean model, we conducted a number of Observing System Simulation Experiments (OSSEs) and found that 20-30 drifters released in optimized locations allows for more accurate reconstruction in the Chukchi Sea than the assimilation of the velocities from a pair of the High Frequency Radars. This creates the prerequisite needed for developing an efficient and cheap drifter observational program using ships of opportunity with the goal of creating an operational hindcast of the circulation in the Chukchi Sea. There is also a possibility to install additional sensors (e.g. ocean color and wind) which may allow accurate analysis of the chlorophyll variations and near surface wind over the Chukchi Sea. Results of multiple OSSEs will be provided and discussed.

A Comparison of Different UASs for Applications in the Arctic

Justin Blank Sr.
Fairweather Science, justin.blank@fairweather.com
Steve Wackowski
Fairweather Science, steve.wackowski@fairweather.com

Unmanned aerial systems (UASs) have become increasingly popular across all industries for their ability to reduce risk to human safety, and cost when compared to manned aircraft. Here we compare and contrast different UASs in a variety of applications so that others may benefit from our experience. Between 2013 and 2016 three different types of unmanned aircraft were deployed (DJI Phantom, In Situ ScanEagle, and Aerovel Flexrotor) for different uses in the Arctic. UAS launch, retrieval, and overflight occurred at both terrestrial and offshore locations. In total, two Visual Line of Sight (VLOS) programs, as well as four Beyond Visual Line of Sight (BVLOS) programs, were conducted. We present details and the intended purpose of each, then evaluate the UAS's performance for that particular use. Metrics evaluated include endurance, weather tolerance, payload performance, and logistics footprint in the various Arctic environments. Also analyzed is quality of sensor data and ease of sensor integration. Each project is qualitatively evaluated on total cost compared to the amount and quality of data that were collected.

Storm Activities over the Chukchi-Beaufort Seas and Associated Surface Climate

Yang Yang
University of Alaska Fairbanks, yyang26@alaska.edu
Xiangdong Zhang
University of Alaska Fairbanks, xdz@iarc.uaf.edu
Annette Rinke
Alfred Wegener Institute for Polar and Marine Research, Annette.Rinke@awi.de

Intensification of Arctic storm activities has been observed in recent decades. Storms may not only bring extreme weather hazards to the coastal community and energy infrastructure, but also change sea ice distribution and mass balance and upper ocean hydrographic structures, which can impacts ecosystem and fisheries. In this study, we examined climatology and changes of storm activity over the Chukchi-Beaufort seas, where the largest summer sea ice retreat has occurred. The datasets we used include the Chukchi-Beaufort seas High-resolution Atmospheric Reanalysis (CBHAR) from 1979-2009 and the ensemble hindcast simulations by the regional coupled climate model HIRHAM-NAOSIM from 1979-2014. We employed a storm identification and tracking algorithm and used 6 hourly sea level pressure data to derive location, intensity, duration, and track of each storm, based on which we constructed climatology and variability of these parameters describing storm activities. The hindcast simulation results are also compared with those derived from the ERA-Interim reanalysis. The climatological seasonal cycle from these analyses demonstrates a stronger storm intensity in winter and a weaker intensity in summer over the Chukchi-Beaufort seas, consistent with that for the pan-Arctic region. Superimposed on the climatology, the storm activity exhibits large interannual variability. The storm induced surface wind and wind stress are also analyzed.

Relationships Among Sea Level, Hydrography, and Circulation in Coastal Waters near Barrow, Alaska

Stephen Okkonen
University of Alaska Fairbanks, srokkonen@alaska.edu
Todd Sformo
North Slope Borough, todd.sformo@north-slope.org

Sea level estimates derived from pressure gauges deployed in Elson Lagoon near Barrow, Alaska along with concurrent measurements of temperature and salinity indicate that the Meade River freshet occurring in late May and early June 2015 elevated the sea ice cover in Dease Inlet by ~40 cm. The absence of corresponding sea level changes at sites in central and western Elson Lagoon, along with MODIS satellite imagery, suggest that the freshet exited the lagoon primarily through the eastern barrier island passages and contributed to the melting and breakup of the landfast sea ice immediately seaward of these passages.

IceTrackers

Peter Winsor
University of Alaska Fairbanks, pwinsor@alaska.edu
Jeremy Kasper
University of Alaska Fairbanks, jlkasper@alaska.edu
Andrew Mahoney
University of Alaska Fairbanks, armahoney@alaska.edu
Andy Sybrandy
Pacific Gyre, Inc., asybrandy@pacificgyre.com

Twenty prototype satellite-telemetered GPS buoys (IceTrackers) were deployed in winter 2015 along the northern Alaska coast. The units are manufactured by Pacific Gyre, Inc. For the first deployment, two pentagonal clusters of buoys were deployed on pack ice by helicopter in the Beaufort Sea between 20 and 80 km offshore. The second set was a cluster of 5 IceTrackers deployed in Harrison Bay on the central Beaufort Sea coast by snowmachine. The five remaining buoys were deployed by local residents on prominent ridges embedded in the landfast ice within 16 km of Barrow in order to track the fate of such features after they detached from the coast. The ruggedized buoys were designed as low-cost sensors for tracking small scale sea ice motion. The technology is rapidly deployable and long-lived and thus well suited for marking oiled ice in the event of a pipeline rupture or other contaminant spill. In addition, the comparatively low cost, means deploying the sensors *en masse* for studies of ice dynamics is possible including by local environmental observers. The sampling rate of the trackers is adjustable via satellite to allow for adaptive sampling and/or battery preservation; one drifter has continuously reported its position for well over a year. The most recent iteration of the trackers includes an accelerometer to aid in distinguishing whether the trackers are on ice or in the water; thus the trackers may be suitable for determining the approximate date and time of freezeup or breakup of the ice cover. Overall, the trackers have proven to be a robust, low-cost and reliable platform for tracking ice motion at small scales. With rapid environmental and socio-economic change in the Arctic, understanding the complexity of nearshore ice motion is increasingly important for predicting future changes in the ice and the tracking ice-related hazards including contaminants entrained in ice. This work demonstrates the ability of low-cost easily-deployable IceTrackers to generate to generate data of both scientific and operational value.

Optical Instrumentation and Image Analysis as a Means of Studying Particle Types

Rachel Lekanoff
University of Alaska Fairbanks, lekanoff.r@gmail.com
Jessica Pretty
University of Alaska Fairbanks, jlpretty@alaska.edu
Andrew McDonnell
University of Alaska Fairbanks, amcdonnell@alaska.edu

Types of particles in the Beaufort and Chukchi Seas were studied using optical instrumentation. In situ images of particles collected from an Underwater Vision Profiler (UVP) allowed for direct study of particles in the water column. This study characterized particle type in a marine polar environment. Samples were collected in July and August 2016 during the Chukchi Borderlands Cruise in the Chukchi and Beaufort Seas.

Observations of Horizontal Density Structure in the Northeast Chukchi Sea

Hank Statscewich
University of Alaska Fairbanks, hank.stats@alaska.edu
Tom Weingartner
University of Alaska Fairbanks, tjweingartner@alaska.edu
Peter Winsor
University of Alaska Fairbanks, pwinsor@alaska.edu
Cayman Irving
University of Alaska Fairbanks, cayman.irvine@gmail.com
Rachel Potter
University of Alaska Fairbanks, rapotter@alaska.edu

Shipboard themosalinograph (TSG) and towed vehicle CTD data are compared through sections, isopycnal spatial series, and wave number spectra to investigate the spatial variability of horizontal density structure in the Northeastern Chukchi Sea. These data, collected in the late summers of 2012 - 2014, reveal a strongly stratified water column. Over the northern portions of the shelf this is a consequence of fresh, cold meltwaters in the upper 15 m and saline, near-freezing winter waters below 25 m depth. South of about 71.5°N, the stratification is slightly weaker and deeper and a consequence of the northward advection of warm, moderately saline Bering Sea Summer waters at the surface and winter waters at depth. The strong stratification prevalent throughout the region is evident even across Hanna Shoal. Near the Shoal much small scale variability is observed in temperature and salinity within the surface layer, with this variability occurring over spatial scales that range in size from 1 to 10 km. These meltwater fronts and/or small eddies are confined to the surface mixed layer and are thus capable of affecting the surface circulation. Features such as these are frequently observed in two-dimensional surface circulation maps produced by high frequency radars located at the coast. Near Hanna Shoal the surface thermohaline spectra are very energetic with a k^{-2} slope between 0.2 – 20 km wavelength. In contrast, the transects farther south have substantially lower energy spectra at these short wavelengths and exhibit a spectral slope of k^{-3}. These differences imply that quasi-geostrophic mesoscale motions dominate south of Hanna Shoal, whereas both mesoscale and sub-mesocale motions occur over Hanna Shoal. These spatial differences will have a profound impact on upper ocean dispersive properties that will affect the spread of dissolved and suspended materials including plankton, fish larvae, and contaminants. We hypothesize that the large mesoscale and sub-mesoscale variability over Hanna Shoal is associated with meltwater pools, whose size is dependent upon the ice floe distribution in summer and the instability associated with meltwater fronts.

Year-To-Year Comparison of Ice-Keel Occurrences, and Ice and Open-Water Timing from Chukchi Sea Ice Draft Data near Icy Cape, Alaska

Margaret Sullivan
University of Washigton, peggy.sullivan@noaa.gov
Phyllis Stabeno
NOAA Pacific Marine Environmental Laboratory, phyllis.stabeno@noaa.gov
Sigrid Salo
NOAA Pacific Marine Environmental Laboratory, sigrid.a.salo@noaa.gov

Ice profiler data from upward-looking sonar were collected at locations on the Chukchi Sea shelf off-shore of Icy Cape, Alaska. In this annual ice region, ice conditions are driven by currents, wind forcing, solar insolation and ice advection from further north in the Arctic. We look at preliminary ice-draft data over multiple years in order to assess the presence of seasonal ice cover, of open water periods, and of year-to-year variation. Seasonal transitions between ice-cover and open water are analyzed for patterns and correlations to dynamic environmental conditions. We quantify frequency, duration and depth of ice keels, and compare to surface conditions provided by satellite and other available data.

Ice and Physical Oceanographic Observations in the Chukchi and Beaufort Seas 2008-2016

Todd Mudge
ASL Environmental Sciences Inc., tmudge@aslenv.com
Thomas Weingartner
University of Alaska Fairbanks, tjweingartner@alaska.edu

Long-term measurements of sea ice draft and current measurement began with initial deployments of upward looking sonars (ULS) moorings for Shell began back in 2005 in the Beaufort Sea. These were further augmented by 2008 deployments in the Chukchi Sea by Shell, ConocoPhillips and Statoil through collaboration with Olgoonik Fairweather. The final recovery of ULS moorings is scheduled for November 2016 in collaboration with Department of Fisheries and Oceans Canada. ULS moorings are usually a pairing of an Acoustic Doppler Current Profiler (ADCP) that measures water currents and ice velocity, an Ice Profiling Sonar (IPS) that provides high resolution ice draft data and a Conductivity Temperature Depth sensor to measure sound speed and density of the water.

As previously reported at AMSS, this long term data set has providing insights into the evolving ice conditions of the Chukchi Sea. While seasonal ice trends tend to be consistent from year to year, the ice breakup event of 2013 was captured by the moorings. There was some indication that the moorings in the Chukchi observed early indicators of the event that affected much of the pack ice in the Beaufort Sea.

With Shell’s discontinuation of its Chukchi Sea exploration plan, the five remaining ULS moorings in the Chukchi Sea will be recovered for their final time in 2016. This leaves the data from 2014-2015 and 2015-2016 as yet unprocessed. Some data is quite unique, such as the near coastal site with ADCP powered by 9 lithium battery packs with the intent to measure turbulence under the ice. Other data from Crackerjack and Burger will potentially be contiguous from 2008 to 2016. ASL in collaboration with UAF will have a preliminary investigation and presentation of these exceptional oceanographic and ice data sets.

Physiological Effects of Oil, Dispersed Oil and Dispersants on a Sentinel Cold Water Species, the Bay Mussel

Katrina Counihan
Alaska SeaLife Center, katrinac@alaskasealife.org

Oil and gas drilling have been occurring in Alaska since the 1950s, and offshore drilling is expected to increase as regions in the Arctic become ice-free. As petroleum development increases so does the risk of another oil spill. Oil spills can have a devastating effect on the marine environment and chemical dispersants are supposed to mitigate that effect. However, the majority of toxicity testing with dispersed oil or dispersants alone has primarily been conducted at temperate conditions, with species that do not inhabit Arctic and subarctic regions, or with dispersants that are not approved for use in Alaska. Therefore, the project with the following objectives was conducted: 1. Conduct spiked exposure tests with bay mussels in seawater with oil, Corexit 9500 or oil dispersed with different concentrations of Corexit 9500; 2. Assess various physiological responses of bay mussels to the oil, dispersant and dispersed oil in the spiked exposure tests at different time points; 3. Determine the polycyclic aromatic hydrocarbon content of the oil and dispersed oil treatments used in the mussel exposures. Bay mussel mortality was monitored in each treatment during the exposure experiments. Physiological responses were assessed using biomarkers, which are measurable biological processes that indicate exposure to environmental stressors. Contaminants, such as oil and dispersants, have multiple effects on organisms, so various biomarker assays were used including: RNA:DNA ratio, heat-shock protein levels, P450 activity, superoxide dismutase activity and micronuclei presence. The goal of this project was to develop a monitoring tool to assess recovery of coastal ecosystems using bay mussels in the event of an oil spill. Bay mussels are ideal for monitoring programs because they are ubiquitous, sessile organisms that bioaccumulate pollutants through filter-feeding. They would also be easily sampled for cost-effective monitoring programs in the case of an oil spill.

Mesozooplankton Abundance and Distribution in Association with Hydrography on Hanna Shoal, NE Chukchi Sea, during August 2012 and 2013.

Carin Ashjian
Woods Hole Oceanographic Institution, cashjian@whoi.edu
Robert Campbell
University of Rhode Island, rgcampbell@whoi.edu
Celia Gelfman
University of Rhode Island, cegelfman@uri.edu
Philip Alatalo
Woods Hole Oceanographic Institution, palatalo@whoi.edu
Stephen Elliott
Woods Hole Oceanographic Institution, stephenmelliott@gmail.com

Hanna Shoal, in the northeastern Chukchi Sea, is potentially vulnerable to ecosystem disruption under ongoing climate change, however aspects of its ecology, particularly of its zooplankton, have been poorly understood. Mesozooplankton distribution, taxonomic composition, and abundance were described from across Hanna Shoal in August 2012 and 2013 as part of the multidisciplinary COMIDA Hanna Shoal Program. Meroplankton were an important component of the zooplankton and meroplankton taxonomic composition differed between the eastern and western portions of the Shoal and between years. Regions identified on the basis of different taxonomic composition were associated with different water masses and current pathways. The northeast corner of the Shoal in particular was distinct from the crest of the shoal and from Barrow Canyon. Bering Sea Summer water, and intrinsic plankton, was observed in the southwest portion of the Shoal. Two haplotype groups of the copepod *Calanus glacialis* were differentiated using mtCOI genetic analysis and were associated with Arctic vs. Bering Sea water masses. Comparison of plankton abundances with historic and recent studies demonstrated that abundances of the copepod *C. glacialis* appear to be increasing on the time scale of decades, potentially through increased input from the northern Bering Sea.

Functional Diversity of Epibenthic Shelf Communities in the Chukchi Sea Using Biological Trait Analysis

Lauren Sutton
University of Alaska Fairbanks, lsutton7@alaska.edu
Katrin Iken
University of Alaska Fairbanks, kbiken@alaska.edu

The Chukchi Sea experiences many climate change related stresses including increased sea-ice melt, warming waters from the North Pacific, and the invasion of temperate species. Effects of these stresses will directly impact the functionality of benthic shelf communities that support bottom-up food web structures in the Western Arctic Region. There is a pressing need to better understand how these communities are currently distributed and how they might change in response to these stresses. Therefore, this study compares the functional diversity of epibenthic communities along the Chukchi Sea shelf using Biological Trait Analysis (BTA). BTA assigns functional traits to species based on their life history, morphology and behavior, identifying their function and role in a specific environment. BTA brings a new perspective to functional ecology and focuses on similarities within communities as opposed to differences in taxon composition. Here, we present preliminary BTA data for only the mollusk component of the epibenthic community collected in 2015 at ten stations on the northern Chukchi sea shelf. Fuzzy coding analysis is used to quantify and categorize biological traits of collected specimens such as weight, body size, body form and fragility. Other traits (e.g., adult life span, reproductive strategy, trophic level) are obtained from literature searches as well as a developing Pan-arctic database of benthic organism biological traits. The research presented here is part of a larger study using BTA to compare functional diversity of shelf communities of the Chukchi Sea and the eastern Beaufort Sea shelf.

Composition of Suspended Particulate Matter in Artic Nearshore Habitats

Katrina Abel
Florida International University, kabel002@fiu.edu
Mark Barton
Florida International University, Mbart034@fiu.edu
Kevin Boswell
Florida International University, kevin.boswell@fiu.edu

With climate change-induced sea-ice reduction occurring rapidly in the Arctic, these ecosystems have become a focal point not only for environmental researchers, but also for oil and gas exploration, shipping and tourism industries. Estuaries are known to be important nurseries and foraging grounds for a multitude of fish, seabirds and marine mammal species in lower latitude systems. Though we presume that Arctic estuaries provide similar ecosystem services as well as an important resource for local subsistence villages, little is known about these ecosystems and how they may be affected by climate change. Although much has been learned about Artic nearshore environments, little is known about the dynamics of resources at the base of the foodweb in these systems. By focusing on Suspended Particulate Matter we will be able to identify different patterns in basal resources available to planktivores and detritivores in their respective habitats, and establish a comprehensive baseline to assess future impacts on these ecosystems. Since these small organisms and particles are likely to be affected most rapidly in the event of a disturbance, their responses may be crucial indicators of how the rest of the foodweb can be affected. Collection was done in the summer months between July – August for six weeks in 2014. Particles in water samples from three different nearshore habitats in Barrow, Alaska were sorted and identified to the lowest taxonomic level. Clear differences in particulate organic matter between lagoon and coastal sites suggest that basal resources differ spatiotemporally in Arctic nearshore foodwebs. We suggest that these patterns can be explained by a number of environmental factors and physical processes that occur in these types of habitats. It is important that we gain an understanding of the current dynamics of basal resources so that we can compare these to future patterns and properly identify significant changes.

Zooplankton Communities of the Chukchi Sea during August 2015: Results from the Arctic Marine Biodiversity Observing Network

Caitlin Smoot
University of Alaska Fairbanks, casmoot@alaska.edu
Russell Hopcroft
University of Alaska Fairbanks, rrhopcroft@alaska.edu

Long-term observations of zooplankton in the Chukchi Sea are generally lacking. Observations by the Arctic Marine Biodiversity Observing Network (AMBON) in the northeastern Chukchi Sea during 2015 extend surveys spanning 2008-14 from the Chukchi Sea Environmental Studies Program (CSESP). These programs collect zooplankton with identical methodology of a vertically hauled twin 60-cm net fitted with 150 µm nets. Within the 2015 AMBON survey, we observed 68 species of zooplankton with a mean abundance of 6030 ind. m^{-3} and biomass of 110 mg DW m^{-3}. These values are at the upper range of those observed during CSESP. Copepods dominated the community numerically, on average contributing 60% of total abundance, mainly composed of three taxa: *Oithona similis*, *Pseudocalanus* spp., and *Calanus glacialis*. Meroplanktonic categories were also important contributors to overall abundance, on average contributing 15% of total abundance. Multivariate analyses showed six distinct community groups; this structure was strongly associated with mean water column temperature and salinity. These patterns are also consistent with those observed in CSESP; that zooplankton communities in the Chukchi Sea are closely linked to underlying hydrographic properties. The AMBON project provides an important opportunity to continue observations allowing inter-annual comparisons of summer zooplankton communities within the context of the complex hydrography of the Chukchi Sea.

A Comparison of Biomarker Approaches to Investigate Sea Ice Algal Production Consumption by Arctic Benthic Invertebrates

Tanja Schollmeier
University of Alaska Fairbanks, tschollmeier@alaska.edu
Katrin Iken
University of Alaska Fairbanks, kbiken@alaska.edu
Matthew Wooller
University of Alaska Fairbanks, mjwooller@alaska.edu
Simon Belt
University of Plymouth, sbelt@plymouth.ac.uk

The ongoing reduction of seasonal sea ice coverage in the Arctic Chukchi and Beaufort seas due to climate changes is projected to dramatically change the proportions of ice associated particulate organic matter (iPOM) and pelagic particulate organic matter (pPOM). With an expected shift to more pelagically-derived primary production, changes in timing, amount and quality of the organic matter reaching the benthos are anticipated. Many benthic organisms on the Chukchi and Beaufort Sea shelves are thought to rely on the early-season food pulse currently provided by sea ice algae. We aim to analyze the contribution of iPOM to benthic invertebrates using two biomarkers in select benthic invertebrates. First, we use compound specific stable carbon isotope analysis of three fatty acids (FAs), 16:4(n-1), 16:1(n-7) and 20:5(n-3), which are considered to be indicative of diatoms that are especially abundant in iPOM. Second, we use the highly branched isoprenoid IP_{25} (ice proxy with a 25 carbon chain length) that is specifically associated with select Arctic sea ice algae but is not found in adjacent open water phytoplankton. Here we present the first results from the comparison of FA and IP_{25} analyses in select benthic consumers. The greater source specificity of IP_{25} for iPOM could provide a much-needed second line of evidence and corroborate and refine results based on FAs used to infer sea ice algal consumption by benthic consumers in the Arctic.

Identifying the Sources of Amino Acids to Benthic Invertebrates Across the Chukchi Sea Shelf Using Compound Specific Stable Isotope Analyses

Ann-Christine Zinkann
University of Alaska Fairbanks, azinkann@alaska.edu
Katrin Iken
University of Alaska Fairbanks, kbiken@alaska.edu
Diane O'Brien
University of Alaska Fairbanks, dmobrien@alaska.edu
Matthew Wooller
University of Alaska Fairbanks, mjwooller@alaska.edu

Ongoing changes in the Arctic marine system necessitate a better understanding of organic matter pathways in marine food webs, especially the role of microbially-derived carbon. A specific focus of this project is to assess the role of microbially-derived carbon to benthic organisms belonging to different feeding types (suspension-, surface deposit-, subsurface deposit-feeder and predator/scavenger) using amino acid specific stable isotopes ($\delta^{13}C_{AA}$). Approximately half of the amino acids are essential, meaning they cannot be synthesized *de novo* by heterotrophic organisms and have to be incorporated through the organism's diet. Essential amino acids from different primary producers (plants, marine algae, seagrass, fungi, and microbes) have distinct patterns of carbon stable isotope ratios that are conserved in consumers with little isotopic fractionation. Here we use variations in $\delta^{13}C_{EAA}$ values to determine carbon sourcing in eight benthic invertebrate species belonging to the above-mentioned four feeding types across the Chukchi Sea shelf. Preliminary results indicate exploitation of different amino acid sources in the target species. $\delta^{13}C_{AA}$ variation within each species is relatively small for both non-essential and essential amino acids, indicating consistent utilization of amino acid sources within a species. However, $\delta^{13}C_{AA}$ values across species presenting different feeding types differ in some of the essential amino acids, suggesting exploration of different sources.

A Metaproteomic Analysis of Polar Marine Bacteria to Assess Community Function during the Early Stages of Particulate Organic Matter Degradation at 0°C

Molly Mikan
Old Dominion University, mmika003@odu.edu
Emma Timmins-Schiffman
University of Washigton, emmats@u.washington.edu
Brook Nunn
University of Washigton, brookh@uw.edu
Rodger Harvey
Old Dominion University, rharvey@odu.edu

Phylogenetic patterns and metabolic responses of two natural, cold water bacterial communities were measured during the early degradation of algal-derived particulate organic matter (POM). A comparative shotgun metaproteomic approach was employed by using high-mass accuracy tandem mass spectrometry. Ocean water was collected from the surface of the Bering Strait (BSt) and bottom waters of the Chukchi Sea and filtered to isolate microorganisms below 1.0 µm in size. The water was incubated in the dark at 0 ºC and amended with POM > 5.0 µm from the BSt Chlorophyll maximum. The shipboard incubations lasted 10 days.

1,200 – 2,400 proteins were identified per sample from the BSt, with 90+% of proteins belonging to three bacterial classes (Alphaproteobacteria, Gammaproteobacteria and Flavobacteria). 'Information, storage and processing', 'Transporter' and 'Metabolism' protein categories were consistently most abundant during the incubation. At Day 1, a 65% increase was measured within 'Information storage and processing', primarily due to a doubling in the protein subgroup 'Translation, ribosomal structure and biogenesis'. Each of the three main bacterial classes was responsible for this increase, with Flavobacterial proteins representing the most prominent increase (+225%).

By Day 10, 'Transporters' and 'Metabolism' protein abundances increased by 50% and 100%, respectively. Within the BSt bacterial community, Flavobacteria and Gammaproteobacteria dominated outer membrane TonB-dependent transporter expression, possibly reflecting the processing of POM by these two bacterial classes by the end of the incubation experiment. Alternatively, Alphaproteobacteria dominated the expression of ATP-binding cassette and Tripartite ATP-independent periplasmic transporters, both of which are active, high affinity and solute binding transporters. These findings corroborate with previous work that suggests that Flavobacteria acts as a first-responder and degrader of algal blooms, which inadvertently supplies LMW labile sources of organic matter (OM) to other members of the community. This OM 'byproduct' can then be transported as solutes into the cell of bacteria that harness solute-binding transporters. Such a tight coupling between the bacterial classes may result in a predictable succession (i.e., Flavobacteria to Alphaproteobacteria) as OM conditions fluctuate. In addition, this study demonstrates the potential to use proteomics to link the structures and functions of natural marine bacterial communities.

A Molecular Assessment of Marine Bacterial and Protist Communities Within Two Gateways to the Arctic Ocean

Brian Ulaski
University of Alaska Fairbanks, brianulaski@gmail.com
Eric Collins
University of Alaska Fairbanks, recollins@alaska.edu

The Barents and Chukchi Seas are oceanic gateways at which Atlantic and Pacific water masses are introduced to the Arctic Ocean, respectively. The oceanographic drivers are similar between these regions (i.e., temperature, salinity, nutrient concentration and availability), but their characteristics (i.e., warm, cold, brackish, fresher, nutrient-rich, nutrient-poor) are distinguishable among Atlantic, Pacific, and Arctic water masses. Gradients of dispersion and layering of these water masses provide environmental heterogeneity. Principal component analyses have shown that salinity plays a major role in distinguishing sample sites (averages of 35.06 and 31.48 for Barents and Chukchi, respectively). Nutrient concentrations generally increased with depth, but overall the Barents Sea stations were characterized by higher nitrate (NO_3^-) concentrations. This study will assess the composition and diversity of microbial communities across these gradients within and between the Barents and Chukchi Seas. Polymerase chain reactions were employed for targeted sequencing of both the 16S (prokaryote) and 18S (eukaryote) ribosomal RNA genes. Assessment of constructed genetic sequence libraries will offer insight into relationships between different microbial species and between microbes and their environment. Without distinguishing between sample depth and location, preliminary interpretations of sequence data suggest that *Gammaproteobacteria*, *Alphaproteobacteria*, and *Flavobacteria* are the most frequent taxon. In addition to an assessment of abiotic influences, microbial members within a community will be further examined as structural drivers themselves. Analysis of the diversity and distribution of Arctic marine microbes will lay the groundwork for future studies of these tiny, yet biogeochemically paramount organisms within sensitive ecosystems to a changing climate. Accordingly, this project aims to shed light on the vast diversity of bacterial and protist communities within regions of the Arctic Ocean that are directly influenced by Atlantic and Pacific waters.

Diet and Resource Partitioning of Four Arctic Eelpout Species (Genus *Lycodes*) in the U.S. Beaufort Sea

Sarah Apsens
University of Alaska Fairbanks, sjapsens@alaska.edu
Brenda Norcross
University of Alaska Fairbanks, bnorcross@alaska.edu

Eelpouts of the genus *Lycodes* are an abundant group of demersal fishes in the U.S. Beaufort Sea. Currently eelpout diet is poorly understood. Additionally, if and how eelpouts avoid intra- and interspecific competition for resources is unknown. In this study, diets of four common Beaufort Sea eelpout species were analyzed along shelf (longitude), across shelf (depth) gradients, and with ontogeny (body length) to determine diet composition and patterns of resource partitioning. Diets were characterized using a combination of stomach contents and nitrogen and carbon stable isotope analyses. Nitrogen stable isotopes were analyzed to determine trophic level and carbon stable isotopes to elucidate basal sources of carbon in eelpout diets. Fishes were collected in the central and eastern Beaufort Sea in August and September of 2012, 2013 and 2014 as part of the U.S.-Canada Transboundary program. The four most numerous eelpout species were analyzed: Adolf's Eelpout *Lycodes adolfi,* Canadian Eelpout *L. polaris,* Archers Eelpout *L. sagittarius,* and Longear Eelpout *L. seminudus.* Prey groups Polychaeta, Amphipoda, Isopoda, Ophiuroidea, and Copepoda composed a large proportion of the diet (%W) for all four species of *Lycodes*, but proportions differed among the species examined. Intraspecific similarity in diet composition was low suggesting these fish have diverse diets even among individuals of the same species. Increase in fish total length was associated with changes in diet composition for *L. adolfi* and *L. sagittarius*, but not *L. polaris* and *L. seminudus*. *Lycodes polaris* occupied a lower trophic level than the other three eelpout species based on nitrogen stable isotope values. Despite differing across shelf distribution between *L. polaris* and the three deep-water eelpout species, carbon sources of diet were indistinguishable among the four eelpout species. This study indicated that eelpouts feed almost exclusively on benthic prey and avoid interspecific competition by occupying different habitat space and having differing diets. Ecological information on abundant Arctic fish species like eelpouts is needed for long-term ecosystem monitoring, which is especially important in light of pronounced climate changes in the Arctic and increases in human activities.

Effects of Temperature and Food Availability on the Growth, Condition, and Survival of Larval Alaskan Gadids

Brittany Koenker
Oregon State University, koenkerb@oregonstate.edu
Louise Copeman
Oregon State University, Louise.Copeman@noaa.gov
Benjamin Laurel
NOAA Alaska Fisheries Science Center, Ben.Laurel@noaa.gov

Arctic cod (*Boreogadus saida*) is an ecologically significant species in polar food webs, forming a critical link between plankton and upper trophic levels including marine mammals, seabirds, and fish. Arctic cod is uniquely adapted to occupy ice-edges, but shrinkage of sea-ice habitat could facilitate potential invasions by North Pacific gadids (e.g, walleye pollock, *Gadus chalcogrammus*). Both Arctic cod and walleye pollock co-occur in the North Bering and Chukchi Seas, but basic understanding of larval physiology is limited by widespread sea-ice cover. Laboratory experiments allow us to assess the sensitivity of these species to controlled environmental conditions which affect larval growth. Experimentally determined physiological rates can be used along with climate models to forecast species-specific responses to predicted changes in temperature and food availability. These physiological rates will largely dictate the success of species and populations in the face of climate change. In the laboratory, we directly examined larval growth, survival and energetic condition of both gadid species in response to predicted variation in temperature (-1 to 12 °C) and food availability (0.5 to 2 prey/mL). Larvae were cultured from eggs in the laboratory and two larval rearing experiments were carried out; one on first-feeding larvae and one for later stage larvae. Results indicate significantly different growth and survival responses between species across the experimental temperature range. Both first-feeding and later stage Arctic cod had higher growth potential at low temperature but survived across a narrower thermal range than walleye pollock, with extremely high mortality rates at temperatures > 5°C. Total lipids and lipid classes were measured in larvae at the end of each experimental trial. The triacylglycerol (storage lipid class) to sterol (membrane lipid class) ratio (TAG:ST) was used as an index of larval nutritional condition. Results indicated that larvae of both species were in better condition with higher prey densities across most temperatures. Collectively, these results suggest that Arctic cod larvae are more sensitive to variation in spring temperatures and prey availability than walleye pollock, and consequently, may be more vulnerable to the forecasted warming and sea ice loss at the Pacific-Arctic interface.

Marine Fish Community Structure and Habitat Associations in the Western Canadian Arctic

Andrew Majewski
Fisheries and Oceans Canada, andrew.majewski@dfo-mpo.gc.ca
Sheila Atchison
Fisheries and Oceans Canada, sheila.atchison@dfo-mpo.gc.ca
Jane Eert
Fisheries and Oceans Canada, jane.eert@dfo-mpo.gc.ca
Shannon MacPhee
Fisheries and Oceans Canada, shannon.macphee@dfo-mpo.gc.ca
Jim Reist
Fisheries and Oceans Canada, jim.reist@dfo-mpo.gc.ca

Marine fishes in the Canadian Beaufort Sea have complex interactions with habitats and prey, and occupy a pivotal position in the food web by transferring energy between lower- and upper-trophic levels, and also within and among habitats (e.g., benthic-pelagic coupling). The distributions, habitat associations, and community structure of most Beaufort Sea marine fishes, however, are unknown thus precluding effective regulatory management of emerging offshore industries in the region (e.g., hydrocarbon development, shipping, and fisheries). The present study delineates the community structure and habitat associations of offshore marine fishes in the Canadian Beaufort Sea to depths of 1000 m. The fish community was strongly depth-structured and assemblages were closely associated with vertical water mass distributions. This community analysis provides a framework to structure studies examining biological linkages (i.e., fish movements and trophic interactions) among offshore habitats, and assessments of fish stock structure. Understanding regional-scale habitat associations will also provide context to identify potentially unique habitats and fish community characteristics indicative of ecologically and biologically significant areas. Planned follow-on research will expand this work to areas of the southern Canadian Archipelago that are unstudied in this context. Information gained will support a comprehensive regional environmental assessment for the Beaufort Sea, from which the effects of anticipated development will be gauged. New data will also support current conservation initiatives in the Central Arctic Ocean through the development of new knowledge on ecological linkages of the Canada Basin to neighboring shelf systems.

Latitudinal Dependence of Body Condition, Growth Rate, and Stable Isotopes of Juvenile Capelin (*Mallotus villosus*) in the Bering and Chukchi Seas

Mark Barton
Florida International University, mbart034@fiu.edu
Kevin Boswell
Florida International University, kevin.boswell@fiu.edu
Ron Heintz
NOAA Alaska Fisheries Science Center, ron.heintz@noaa.gov
Johanna Vollenweider
NOAA Alaska Fisheries Science Center, johanna.vollenweider@noaa.gov
John Moran
NOAA Alaska Fisheries Science Center, john.moran@noaa.gov

Capelin occupy a key trophic role and have a broad latitudinal distribution in the northeastern Pacific and Arctic Oceans. Understanding their adaptation to a range of conditions is important to predicting how they will respond to climate change. To quantify the variation in body condition in different physical environments, we measured energy density, RNA/DNA ratios, carbon and nitrogen stable isotope ratios in 62 juvenile capelin along the Western Alaskan coast from Bristol Bay to Point Barrow ranging across approximately 14 degrees of latitude. Energy density correlated positively with latitude, whereas RNA/DNA (instantaneous growth index) was strongly correlated with sea surface temperature, indicating that optimal growth of capelin was achieved at ~9°C, followed by rapid decreases in RNA/DNA ratios at higher temperatures. δ13C and δ15N had strong, inverse non-linear relationships with latitude. Depletion of δ13C seen in capelin North of Bristol Bay may be related to the incorporation of allochthonous basal resources into the diets of juvenile capelin from nearby riverine inputs. Observed enrichment of δ15N North of Bristol Bay is likely to be related to incorporation of higher trophic level prey items. Given inverse relationship between $\delta^{13}C$ and $\delta^{15}N$, these prey items are likely available due to the increased diversity of basal resources from increased inputs of riverine organic material.

Environmental Drivers of Spatio-Temporal Changes in Arctic Nearshore Fish Communities

Mark Barton
Florida International University, mbart034@fiu.edu
Kevin Boswell
Florida International University, kevin.boswell@fiu.edu
Johanna Vollenweider
NOAA Alaska Fisheries Science Center, johanna.vollenweider@noaa.gov
Ron Heintz
NOAA Alaska Fisheries Science Center, ron.heintz@fiu.edu
Brenda Norcross
University of Alaska Fairbanks, bnorcross@alaska.edu
Chunyan Li
Louisiana State University, cli@lsu.edu
Nathan Lemoine
University of Richmond, nathan.lemoine@richmond.edu
Leandra Sousa
North Slope Borough, Leandra.sousa@north-slope.org

The Arctic is facing imminent threats from climate change and the anthropogenic activities that accompany it. It is important that we establish a thorough understanding of the functionality of Arctic marine ecosystems before these threats are realized so that we can properly identify future impacts or ecosystem injuries. Much work has been done in offshore regions of the Arctic Ocean, but our understanding of the role of nearshore habitats is lacking in comparison. Spatio-temporal changes in community composition may be the best indicator of ecosystem changes. However, in order to identify impacts and ecosystem injuries we must first understand the current community structure and variability associated with seasonal patterns and physicochemical factors. Using catch data collected with beach seines (n=178 hauls) during three consecutive summers (2013-15) at weekly intervals at 12 sampling stations around Point Barrow, AK, we identified distinct differences in the communities found in broad shelf coastal beaches (Beaufort Sea), narrow shelf coastal beaches (Chukchi Sea), and sheltered shallow lagoons (Elson Lagoon). Furthermore, we identified 7 major environmental, spatial and temporal factors responsible for approximately 40% of variability in community composition. This information will help streamline future monitoring efforts and aid in identifying impacts of climate change or anthropogenic activities.

Identifying Overwintering Habitat for Whitefishes in Arctic Coastal Lagoons Using Remote Sensing Techniques

Marguerite Tibbles
University of Alaska Fairbanks, mtibbles2@alaska.edu
Andy Seitz
University of Alaska Fairbanks, acseitz@alaska.edu
Trevor Haynes
Wildlife Conservation Society, thaynes9@alaska.edu
Martin Robards
Wildlife Conservation Society, mrobards@wcs.org
Tahzay Jones
National Park Service, tahzay_jones@nps.gov

The Arctic coast provides critical overwintering habitat for whitefish populations, which in turn sustain vital subsistence fisheries for many northern communities. Over one-third of Alaska's Arctic coastline is comprised of lagoons and barrier island ecosystems; nevertheless, very little is known about the overwintering habitat of whitefishes in these habitats. In efforts to better understand this critical habitat type, we will use Synthetic Aperture Radar (SAR) remote sensing techniques to identify and characterize overwintering areas for whitefishes in Arctic coastal lagoons and their associated watersheds. Specifically, we will use traditional and novel analyses of SAR imagery to identify winter liquid water in coastal freshwater drainages and brackish lagoons. We will assess changes in available overwintering habitat over time by examining a time series of historical data to locate areas that consistently have liquid water. We will complement SAR image analysis with spring field studies 2017 to determine the accuracy of SAR imagery for identifying liquid water. When liquid water is found, we will measure the water quality parameters beneath the ice to determine if the pools are viable overwintering habitat for fish. Concurrently, we will sample for fish in identified pools using hook and line and underwater video to sample for fish. This information will further our understanding of the winter distribution of overwintering habitat for whitefishes across the Arctic coast and the potential impacts of climate change on overwintering habitat. This may enhance management of whitefish habitat that support subsistence fisheries and the food security of Alaska Native communities.

Interconnectivity and Structure in Arctic Nearshore Foodwebs Around Barrow, AK

Mark Barton
Florida International University, mbart034@fiu.edu
Kevin Boswell
Florida International University, kevin.boswell@fiu.edu
Johanna Vollenweider
NOAA Alaska Fisheries Science Center, johanna.vollenweider@noaa.gov
Ron Heintz
NOAA Alaska Fisheries Science Center, ron.heintz@noaa.gov
Brenda Norcross
University of Alaska Fairbanks, bnorcross@alaska.edu
Chunyan Li
Louisiana State University, cli@lsu.edu

Arctic nearshore ecosystems contain dynamic and complex foodwebs that support populations of endangered and protected marine mammals and seabirds, as well as provide subsistence resources for local villages. As climate change continues and anthropogenic activities increase, we may expect foodweb structures to shift as the abundances of prey resources respond to new conditions. In order to predict how these resources may shift in the face of climate change, we must first understand how these foodwebs are structured across spatial and temporal scales. Stable carbon and nitrogen isotope analysis was carried out on 415 samples of 20 common species of nearshore fish and invertebrates across three common Arctic nearshore habitats surrounding Point Barrow, AK. Results indicate that species may feed differently across spatial scales and that distinct foodwebs exist between interconnected habitats. We also present evidence of relatively low trophic fractionation of nitrogen isotopes, and high trophic fractionation of carbon isotopes, and suggest that Arctic marine foodwebs may contain more trophic levels than previously thought. This could drastically alter the interpretation of trophodynamics in Arctic marine systems.

Modeling the Dispersal of Arctic Cod Early Life Stages in the Pacific Arctic Using a Biophysical Transport Model

Cathleen Vestfals
University of Alaska Fairbanks, cdvestfals@alaska.edu
Franz Mueter
University of Alaska Fairbanks, fmueter@alaska.edu
Colleen Petrik
Princeton University, cpetrik@princeton.edu
Benjamin Laurel
NOAA Alaska Fisheries Science Center, ben.laurel@noaa.gov
Janet Duffy-Anderson
NOAA Alaska Fisheries Science Center, janet.duffy-anderson@noaa.gov
Seth Danielson
University of Alaska Fairbanks, sldanielson@alaska.edu
Katherine Hedstrom
University of Alaska Fairbanks, kshedstrom@alaska.edu
Enrique Curchitser
Rutgers University, enrique@esm.rutgers.edu

Arctic cod (*Boreogadus saida*) are the most abundant and ubiquitous fish species in the Arctic marine ecosystem and serve as an important trophic link between plankton and apex predators. While our understanding of their basic biology and life history is relatively good at the species level, little is known about their life history in Alaska's Arctic. For example, their spawning locations are currently unknown and information about the distribution of their early life stages is limited. To address these critical knowledge gaps, we developed an individual-based, biophysical transport model (TRACMASS) coupled to a high-resolution ocean circulation model (PAROMS) to identify potential spawning locations and examine the connectivity between the Chukchi and Beaufort seas. Summer distributions of age-0 Arctic cod from acoustic-trawl surveys conducted in 2012 and 2013 as part of the Arctic Ecosystem Integrated Survey project (Arctic Eis) were used to initialize the particle tracking model, which was run backwards in time to infer likely origins of water masses. We then modeled growth and transport of Arctic cod early life stages from hypothesized spawning locations and ground-truthed the simulated distribution and size composition during summer to those observed during the Arctic Eis surveys. Connectivity between the Chukchi and Beaufort seas was examined by seeding the model with particles based on the observed summer distributions in 2012 and 2013, and running the model forward in time until the fish reached 45 mm, a size corresponding to the onset of migration to deeper waters. Model results indicate that there are interannual differences in transport pathways, which suggests that larval transport and connectivity are sensitive to environmental forcing. This research improves our knowledge of Arctic cod spawning habitat and provides important information about the dispersal of their early life stages. Additionally, our

findings provide a better understanding of climate change impacts on this key forage species by examining changes in their growth and dispersal under variable climate forcing.

Sizes of Fishes Consumed by Ice Seals in the Alaskan Arctic

Kelly Walker
University of Alaska Fairbanks, klwalker2@alaska.edu
Brenda Norcross
University of Alaska Fairbanks, bnorcross@alaska.edu

Climate change effects such as changing sea ice cover in the Arctic will affect the distributions of Arctic fishes and ice seals. A large component of bearded (*Erignathus barbatus*), spotted (*Phoca largha*) and ringed (*Pusa hispida*) seal diets is fish, making it important to fully understand diets of these top-level predators. Otoliths are often the only remains of fish that can be used to identify species of fishes consumed, making it impossible to physically measure and weigh individual consumed fish. Otolith length – fish length and fish length – fish weight relationships were used in this project to estimate sizes of fish consumed by bearded, spotted and ringed seals. Stomachs contents of seals harvested by northern Alaskan communities were processed by the Alaska Department of Fish and Game. Otoliths from these stomachs were used in this project to estimate lengths of fishes consumed by each seal using otolith length – fish length relationships previously developed in this project. Sizes of fish consumed were compared by seal species, age class (pup, subadult and adult), harvest location, and sex. For bearded seals, seal harvest location was the primary factor influencing sizes of consumed fishes. Bearded seals harvested near Little Diomede consumed larger Arctic Cod, Arctic Staghorn Sculpin and Shorthorn Sculpin than those harvested near Barrow. Seal age class and seal harvest location were the primary drivers influencing spotted seal fish consumption. Adult spotted seals consumed larger Saffron Cod than pups, and spotted seals harvested near Shishmaref consumed larger Arctic Cod than those harvested near Little Diomede. Seal age class was the only factor influencing fish size in ringed seal diets. Adult ringed seals consumed larger Saffron Cod than pups. With this new information, fish weight can be calculated from fish length, which will make it possible to investigate energetic requirements of ice seals. A thorough understanding of ice seal diets is needed to better understand how flexible their nutritional requirements will be in the face of increasing climate change in the Alaskan Arctic.

Estimated Abundance and Reproductive Potential of Arctic Cod (*Boreogadus saida*) in the US Chukchi Sea

Jennifer Marsh
University of Alaska Fairbanks, jmmarsh@alaska.edu
Franz Mueter
University of Alaska Fairbanks, fmueter@alaska.edu
Terrance Quinn II
University of Alaska Fairbanks, terry.quinn@alaska.edu

As the most abundant and widespread fish in the Chukchi Sea, Arctic cod (*Boreogadus saida*) is considered a keystone species linking upper and lower trophic levels and transferring energy between benthic and pelagic realms. In addition its integral role in the ecosystem, Arctic cod was identified as one of three potential target species in the 2009 Arctic Fisheries Management Plan. Currently, commercial fishing is prohibited in the US Arctic due to insufficient data to assess the sustainability of potential fisheries. To address this need, comprehensive fisheries oceanography surveys took place throughout the US Chukchi Sea during the late summers of 2012 and 2013. Arctic cod were sampled by surface trawl, bottom trawl (2012 only) and acoustic surveys. High densities of age-0 Arctic cod were observed in the northeast Chukchi Sea during both years, while older Arctic cod (age-1+) were more widely distributed throughout the survey area. We will present estimates of Arctic cod age-structure, abundance, biomass, and reproductive potential using data from the recent surveys combined with available estimates of biological parameters for Arctic cod, including those from other regions. Results indicate that the number of mature Arctic cod present in the summer are unlikely to produce the observed high abundances of age-0 Arctic cod in the US Chukchi Sea. This could imply that either mature Arctic cod migrate to the Chukchi Sea to spawn in the winter or that the age-0s are advected in from elsewhere or that we are underestimating the abundance of adult Arctic cod. Further research is needed on the origins of age-0 Arctic cod, spawning locations and early life survival.

Utilizing Otolith Microchemisty to Determine Natal Origin of Arctic Cod *Boreogadus saida* from the Chukchi and Beaufort Seas

Alyssa Frothingham
University of Alaska Fairbanks, afrothingham@alaska.edu
Brenda Norcross
University of Alaska Fairbanks, bnorcross@alaska.edu

Dramatic changes to the Arctic have highlighted the need for a greater understanding of the present Arctic ecosystem. Arctic Cod *Boreogadus saida* commonly dominate fish assemblages in the Arctic region and are closely associated with sea ice. With the strong potential of an ice-free Arctic summer in the near future, it is imperative to document the current state of Arctic marine biota such as Arctic Cod, a keystone species. Recent studies in the western Arctic indicate otolith microchemistry can assist in answering questions regarding patterns of dispersion and migration. Unlike genetic markers commonly used in identifying fish populations, trace element analysis can be useful in determining specific geographic regions utilized by fishes. For this project, otolith microchemistry was used to assess the potential for determining natal origins of age-0 Arctic Cod from the Beaufort and Chukchi Seas by comparing elemental signatures from otoliths. Elemental signatures were analyzed from the core and outer edge of otoliths using a laser ablation inductively coupled plasma mass spectrometer (LA-ICPMS). Age-0 Arctic Cod otoliths were selected from offshore sample sites in the Chukchi Sea from the 2009 Russian-American Long-term Census of the Arctic (RUSALCA) cruise and in the Eastern Beaufort Sea from the 2013 US-Canada Transboundary Fish and Lower Trophic Communities (TB-2013-US) scientific cruise. Arctic Cod otoliths were also selected from nearshore sites collected in 2015 from the Arctic Forage Fish (AFF2015) project. Results indicate otolith microchemistry can assist in answering questions regarding life history movement patterns of Arctic Cod across their US Arctic distribution. This information will provide a better understanding as to how the species will adapt to the effects of climate change and an increase in human activities such as shipping routes and oil and gas exploration.

Length-Weight-Age Relationships of Nearshore Fishes from Barrow, Alaska

Caitlin Forster
University of Alaska Fairbanks, ceforster@alaska.edu
Alyssa Frothingham
University of Alaska Fairbanks, afrothingham@alaska.edu
Kelly Walker
University of Alaska Fairbanks, klwalker2@alaska.edu
Brenda Norcross
University of Alaska Fairbanks, bnorcross@alaska.edu

The Alaskan Arctic is a dynamic and changing environment. In recent years, climate change has decreased ice cover, which in turn has led to increased ship traffic and oil and gas exploration in the region. This increase highlights the need for basic life history understanding of the fish species that utilize this region in order to fully understand the impact changes might have on Arctic fishes. Length-weight and length-at-age relationships are important indicators of fish population status. Length-weight relationships are used to determine growth patterns of a fish species that can be used to detect differences in growth between regions for a single fish species. By using length-at-age information from different regions in conjunction with length-weight relationships, we can better identify prime growth habitat for Arctic fishes. In 2013 and 2014, nearshore fish surveys were conducted near Barrow, Alaska in the Chukchi Sea, Beaufort Sea and Elson Lagoon using beach seines as part of the Arctic Coastal Ecosystem Study (ACES). Length (mm) and weight (g) measurements were taken for all fishes collected and otoliths were removed. A total of 3,271 fishes were analyzed for length-weight relationships from fourteen species (least cisco, capelin, rainbow smelt, ninespine stickleback, arctic cod, saffron cod, belligerent sculpin, *myoxocephalus* spp. sculpins, arctic alligatorfish, slender eelblenny, arctic shanny, pacific sand lance, yellowfin sole, longhead dab and arctic flounder). A total of 309 fishes had ages estimated from nine species (least cisco, capelin, rainbow smelt, arctic cod, saffron cod, belligerent sculpin, *Myoxocephalus* spp. sculpins, yellowfin sole and longhead dab). Fishes were analyzed separately by Chukchi Sea, Beaufort Sea and Elson Lagoon to determine if regional differences were present in fish populations. Results from this study will be combined with results from the 2015 continuation of the ACES project to further analyze fish population differences among regions in the Alaskan Arctic.

Fyke Net Based Fish Studies (2011-2016) in Elson Lagoon, Barrow, Alaska

Todd Sformo
North Slope Borough, todd.sformo@north-slope.org
Craig George
North Slope Borough, Craig.George@north-slope.org

Fish surveys by the North Slope Borough Department of Wildlife Management have been conducted using fyke nets in Elson Lagoon in 1996 and from 2009-2016 with goals to better understand fish phenology, diversity, relative abundance, and to establish a time series useful in evaluating trends as the result of climate change and increased industry activity in the Arctic. This study summarizes fish catches by species, length and relative abundance in North Salt Lagoon (part of Elson Lagoon in Barrow, AK) between 2011-2016. Daily Variations in temperature and salinity during the open water season characterize local fish habitat at fyke net location, while an overwintering 12 month record of temperature salinity in a main pass in Elson Lagoon characterizes the larger scale changes in water properties in the lagoon system. Of the more than 11,000 fish caught between 2011-2016, 14 species of fish were routinely caught in the fyke net. Least cisco and fourhorn sculpin made up ~85% of the catch, while Arctic flounder, rainbow smelt, saffron cod, and threespine stickleback made up another 13%. It is hoped that information from this sampling program will contribute to NRDA assessments, as needed. However, it should be noted that NRDA evaluations based on fyke net captures alone cannot represent the species and size diversity of fish in Elson Lagoon. While only 0.2% of the fyke net catch are represented by pink and chum salmon, large broad whitefish, and dolly varden, these fish are regularly caught in gill nets at the same time and same location as the fyke net. Use of different fishing methods should be integrated into overall fish monitoring program to provide accurate results for NRDA assessments.

Investigation of Natural Selection on the Mitochondrial Genome of Arctic Cod and other Arctic Cod Species

Robert Wilson
U.S. Geological Survey, Alaska Science Center, rewilson@usgs.gov
Sandra Talbot
U.S. Geological Survey, Alaska Science Center, stalbot@usgs.gov
Sarah Sosnthagen
U.S. Geological Survey, Alaska Science Center, ssonsthagen@usgs.gov
Gabriel Degange
U.S. Geological Survey, Alaska Science Center, gdegange@usgs.gov
Noel Sme
University of Alaska Fairbanks, nasme@alaska.edu
Anthony Gharrett
University of Alaska Fairbanks, ajgharrett@alaska.edu
Andrew Majewski
Fisheries and Oceans Canada, Andrew.Majewski@dfo-mpo.gc.ca
Kate Wedemeyer
Bureau of Ocean Energy Management, kate.wedemeyer@boem.gov

In high-Arctic marine ecosystems, Arctic Cod (*Boreogadus saida*) plays a pivotal role as the primary pathway through which lower trophic production transfers to other marine vertebrates. Arctic Cod has a pan-Arctic distribution, is regularly associated with sea-ice, and given their narrow range of temperature preference and tolerance, are considered an indicator species for ecosystem health. High temperature sensitivity may alter the distribution and abundance of Arctic Cod due to recent warming of Arctic waters and diminishing sea ice. Such changes in turn could indirectly alter marine community structure. Thus, an understanding of Arctic Cod population dynamics, including levels and distribution of genetic diversity, may be informative when evaluating community response to predicted and observed changes in Arctic sea ice. Genetic diversity at the mitochondrial genome has been used to describe population structure and infer past demography, but recent analyses of entire mitogenomes has detected selection at certain mtDNA genes that may complicate interpretation of population-level data. Although prior analyses of mitochondrial cytochrome b in Arctic Cod uncovered shallow but significant population differentiation between Chukchi and southern Beaufort Sea populations, our analyses from entire mitochondrial genomes in Arctic waters failed to detect significant genetic differentiation. Similarly, we found no evidence for population structure across the Bering Strait in other gadid species (Alaskan Pollock *Gadus chalcogrammus* and Saffron Cod *Eleginus gracilis*); however, the Saffron Cod Kodiak population was differentiated from other locales. Although the mitogenome plays an important role in thermal adaptation and aerobic capacity, we failed to uncover a signal of selection within Arctic Cod sampled from various depths and locales. However, comparative analyses revealed selective differences between the Arctic cod and Alaskan

Pollock mitogenomes. Therefore, selection may be occurring at the species level. We are now testing for selection on mitogenomes from two other Alaska cod species with differing responses to temperature: Polar Cod (*Arctogadus glacialis*), and Saffron Cod. These results will enhance our understanding of the interaction between Arctic Cod and other cod species with their environment and inform management plans targeting Arctic Cod in the southern Beaufort Sea.

Sea Ice Formation and Concentration Determines the Nonbreeding Movements and Distribution of Mandt's Black Guillemot: a Resident Arctic Seabird

George Divoky
Friends of Cooper Island, divoky@cooperisland.org
David Douglas
U.S. Geological Survey, ddouglas@usgs.gov
Iain Stenhouse
BioDiversity Research Institute, iain.stenhouse@briloon.org

Arctic birds are known for their highly seasonal occupation of the Arctic, arriving with the onset of summer from wintering areas as far away as the subantarctic to breed during the short Arctic summer before snow and ice again dominates the region for up to nine months of the year. We examined the movements of Mandt's Black Guillemot (*Cepphus grylle mandtii*), a diving seabird, during the nonbreeding season. To examine the movements and the seasonal importance of sea ice to the nonbreeding distribution of the species, we deployed and recovered (n=45) geolocators on individuals during 2011-2015 at Cooper Island, a breeding colony 30 km east of Point Barrow, Alaska. Guillemots moved north to the marginal ice zone (MIZ) in the Beaufort and Chukchi seas immediately after breeding, moved south to the Bering Sea during freeze-up in December, and wintered in the Bering Sea January-April, further north than any seabird. Most Black Guillemots occupied the MIZ in regions averaging 30-60% sea ice concentration, with little seasonal variation. Annual variation in the timing and extent of fall and winter distributions were correlated with temporal and spatial variation in sea ice formation and extent and all movement was facultative in nature, being dictated by the location of the MIZ. Birds left the MIZ in April to migrate from the Bering Sea to staging areas off Point Barrow in the only directed migration recorded. Birds regularly roosted on ice in all seasons averaging 5h d-1, primarily at night. By utilizing the MIZ, with its roosting opportunities and associated prey, Mandt's Black Guillemots can remain in the Arctic during winter when littoral waters are largely ice-covered. Substantial recent decreases in summer sea ice extent have affected productivity and population size of the study colony, as the species' preferred prey, Arctic Cod (*Boreogadus saida*) becomes less available in nearshore waters. Annual overwinter adult survival for the study colony has shown no trend over the last four decades, however, indicating that the species' facultative movements during the nonbreeding period allows it to find sufficient prey in the MIZ.

Scale-Dependent Correlations Between Seabird and Prey Aggregations Across Two Years in the Northern Bering and Chukchi Seas

A. Catherine Pham
Hawai'i Pacific University, apham4@my.hpu.edu
K. David Hyrenbach
Hawai'i Pacific University, khyrenbach@hpu.edu
Kathy Kuletz
U.S. Fish and Wildlfie Service, kathy_kuletz@fws.gov

At small spatial scales, seabird abundances are generally poorly correlated with the abundances of their prey. This may be in part due to the patchiness of both seabird and prey distributions which are, to some extent, driven by their behavior. For prey, schooling behavior reduces predation risk on the individual, while for an individual seabird, the likelihood of finding other foraging birds may be greater than the likelihood of finding a prey patch. Thus, seabirds tend to aggregate over a few prey patches, while other prey patches remain predator-free. Several studies have found strong concordance between seabird and prey aggregations, but the strength of correlation varies by species and spatial scale. Our goal was to test whether such scale-dependent and species-dependent patterns held in the Pacific Arctic marine system, which is uniformly shallow, is highly seasonal, and has low species diversity. We used data from the Arctic Ecosystem Integrated Survey project to examine the aggregation of seven seabird species (e.g., kittiwakes, murres, auklets, procellarids) relative to that of forage fishes and zooplankton in the northern Bering and Chukchi seas in 2012 and 2013. We used the local Moran's I statistic (I_i), and analyzed the effect of spatial scale on aggregation by calculating I_i using four different neighborhoods (defined by critical distance thresholds: 6 km, 12 km, 24 km, 48 km). We also examined interannual differences in aggregation at all four spatial scales, and the interaction between spatial scale and year. We then correlated the aggregation of each seabird species to that of their prey for each spatial scale and year. Seabird aggregation generally was lower in 2013 than in 2012, and diving species were overall more highly aggregated than surface-foraging species across years and spatial scales. The strength of correlations between seabird and prey aggregations varied by species, year, and spatial scale. However, for most species the degree of aggregation varied more between years than spatial scale. These results confirm the presence of spatial relationships between seabird and prey aggregations in the northern Bering and Chukchi seas, but these relationships vary strongly between years and species.

Assessing Bird Interactions with Vessels in the Arctic

Willow Hetrick
Fairweather Science, willow.hetrick@fairweather.com
Sioned Sitkiewicz
Fairweather Science, sioned.sitkiewicz@fairweather.com

The avian community of the northeastern Chukchi Sea contains great diversity, species richness, and populations of global significance. The goal of this data analysis is to create a comprehensive overview of bird interactions (with vessels) observed as part of the Chukchi Sea Environmental Studies Program (CSESP) on the *R/V Westward Wind* and *R/V Norseman II*, and the Anchor Retrieval Project (ARP) on the *AHTSs M/V Dino* Chouest and *M/V Ross Chouest* (there were other vessel in theater, but no bird interactions were recorded) during open water seasons from 2008-2014 and 2016, respectively. The CSESP (2008-2014) was a multidisciplinary research program in the northeastern Chukchi Sea jointly funded by ConocoPhillips Company, Shell Exploration and Production Company, and Statoil, formed to collect environmental baseline data on study areas within Chukchi Sea Lease Sale 193. The ARP (2016) was a Shell-funded project which successfully retrieved 55 anchors and associated gear from the sea floor in the Arctic. Together, these two programs resulted in a total of 11,318 hours of at-sea observation and 47 recorded seabird observations.

Factors which influence birds to interact with working vessels at sea may vary depending on several elements including weather, vessel size, migration season, anthropogenic lighting, and the physical state of the bird. The data reveal that less than one percent of total Chukchi Sea bird observations have physical interactions with the research vessel. Of the 47 recorded observations, 15 were recorded as downed birds (required human assistance to depart vessel, or deceased) or incidental landings (required no human assistance to depart vessel, generally unharmed). Bird interactions with the vessels were higher during months in the open water season with less daylight such as September and October. Inclement weather (rain, fog, overcast sky conditions) were observed to cause a higher number of interactions with the vessel, especially within pelagic species. A higher number of interactions were also observed during months of annual migration in passerines, pelagic birds, and shorebirds. This review of seabird interaction data lays an important comprehensive foundation for the evaluation of future offshore programs.

Walrus Lifestyle - What Stable Carbon and Nitrogen Isotopes in Walrus Whiskers Reveal

Michelle Dela Rosa
Rural Alaska Honors Institute, shelly_striver09@yahoo.com
Larissa Horstmann
University of Alaska Fairbanks, lara.horstmann@alaska.edu
Alexander Thornton
University of Alaska Fairbanks, aethornton@alaska.edu
Nicole Misarti
University of Alaska Fairbanks, nmisarti@alaska.edu

Pacific walruses (*Odobenus rosmarus divergens*) are tusked Arctic pinnipeds that segregate by sex after the mating season. Females move north to the Chukchi Sea, and males south to Bristol Bay and the Bering Sea. Walruses mainly eat clams, but some may eat seals, although this is a poorly understood phenomenon. In this study, we are using stable isotopes of carbon and nitrogen ($\delta^{13}C$ and $\delta^{15}N$) in walrus whiskers to reveal their feeding habits over the course of approximately 1-2 years. Walrus whiskers were provided by subsistence hunters from Savoonga and Gambell on St. Lawrence Island in 2015 and 2016. Ten whiskers (5 males and 5 females) were split lengthwise and then sequentially cut every 0.5 mm and analyzed for $\delta^{13}C$ and $\delta^{15}N$. $\delta^{15}N$ varied widely over the length of the whisker and among individuals, ranging from 10.8‰ to 16.3‰ . $\delta^{15}N$ at the base (breeding ground signature) of male whiskers indicate consumption of similar, low trophic level prey (e.g., mollusks), while $\delta^{15}N$ at the base of the female whiskers varied from 11.9‰ to 13.9‰. Some walruses showed distinct stable isotope patterns, high $\delta^{15}N$ values combined with depleted ^{13}C that are indicative of pinniped consumption, and are in contrast to walruses that are both enriched in $\delta\ ^{15}N$ and $\delta\ ^{13}C$, suggesting higher trophic level benthic prey (e.g., scavengers). While the exact timing of whisker growth remains unknown, our data depict walruses as opportunistic predators foraging in a variety of different habitats. This flexibility may award them some protection from changing food web dynamics as a result of ongoing sea ice loss.

Time Travel Through Walrus Teeth and Bones: Collagen and the Story Behind it

Zhane' Akeya
Rural Alaska Honors Institute, zsakeya@alaska.edu
Evelyn Oxereok
Rural Alaska Honors Institute, egoxereok@alaska.edu
Larissa Horstmann
University of Alaska Fairbanks, lara.horstmann@alaska.edu
Alexander Thornton
University of Alaska Fairbanks, aethornton@alaska.edu
Casey Clark
University of Alaska Fairbanks, ctclark@alaska.edu
Nicole Misarti
University of Alaska Fairbanks, nmisarti@alaska.edu

Pacific walruses (*Odobenus rosmarus divergens*) are ice-associated marine mammals that migrate between arctic and sub-arctic waters of the Bering and Chukchi Seas. The habitat of these unique pinnipeds is being threatened by rapid climate change. Walruses are an important food source for subsistence users and an essential part of this ecosystem. In this study, we used stable carbon and nitrogen isotopes ($\delta^{13}C$ and $\delta^{15}N$) in walrus tooth and bone collagen to determine if collagen from the two sources can be used interchangeably, and if walrus diet has changed over the last century. Sixteen paired sets of walrus teeth and bone spanning approximately the last 75 years (1931—2006) were provided by the University of Alaska Museum Mammal Collection. We show that in recent years, walruses have become more depleted in ^{13}C (after Suess correction), indicating that walruses have been feeding more pelagically compared with their typical benthic prey (e.g., mollusks). $\delta^{15}N$ in females increased over time, but not in male walruses. Due to differences in walrus migration patterns and summer feeding areas, sea ice loss may be affecting female diet more than it does males. Lastly, $\delta^{15}N$ in paired bone and tooth samples was correlated (P=0.01), but tooth collagen was overall more enriched in ^{15}N over bone. $\delta^{13}C$ in paired samples was more directly comparable, but variability around the 1:1 line was high, although both tissues were still significantly correlated (P<0.05). With greater numbers of samples, these correlations may become more robust, and will open up the vast inventory of archived walrus samples over several hundred years.

Demography of the Pacific Walrus (*Odobenus rosmarus divergens*) through 2015

Rebecca Taylor
U.S. Geological Survey, Alaska Science Center, rebeccataylor@usgs.gov
Mark Udevitz
U.S. Geological Survey, Alaska Science Center, mudevitz@usgs.gov
Chad Jay
U.S. Geological Survey, Alaska Science Center, cjay@usgs.gov
John Citta
Alaska Department of Fish & Game, john.citta@alaska.gov
Lori Quakenbush
Alaska Department of Fish & Game, lori.quakenbush@alaska.gov
Patrick Lemons
U.S. Fish and Wildlfie Service, patrick_lemons@fws.gov
Jonathan Snyder
U.S. Fish and Wildlfie Service, jonathan_snyder@fws.gov

The Pacific walrus (*Odobenus rosmarus divergens*) is a candidate to be listed as an endangered species under United States law, and a final decision is due in 2017. Although Taylor and Udevitz (2015) showed that the population was declining in the 1980s and 1990s, its recent status has not been determined. We extended and enhanced the Bayesian model developed by Taylor and Udevitz to assess the walrus population by combining the available information on population sizes, age structures, reproductive rates and harvests for 1974-2015. The model was based on female vital rates and allowed for density dependence in reproduction and calf survival, as well as temporally varying density independent survival rates for older age classes. Natural survival throughout the study period (exclusive of harvest mortality) was high for adults at 0.99 (95% credibility interval: 0.98, 1.0) and lower for juveniles at 0.90 (0.83, 0.97). Annual reproductive rates rose from to , neonatal calf survival rates rose from 0.36 (0.21, 0.56) to 0.65 (0.39, 0.80), and older calf survival rates rose from 0.52 (0.34, 0.67) to 0.76 (0.65, 0.89). The total (male and female) population underwent a long term decline: the 2015 population (in the last year of age structure data collection) was 42% (23%, 64%) of the size of the 1981 population (in the first year of age structure data collection). However, the decline lessened over time, and was equivocal in seven of the last twelve years of the analysis. The probability the population was still declining in 2015 was 45%.

Visual and Tagging Results from Multi-Disciplinary Marine Mammal Research Cruises in the Northern Bering, Chukchi, and Beaufort Seas Between 2010 and 2016

Amy Kennedy
NOAA Alaska Fisheries Science Center, amy.kennedy@noaa.gov
Brenda Rone
NOAA Alaska Fisheries Science Center, brenda.rone@noaa.gov
Alexandre Zerbini
NOAA Alaska Fisheries Science Center, alex.zerbini@noaa.gov
Catherine Berchok
NOAA Alaska Fisheries Science Center, catherine.berchok@noaa.gov
Phillip Clapham
NOAA Alaska Fisheries Science Center, phillip.clapham@noaa.gov

During the summers of 2010 through 2016, the Marine Mammal Lab, with funding from the Bureau of Ocean and Energy Management (BOEM), conducted 3 multi-disciplinary research projects in the northern Bering, Chukchi and Beaufort Seas: CHAOZ (Chukchi Acoustics, Oceanography and Zooplankton Study, 2010-2012), ARCWEST (Arctic Whale Ecology Study, 2013-2016) and CHAOZ-X (CHAOZ extension, 2013-2015). During these cruises, teams of 2-3 marine mammal observers conducted big-eye or hand-held binocular visual observations during daylight hours while underway. Excluding the 2016 results (which are still being processed), observers recorded 565 sightings of 1007 cetaceans and 248 sightings of 2077 pinnipeds, otters, and polar bears over nearly 6,000 nm of effort. Remarkably, in 2013, observers photographed and recorded a killer whale predation event on a gray whale calf approximately 30 nm west of Wainwright, Alaska. Gray whale satellite tagging operations were conducted opportunistically between 2012 and 2014. In August and September of 2012 and 2013, five individuals were tracked with satellite tags deployed in the Chukchi Sea for an average of 44 days (range = 12-67d). Results from switching state-space models of the telemetry data reveal area-restricted search behavior in well-known gray whale foraging habitats. One tag equipped with dive-depth sensors recorded regular dives of 55-60m during periods of area-restricted search approximately 120 nm southwest of Pt. Hope and 150 nm west of St. Lawrence Island, further underscoring the significance of these habitats for gray whale foraging. The sighting results, while opportunistic, provide additional marine mammal distribution information in an area with very little systematic vessel-based coverage. Additionally, telemetry results provide invaluable fine-scale habitat use information for gray whales in the Chukchi and northern Bering Seas.

Concentrate! - Laboratory Testing and Field use of an Oxygen Concentrator in Anesthetized Polar Bears

Maria Spriggs
SeaWorld, maria.spriggs@buschgardens.com
Todd Atwood
U.S. Geological Survey, Alaska Science Center, tatwood@usgs.gov

Oxygen supplementation can reduce the risk of anesthetic complications. Air travel with compressed oxygen cylinders may be problematic and alternative methods are needed for field anesthesia of wild animals. The SimplyGo portable oxygen concentrator (Respironics, Murrysville, Pennsylvania, USA) converts air into 87-96% oxygen at operating conditions of 5-40°C. We tested the concentrator at colder temperatures in an adjustable freezer at four intervals: -12 to -6°C (10-20°F), -18 to -12°C (0-10°F), -23 to -18°C (-10-0°F), and -29 to -23°C (-20 to -10°F). After 30 minutes, the oxygen output at 2L/minute continuous flow was measured using an oxygen monitor (MiniOx-I, MSA Medical Products, Pittsburgh, Pennsylvania, USA) every 3 minutes for 12 minutes. The unit performed within the manufacturer specifications at all temperatures, except during the first 3 minutes of the coldest interval. We suggest that the concentrator be turned on for a minimum of 3 minutes at extreme temperatures before use. We used the oxygen concentrator to provide nasal oxygen to immobilized wild polar bears (n=11) at temperatures ranging from -16 to -2°C. We measured pulse oximetry and/or arterial oxygenation on a limited number of bears immobilized with tiletamine-zolazepam (n=9) (Telazol, Fort Dodge Animal Health, Fort Dodge, Iowa, USA) and medetomidine-tiletamine-zolazepam (n=2) (medetomidine 20 mg/ml, Wildlife Pharmaceutical, Inc., Windsor, Colorado, USA) before and after receiving nasal oxygen. After 10 minutes, 87.5% (7/8) of bears had an increase in oxygenation as determined by SpO2 and 71.4% (5/7) bears had an increase in arterial O_2 determined with an i-STAT (Abbott, Princeton, New Jersey, USA) blood gas monitor. No statistical analysis was done due to the small sample sizes. Challenges encountered included keeping the batteries and unit relatively warm by stowing them in the helicopter cabin, budgeting for the weight of the concentrator, replacing batteries approximately every 30 minutes, keeping the nasal cannula in place, obtaining consistent arterial samples, and reliable operation of the i-STAT. Our results indicate that further testing of the efficacy of the oxygen concentrator in increasing oxygenation of anesthetized polar bears is warranted.

Like Pulling Teeth: Reconstructing Pacific Walrus Movements from Trace Element Concentrations in Teeth

Casey Clark
University of Alaska Fairbanks, ctclark@alaska.edu
Lara Horstmann
University of Alaska Fairbanks, lara.horstmann@alaska.edu
Nicole Misarti
University of Alaska Fairbanks, nmisarti@alaska.edu

Advances in analytical techniques have made it possible to reconstruct animal movements from biological structures that contain incremental growth layers. These structures act as biological archives, recording and storing information throughout the life of an animal. Teeth of Pacific walruses (*Odobenus rosmarus divergens*) contain an unusually large cementum layer, which is laid down seasonally in dark and light bands. Naturally occurring trace elements are included in the matrix of the cementum in concentrations that reflect those of the environment in which walruses lived and fed. Thus, by measuring these trace element concentrations, the lifetime history of the animal's movements and foraging locations can be reconstructed. The purpose of this study was to establish the relationship between trace elements and seasonal growth layers in walrus teeth, thereby allowing the reconstruction of recent and historic walrus movements. We used an Agilent 7500ce Inductively Coupled Plasma Mass Spectrometer to measure concentrations of barium, cadmium, cesium, cobalt, copper, iron, lead, manganese, molybdenum, nickel, strontium, and zinc in teeth from walruses (n = 20) taken as part of the Alaska Native subsistence harvest on St. Lawrence Island in 2014 and 2015. Variability in trace element concentrations was then related to annual growth layers to identify elements associated with seasonal movements. Male and female walruses were analyzed separately to account for differences in geographic distribution and seasonal migrations. Historic teeth collected between 1932 and 1981 (n = 32) were sampled from the University of Alaska Museum to examine if and how walrus movements changed over the past ~85 years. Future research will incorporate more historic and prehistoric specimens to examine changes in walrus movement across thousands of years and to relate these changes to climate variability.

Not All Are in Canada….Bowhead Whales (*Balaena mysticetus*) in the Western Beaufort Sea, July-August, 2012-2016

Janet Clarke
Leidos, janet.clarke@leidos.com
Megan Ferguson
NOAA Alaska Fisheries Science Center, megan.ferguson@noaa.gov
Amelia Brower
NOAA Alaska Fisheries Science Center, amelia.brower@noaa.gov
Amy Willoughby
NOAA Alaska Fisheries Science Center, amy.willoughby@noaa.gov

Aerial surveys were conducted during summer (18 July through 31 August), 2012-2016, in the western Beaufort Sea (140°W-157°W, north to 72°N) as part of the Aerial Surveys of Arctic Marine Mammals (ASAMM) project. ASAMM is funded and co-managed by BOEM, and conducted and co-managed by NOAA. Results from these surveys have expanded our knowledge of bowhead whale (*Balaena mysticetus*) distribution, relative density, and behavior in the western Beaufort Sea during summer, a season when the majority of bowhead whales were largely assumed to be feeding in the eastern Beaufort Sea. More than 65,000 km of transect effort (including circling on transect) were flown, resulting in sightings of over 1,900 bowhead whales. While every summer was unique, 2016 had the highest bowhead whale sighting rate (whales per transect kilometer; sighting rate was more than double that of any previous year), greatest percentage of sightings of feeding and milling bowhead whales (57%), and broadest distribution of bowhead whale sightings in the western Beaufort Sea. Seasonal feeding opportunities in the eastern and western Beaufort Sea are likely important drivers of bowhead whale distribution and relative density. Favorable feeding conditions for bowhead whales are variable both intra- and inter-annually, and dependent on oceanographic conditions, including upwelling events, water temperature, and freshwater river discharge. These variables are investigated using remotely-sensed data to determine potential relationships with bowhead whale distribution and density. Annual collection of data on bowhead whales, physical and biological oceanography, and anthropogenic activities in the Beaufort Sea remains essential for managing arctic resources and understanding the arctic ecosystem as it continues to undergo climate-driven changes.

Opportunistic Photo-identification of Gray Whales in the Eastern Chukchi Sea, Summer and Fall 2016

Amy Willoughby
Joint Institute for the Study of the Atmosphere and Ocean, amy.willoughby@noaa.gov
Megan Ferguson
NOAA Alaska Fisheries Science Center, megan.ferguson@noaa.gov
Janet Clarke
Leidos, janet.clarke@leidos.com
Amelia Brower
Joint Institute for the Study of the Atmosphere and Ocean, amelia.brower@noaa.gov

The eastern Chukchi Sea serves as important foraging and weaning grounds for gray whale (*Eschrichtius robustus*) cow-calf pairs of the Eastern Pacific population during summer and fall. However, it is unknown how many gray whale cow-calf pairs use the eastern Chukchi Sea in any particular year. Individual gray whales are identifiable using skin pigmentation, scarring, and mottling on the whale's body. Using photos to identify individuals could provide a way to account for intra-annual resightings of gray whales, including cow-calf pairs. This knowledge could be used to strengthen conservation, management, and response plans related to anthropogenic activities and climate change. The distribution and relative abundance of gray whales in the eastern Chukchi Sea (67°-72°N, 169°-155°W) have been documented annually from July through October since 2009 by systematic line-transect aerial surveys conducted as part of the Aerial Surveys of Arctic Marine Mammals (ASAMM) project. ASAMM is funded and co-managed by the Bureau of Ocean Energy Management and conducted and co-managed by the National Oceanic and Atmospheric Administration. In 2016, opportunistic photo-identification data were collected during ASAMM surveys. Photos of gray whales were taken while the aircraft was circling to confirm species identification, estimate group size, observe behavior, and determine whether a calf was present. Images were analyzed for July, when gray whale relative density and calf sighting rates are known to be high. Preliminary analysis of images collected in July indicates that aerial photographs of gray whales can produce identification quality images of gray whales and that calves were not resighted in the images collected. Although further sampling and analysis are needed, these preliminary data hold promise for deriving a mark-recapture estimate of gray whale cow-calf pairs in the ASAMM study area.

Clinical Findings from Stranded Ice-Dependent Arctic Seals

Caroline Goertz
Alaska SeaLife Center, carrieg@alaskasealife.org
Pam Tuomi
Alaska SeaLife Center, pamt@alaskasealife.org
Kathleen Woodie
Alaska SeaLife Center, kathyw@alaskasealife.org
Jane Belovarac
Alaska SeaLife Center, janeb@alaskasealife.org
Natalie Rouse
Alaska SeaLife Center, natalier@alaskasealife.org
Nicole Thometz
University of California, Santa Cruz, nthometz@ucsc.edu
Colleen Reichmuth
University of California, Santa Cruz, coll@ucsc.edu

Bearded (*Erignatus barbatus*), ringed (*Phoca hispida*), spotted (*Phoca largha*), and ribbon (*Histriophoca fasciata*) seals rely on seasonal sea-ice in Arctic and sub-Arctic regions. Many aspects of their biology and physiology are poorly known, and most species-typical health parameters are not available. Such information has proven difficult to obtain due to the challenges of studying Arctic seals in the wild and their minimal historic representation in aquaria. Stranded ice seals provide the unique opportunity to obtain fundamental information about physiology and health, and to follow individuals throughout their rehabilitation to better understand factors related to development and key life history events.

Animals in distress are identified to ASLC by the public and carefully assessed prior to intervention. Live seals are retrieved only if it is determined—in coordination with NOAA's National Marine Fisheries Service—that the seal would be unable to survive on its own. Upon admission to the rehabilitation program, seals receive a physical examination that includes sampling for routine diagnostic analysis and disease screening. These tests not only guide treatment of rehabilitating animals but also provide insight into disease processes active in wild populations. Dead seals undergo thorough post-mortem examination by an experienced veterinarian. All individuals are screened for fecal pathogens and for exposure to a variety of diseases known to affect marine mammals and/or humans including seal herpesvirus, phocine distemper virus, avian influenza, canine distemper virus, brucellosis and leptospirosis.

We have compiled this veterinary data for stranded Arctic seals admitted to ASLC (13 ringed seals, 11 spotted seals, 1 bearded seal, and 1 ribbon seal) in an effort to make these data readily available to scientists and wildlife managers. By providing baseline health parameters for apparently healthy seals as well as those suffering from

detectable illnesses, we hope to contribute much-needed information about these vulnerable species.

Yesterday is Gone, Tomorrow Has Not Yet Come: Compound-Specific Stable Isotopes of Polar Bear Bone Collagen over 2000 Years

Raphaela Stimmelmayr
North Slope Borough, Raphaela.Stimmelmayr@north-slope.org
Lara Horstmann
University of Alaska Fairbanks, lara.horstmann@alaska.edu
Matthew McCarthy
University of California, Santa Cruz, mdmccar@ucsc.edu

Polar bears (*Ursus maritimus*) are the internationally recognized face of Arctic climate change and sea ice related habitat loss. In Alaska, two polar bear stocks are recognized, the Southern Beaufort Sea (SBS) and the Chukchi Sea stock. The SBS stock is currently in decline, and poor body condition, reduced fecundity, and survival have all been noted. Sea ice loss, population recruitment, and increased land use by bears in response to the rapidly changing Arctic are ongoing management concerns. We analyzed bone collagen of SBS polar bears obtained from subsistence harvests (2006-2016; n=14), University of Alaska Museum (1906-1971; n=7), and archeological digs (1850BP-1180BP; n=4) for bulk stable isotopes (SI) and compound specific SI (CSI) of 12 individual amino acids (AA). $d^{15}N$ of bulk collagen did not differ among present-day, historic, and ancient bears (P=0.08), while ^{13}C was significantly depleted in modern bears compared with historic and ancient bears (P<0.0001, after Suess correction). This phenomenon has also been observed in other Arctic marine mammals, e.g., pinnipeds, and may suggest an increased sourcing of carbon from open-water phytoplankton over ice-associated primary production. $d^{15}N$ of essential “source” AA (e.g., phenylalanine that change only minimally in trophic transfer) did not differ among bears of the three gross time groupings (P=0.60) indicating that baseline $d^{15}N$ values in the Arctic food web have remained virtually unchanged. Threonine is a unique AA in its $d^{15}N$ systematics. Alone among protein AA, threonine deamination involves an enzyme system, where the catabolism leads to depletion rather than enrichment of ^{15}N. This effect is more pronounced in marine than terrestrial food webs. Interestingly, threonine was significantly enriched in ^{15}N of modern bears over historic and ancient animals (P=0.008). There could be three reasons: 1) modern bears are in better body condition than in the past; 2) the modern food web is shorter leading to less reworking of nitrogen; and 3) modern bears rely more heavily on terrestrial food webs.

Assessing Changes in Ice Seal Presence and Estimating Residency Time Near Offshore Drilling Units in the Alaskan Beaufort and Chukchi Seas

Lauren Bisson
LGL Alaska Research Associates, Inc., lbisson@lglalaska.com
Heather Patterson
LGL Alaska Research Associates, Inc., hpatterson@lglalaska.com
Darren Ireland
LGL Alaska Research Associates, Inc., direland@lglalaska.com

Understanding changes in marine mammal presence and duration of time spent near exploration drilling activities is important to effectively assess potential impacts. Recent methods to assess potential impacts to marine mammals from anthropogenic activities typically assume a maximum duration of exposure (e.g. 24-hours) and may assume some avoidance of areas exposed to sound. Recurrent sightings of naturally-marked individual seals near offshore activities can provide important information on residency times in areas exposed to anthropogenic sounds. Data collected in the Chukchi and Beaufort seas by protected species observers stationed onboard drilling units and associated support vessels in 2012 and 2015 were used to assess the occurrence, distribution, closest point of approach, and residency time of ice seals, specifically bearded seals (*Erignathus barbatus*), ringed seals (*Phoca hispida*), and spotted seals (*Phoca largha*), around project vessels. The ice seal sighting rate from drilling units was significantly higher during sound-producing activities (drilling, mudline cellar construction) than when drilling units were idle ($G=5.93$, $df=1$, $p=0.015$) and the mean closest point of approach was significantly closer during sound-producing activities (123 m) than when idle (251 m, $W=5740$, $p<0.001$). The sighting rate and mean CPA of ice seals from stationary support vessels both while idle and while engaged in sound producing activity were similar to the sighting rate and mean CPA of seals from idle drilling units. To calculate residency times of individuals around drilling units, naturally-marked bearded seals and ringed seals sighted repeatedly from drilling units were identified as unique individuals ($n=18$). The time period from initial identification to final sighting ranged from 4 to 24 days. Results indicate that ice seals may actively approach drilling units during certain sound-producing activities. Additionally, ice seal residency times based on photo-identification indicate that individuals may remain in areas exposed to drilling-related sounds for >24 hrs. Combined, these results suggest that further studies into the response of ice seals to offshore drilling activities are warranted and that some assumptions in calculating cumulative sound exposure levels should be carefully evaluated before being applied.

Ringed Seal (*Pusa hispida*) Spatial Use, Dives, and Haul-Out Behavior in the Beaufort, Chukchi, and Bering Seas (2011-2016)

Aaron Morris
North Slope Borough, amorris03@hamline.edu
Andrew Von Duyke
North Slope Borough, andrew.vonduyke@north-slope.org
David Douglas
U.S. Geological Survey, Alaska Science Center, ddouglas@usgs.gov
Jason Herreman
Alaska Department of Fish & Game, Jason.herreman@alaska.gov

Ringed seals (*Pusa hispida*) are ecologically important as upper trophic level predators, the primary prey of polar bears (*Ursus maritimus*), and as a subsistence resource for Alaska natives. Ringed seals are ice-dependent and therefore vulnerable to sea-ice loss, industrialization, and increased Arctic shipping. Rather sparse ecological data make it difficult to assess the influences of these ecological disruptions, and creates challenges for developing mitigation measures. To address this information need, we captured ringed seals (n = 37) in the Chukchi Sea near Barrow, AK and affixed Wildlife Computers Argos satellite transmitters to their back or head (SPLASH model) and to a rear flipper (SPOT model). Daily movements, diving, and haul-out data were collected in order to characterize temporal trends in their spatial ecology. Results indicate that ringed seals range extensively across the Beaufort, Chukchi, and Bering Seas. Continental shelf (<100 m) areas were important and ringed seals occupy this habitat for >60% of the time annually and upwards of 85% in the fall & early winter. During spring, ringed seals occupied the shelf-break (100-300 m) in the Bering Sea for >34% of the time, while the deep basin (>300 m) Beaufort Sea was occupied for >15% of the time during the summer. Coastal areas (<10 km from shore) were occupied from 6.6-10.9% of the time from spring to fall, but not during the winter. Dives averaged 29.4 m (σ = 26.3) in the summer, 15.2 m (σ = 12.4) in the fall, 15.3 m (σ = 2.3) in the winter, and 13.5 m (σ = 2.7) in the spring. Dive depths were bimodal in the summer, a time when several seals ventured beyond the shelf break. Sea-ice habitat varied seasonally with the least occupancy of pack-ice (1.9%) in the summer, >34% in the fall, >93% in the winter, and >62% in the spring. Wet/dry sensor data indicated that haul-out times peak in April & May, and are lowest in autumn and during winter daylight hours. This study provides new baseline information to serve as a guide to wildlife managers, planners, and developers.

Refining Behavioral Inferences from Satellite Tagged Spotted and Bearded Seals Using Dive and Environmental Variables

Rowenna Gryba
Stantec, rowenna.gryba@stantec.com
Brendan Kelly
International Arctic Research Center, bpkelly@alaska.edu
Francis Wiese
Stantec, francis.wiese@stantec.com

State space modelling is commonly used to infer marine mammal behavior based on movements, typically in the horizontal plane. Adding vertical movements and environmental variables might improve inferences, particularly when looking at behaviors such as area restricted search (ARS), which are typically linked to foraging, although increased complexity of these models does not necessarily result in more realistic or behaviorally meaningful results. With the increasing ability to collect more data in smaller packages, the temptation is to collect more data without considering its necessity. We explored the value of including dive metrics and environmental variables in Bayesian state space modelling to estimate behavior of three spotted and two bearded seals, captured near Barrow, AK, and tracked with satellite-linked transmitters that reported location, diving behavior, salinity, temperature, and chlorophyll fluorescence. Initial estimates of behavior, using only the horizontal movement, identified several areas where predictions of area restricted search (ARS) overlapped between species and within species in the Chukchi and Bering Sea. The addition of vertical movements, included as covariates that influence the probability of switching between ARS and transiting states, only marginally changed the estimated percent of time spent in each state, but did alter the spatial predictions where ARS occurred for bearded seals. Estimates of travelling behaviour could be distinguished from areas of ARS by the ratio of dive duration to maximal depth but not dive shape, as indicated by the time-allocated-at-depth metric. Increased model complexity refined results or differed from simpler models, sometimes only marginally, but revealed interesting relationships and the need to consider the types of data collected.

Seals of the Okhotsk Sea: Migrations and Ecology as Context for Comparison with Bering Sea Populations

Maria Solovyeva
A.N. Severtsov Institute of Ecology and Evolution, solovjova.m@gmail.com
Dmitriy Glazov
A.N. Severtsov Institute of Ecology and Evolution, dglazov@yandex.ru
Daria Kuznetsova
A.N. Severtsov Institute of Ecology and Evolution, datakuz@mail.ru
Vladimir Burkanov
NOAA Alaska Fisheries Science Center, vburkanov@gmail.com
Peter Boveng
NOAA Alaska Fisheries Science Center, peter.boveng@noaa.gov
Josh London
NOAA Alaska Fisheries Science Center, josh.london@noaa.gov
Vyacheslav Rozhnov
A.N. Severtsov Institute of Ecology and Evolution, rozhnov.v@gmail.com

In 2011-2014, we tagged 29 seals of three species (8 bearded, 16 spotted and 5 ringed) in three regions of the Okhotsk Sea: Ptichiy Island, the mouth of the Bolshaya River (west coast of Kamchatka), and Chkalova Island (Sakhalin Bay). We tracked individual seals from 10 to 269 days to investigate migration routes and connections between summer feeding areas and winter breeding areas. During winter, spotted seals from Kamchatka used the northwestern Sea of Okhotsk; seals from Sakhalin Bay – went to Tatar strait. Bearded seals chose only the nearest breeding area, over the continental shelf near northern and northwestern Sakhalin Island, and didn't use other well-known breeding areas in the Okhotsk and Japan seas. Ringed seals from Sakhalin Bay spent the winter around Sakhalin Island.

All seals used mostly shallow water (about 20 m) until the ice formation. Then, spotted and ringed seals immediately went into deeper water. Bearded seals occupied only shallow waters until ice pushed them from the coast (but not deeper than 200 m). During winter, ringed seals preferred first-year ice of 30-200 cm thickness (more than 40% of locations in January and 60% in February). From January to April, almost all locations of bearded seals were on ice while the proportion of first-year ice (30-200 cm) increased with each month. In March, when the breeding season started, more than 80% of locations were recorded on thick annual and closely packed (9-10 tenths cover) ice. Spotted seals from January to May preferred first-year ice (46-90% of locations). During winter the most locations (62-95%) were in dense ice (9-10 tenths). Seals rarely used ice of 2-6 tenths cover, as they tend not to lie on separate floes. The thickness of the ice cover was the most significant factor for the all species (48.8% variance explained for ringed, 62% for spotted and 60% for bearded). Water depth was important only for bearded seals (27% variance explained). Seal populations in the Sea of Okhotsk

are distinct from their counterparts in the Bering Sea, and this information is important for comparative studies about foraging ecology and responses to climate warming.

Subarctic Cetacean Occurrence in the Eastern Chukchi Sea, Summer and Fall 2016

Amelia Brower
Joint Institute for the Study of the Atmosphere and Ocean, amelia.brower@noaa.gov
Janet Clarke
Leidos, janet.clarke@leidos.com
Megan Ferguson
NOAA Fisheries, megan.ferguson@noaa.gov
Amy Willoughby
Joint Institute for the Study of the Atmosphere and Ocean, amy.willoughby@noaa.gov

Cetacean occurrence in the Chukchi Sea is seasonal and primarily dependent on sea ice retreat and prey occurrence in spring through fall. Fin whales (*Balaenoptera physalus*), humpback whales (*Megaptera novaeangliae*), minke whales (*Balaenoptera acutorostrata*), harbor porpoise (*Phocoena phocoena*), and killer whales (*Orcinus orca*), although often found in polar waters elsewhere, are not common in the eastern Chukchi Sea, and for the purpose of this study are referred to as "subarctic" species. These species have been sighted with increasing frequency in the Chukchi Sea in recent years. In summer and fall 2016, all five subarctic species were sighted in the eastern Chukchi Sea (67°-72°N and 157°-169°W) by the Aerial Surveys for Arctic Marine Mammals (ASAMM) project. ASAMM line transect surveys in 2016 were conducted from July through October by NOAA Fisheries and funded and co-managed by the Bureau of Ocean Energy Management. The majority of subarctic cetacean sightings occurred in the south-central Chukchi Sea, 67°-69°N and 166°-169°W, except for killer whales, which were sighted in the northeastern Chukchi Sea, 69°-72°N and 157°-169°W. In the south-central Chukchi Sea, fin, humpback, and minke whales, and harbor porpoises, were sighted in different multi-species combinations in close proximity to each other. Fin whales were sighted in August, humpback and minke whales were sighted in August and September, harbor porpoise were sighted in July and August, and killer whales were sighted in September. The behavior recorded for most subarctic species was swimming (71%); other behaviors included resting, diving, milling, and feeding. Calves were sighted with fin, humpback, and killer whales. It is unknown whether the increased frequency of subarctic cetacean sightings in the eastern Chukchi Sea in recent years is a result of increased marine mammal survey effort, population recoveries from commercial whaling, climate change, or a combination of all three. Understanding subarctic cetacean ecology in the Arctic will likely provide insight into the effects of climate change and will allow responsible management and conservation of these cetacean stocks.

Detecting Population Structure in Bearded and Ringed Seals: Current Understanding and Future Challenges

Aimee Lang
NOAA Southwest Fisheries and Science Center, aimee.lang@noaa.gov
Lori Quakenbush
Alaska Department of Fish & Game, lori.quakenbush@alaska.gov
Heather Ziel
NOAA Alaska Fisheries Science Center, heather.ziel@noaa.gov
Kelly Robertson
NOAA Southwest Fisheries and Science Center, kelly.robertson@noaa.gov
Morgane Lauf
NOAA Southwest Fisheries and Science Center, morgane.lauf@noaa.gov
Peter Boveng
NOAA Alaska Fisheries Science Center, peter.boveng@noaa.gov

Bearded seals (*Erignathus barbatus*) and ringed seals (*Pusa hispida*) are dependent on sea ice as a platform for hauling out, whelping, and molting. Concern for these species, which are important resources for Alaska Native communities, has arisen from projections of diminishing ice and snow cover in the warming Arctic, and a better understanding of stock structure in both species is needed to evaluate the risk of localized depletions. The objective of this work was to evaluate whether genetic analysis of existing tissue samples, many of which were collected during the Alaska Native harvest, could provide insight into whether spatial genetic structure exists in either species within the Pacific Arctic. Mitochondrial DNA control region (mtDNA) sequence data were generated from samples (n=188, bearded seals; n=159, ringed seals) collected during the breeding season (March through May). Both ringed and bearded seals demonstrated high mtDNA diversity ($h \geq 0.98$), with few haplotypes (11%, bearded seals; 1%, ringed seals) shared among regions. For both species, no significant differences were detected in comparisons of mtDNA sequence data obtained from seals sampled at different sites in the Bering and Chukchi Seas during the breeding season. However, significant differences were identified when a limited number of samples collected from ringed seals in the Sea of Okhotsk (*P. h. ochotensis*) were compared with those from Alaskan sites (*P. h. hispida*). Only small, insignificant differences were apparent in comparisons of data from bearded seals sampled in the Sea of Okhotsk and those sampled in the Bering and Chukchi seas. While inconclusive, these results suggest that 1) high levels of mtDNA differentiation are unlikely to exist between the sampled breeding sites within the Pacific Arctic, and 2) detecting any existing differences will require a dataset with increased power. Although dedicated sampling efforts are needed, the power to detect genetic differences can also be increased by analyzing more loci. We are currently working on a project using next generation sequencing to genotype a subset of these samples at hundreds to thousands of loci and will also report on the progress of these efforts.

Comparing Estimates of Arctic Cetacean Density Derived from Manned and Unmanned Aerial Surveys

Megan Ferguson
NOAA Alaska Fisheries Science Center, megan.ferguson@noaa.gov
Robyn Angliss
NOAA Alaska Fisheries Science Center, robyn.angliss@noaa.gov
Amy Kennedy
Joint Institute for the Study of the Atmosphere and Ocean, amy.kennedy@noaa.gov
Bob Lynch
Center for Coastal Studies, blynch@coastalstudies.org
Amy Willoughby
Joint Institute for the Study of the Atmosphere and Ocean, amy.willoughby@noaa.gov
Van Helker
NOAA Alaska Fisheries Science Center, van.helker@noaa.gov
Amelia Brower
Joint Institute for the Study of the Atmosphere and Ocean, amelia.brower@noaa.gov
Janet Clarke
Leidos, janet.clarke@leidos.com

Manned aerial surveys have been used successfully for decades to collect data to infer cetacean distribution and density. Unmanned aerial systems (UAS) have potential to augment or replace some manned aerial surveys for cetaceans in the future. To ascertain the utility of UAS for such missions, however, it is first necessary to define the specific scientific objective(s) and then compare the cost-benefit of alternative platforms and methodologies. NOAA led and conducted such a direct comparison of aerial surveys for cetaceans near Barrow, Alaska, during fall 2015 via a collaborative effort that included the Bureau of Ocean Energy Management, US Navy, North Slope Borough Department of Wildlife Management, and Shell. We conducted a three-way comparison among visual observations made by human marine mammal observers aboard a Turbo Commander operated by Clearwater Air, Inc; imagery autonomously collected by a Nikon D810 camera system mounted on the belly of the Turbo Commander; and imagery collected by a similar camera system on a remotely-controlled ScanEagle operated by the Naval Surface Warfare Center Dahlgren Division. The platforms each conducted five flights within a 16,800 km^2 study area. Surveys from manned and unmanned platforms did not directly overlap geographically and temporally to maintain safety of flight; the two platforms operated as close as safely possible. The Turbo Commander collected 44,849 images in 26.7 flight hours. The ScanEagle collected 24,600 images in 21.8 flight hours. Manual image processing and analysis by marine mammal photo analysts required 332.5 total hours, averaging 6.9 hours to analyze one flight hour, which involved reviewing 30% of the images taken in flight. In total, eight bowhead whales (*Balaena mysticetus*) and 14 belugas (*Delphinapterus leucas*) were identified in the images from the Turbo Commander.

Fifteen bowhead whales, four belugas, and three gray whales (*Eschrichtius robustus*) were identified in the UAS images. Sixty-one bowhead whales, 54 belugas, nine gray whales, and 48 unidentified cetaceans were sighted by the marine mammal observers aboard the Turbo Commander. Resulting density estimates and associated coefficients of variation, logistical requirements, and costs of the three survey methods are discussed.

Arctic - Mammals

Marine Mammal Distribution and Habitat in the Eastern Chukchi Sea During 2015 and 2016 Observed from a Slocum Ocean Glider

Mark Baumgartner
Woods Hole Oceanographic Institution, mbaumgartner@whoi.edu
Kathleen Stafford
University of Washigton, stafford@apl.washington.edu
Brita Irving
University of Alaska Fairbanks, bkirving@alaska.edu
Hank Statscewich
University of Alaska Fairbanks, hstatscewich@alaska.edu
Peter Winsor
University of Alaska Fairbanks, pwinsor@alaska.edu

The Arctic is home to a diverse group of marine mammals that are highly adapted to survive in difficult environmental conditions, but basic information about the oceanographic processes and features that govern marine mammal distribution is sorely lacking. The Arctic poses particular challenges to at-sea marine mammal research that hinder our efforts to study the relationship between animal distribution and oceanographic conditions, including notoriously poor weather and underdeveloped port facilities. To address these challenges, we have developed the capability to simultaneously monitor marine mammal occurrence (via passive acoustics) and oceanographic conditions with autonomous Slocum ocean gliders. During the summers of 2015 and 2016, we deployed a single Slocum glider in the southern Chukchi Sea just north of the Bering Strait during July. Using an onshore-offshore zigzag track, the glider surveyed past Kotzebue (Cape Krusenstern), Point Hope, Cape Lisburne, Point Lay, Icy Cape, and Wainwright. The glider surveyed 1070 km over 59 days during 2015, and 1471 km over 86 days during 2016. The glider observed strong variability in temperature, salinity, and current speed associated with the Alaska Coastal Current (inshore) and the more quiescent Bering Sea water (offshore). Strong northerly winds caused 4 ACC reversals during 2016 compared to only 1 in 2015. Marine mammals were detected in both real-time and after review of archived recordings from the glider. Analyses of these data will focus on changes in species community composition with location (north/south Chukchi Sea) and water mass, as well as associations between species occurrence and fronts. We plan to repeat this survey annually for the foreseeable future to investigate trends in occurrence and distribution of Chukchi Sea marine mammals that coincide with changes in oceanographic conditions.

Automated Detection of Wildlife in Aerial Digital Imagery: A Case Study of Arctic Marine Mammals

Kathleen Leonard
LGL Alaska Research Associates, Inc., kleonard@lglalaska.com
Darren Ireland
LGL Alaska Research Associates, Inc., direland@lgl.com
Gregory Schaefer
Brainlike Inc., gregoryschaefer@brainlike.com
Grant Mercer
Brainlike Inc., grantmercer@brainlike.com
Robert Jannarone
Brainlike Inc., bobjannarone@brainlike.com
Ciani Sparks
Brainlike Inc., cianisparks@brainlike.com
Heather Patterson
LGL Alaska Research Associates, Inc., hpatterson@lglalaska.com
William Koski
LGL Alaska Research Associates, Inc., bkoski@lgl.com
A. Michael Macrander
Shell Exploration & Production Company, a.macrander@shell.com
Koen Broker
Shell Exploration & Production Company, Koen.Broker@shell.com

Emerging technologies like unmanned aerial systems (UAS) and digital sensors promise to deliver large quantities of useful data in novel ways. However, traditional manual methods of reviewing sizable amounts of data can be very time consuming and eliminate any potential cost savings gained through the use of new technologies. We developed automated detection software to reduce the time required to manually review aerial digital imagery from marine mammal surveys and provide near real-time results for making operational decisions. Data were collected using high-resolution digital single lens reflex (DSLR) cameras installed in the belly ports of twin-engine high-wing aircraft conducting line-transect surveys of marine mammal distribution and abundance near offshore drilling operations in the Chukchi and Beaufort seas, Alaska. Approximately 200,000 images were manually reviewed by a team of analysts over a period of 18 months, and a sample of the marine mammal sightings recorded were used to develop and refine automated detection software. A series of templates in various sizes and orientations were designed to detect the characteristic sizes, shapes, and features of large whales. For walrus, the software was designed to detect the visual and RGB value contrast between the distinct brown hue of the animals and the surrounding environment of water and/or ice. The automated detection software processed an image by scanning for, flagging, and extracting areas within each image that contained potential whale and walrus. A survey of images was thereby triaged into a series of

extracted image "chips" for manual review by an analyst. Automated detection processing significantly reduced (by over 95%) analysis effort from 50 person days to 2 person days for an average survey. Additionally, the software correctly identified 85% of large whale sightings and 69% of walrus sightings. Such results suggest a comparable alternative to standard visual observations while continuing to advance the transition towards utilizing UAS.

Assessing Disturbance Responses of Marine Mammals to Vessel Presence in the Bering, Chukchi, and Beaufort Seas

Sasha McFarland
Fairweather Science, sasha.mcfarland@fairweather.com
Sheyna Wisdom
Fairweather Science, sheyna.wisdom@fairweather.com
Willow Hetrick
Fairweather Science, willow.hetrick@fairweather.com

Many marine mammal species are seasonally present in the Alaskan Arctic where interest in oil and gas has been prevalent, and where, with the reduction in sea ice, shipping traffic is increasing. These species include Pacific walruses (*Odobenus rosmarus*) and polar bears (*Ursus maritimus*), and species of subsistence importance, such as bowhead (*Balaena mysticetus*) and beluga (*Delphinapterus leucas*) whales, and Arctic pinnipeds. Marine mammal disturbance reactions to vessel presence and distance at which such reactions occur is not well understood, but is information that may be useful for management purposes. We recorded marine mammal behavioral response data during vessel-based marine mammal line-transect surveys during summer and fall from 2009-2014 as part of the Chukchi Sea Environmental Studies Program, and during anchor handling operations in 2016. We analyzed behavioral responses for 5,378 marine mammal sightings by individual species, and by grouped data for all cetaceans and all pinnipeds. We used linear mixed-effects models, followed by post-hoc multiple-comparisons-of-means to compare distances at which four behavior responses occurred: no reaction (NO), looking at the vessel (LO), changing direction/speed (CD), and diving (DI). Covariates in the model included year, geographical area, Beaufort sea state, vessel from which the sighting occurred, and whether the sighting occurred in the water or on ice. There were no significant differences between distances at which marine mammals exhibited CD and DI reactions; however most other comparisons between NO, LO, and CD/DI revealed significant differences in distance of occurrence. The two most energetic behavior responses, CD and DI, occurred closest to the vessels for pinnipeds (including walruses), followed by polar bears, and then cetaceans. There was no significant difference between the distances of LO and NO in polar bears, but sample size was small. 75% of walruses exhibiting CD/DI reactions were <450 m of the vessels, and LO were <600 m from the vessels. Additional studies on marine mammal behaviors in relation to vessel proximity, as well as dedicated documentation of marine mammals during vessels' transits would contribute to an improved understanding of marine mammal responses to vessel traffic.

The Effects of Sea Ice Loss on Protein and Fat Stores of Food-Deprived Polar Bears

John Whiteman
University of Wyoming, jwhitema@uwyo.edu
Seth Newsome
University of New Mexico, newsome@unm.edu
Merav Ben-David
University of Wyoming, bendavid@uwyo.edu

In some regions of the Arctic, sea ice decline and the resulting loss of foraging opportunities have been associated with recent reductions in polar bear abundance, survival, and reproduction. It is often assumed that during food deprivation lipid reserves (e.g., adipose fat) are the limiting factor to polar bear survival, and the role of protein reserves (e.g., skeletal muscle) is often under appreciated. Structural tissues require a constant input of amino acids for maintenance; to provide these amino acids, fasting bears catabolize endogenous protein, potentially at a greater rate than endogenous lipid. Recent studies with captive vertebrates demonstrated that when feeding, animals may use carbon derived from dietary lipids to synthesize proteins used to build structural tissue. We hypothesize that fasting polar bears use a similar process to transfer carbon from stored adipose fat to stored protein. To test this hypothesis, we are using amino acid carbon isotope (^{13}C) analysis, and archived samples from a previous study of nutritional ecology in the Southern Beaufort Sea, to track carbon flux between protein-rich (red blood cells, serum, skeletal muscle) and lipid-rich (adipose) tissues in individual, free-ranging polar bears that exhibit a spectrum of body condition and feeding status. Our preliminary data suggest that a portion of the non-essential amino acids in red blood cells of fasting polar bears were newly synthesized with carbon that had been transferred from endogenous adipose tissue. If carbon movement between lipid and protein is substantial, it will change our understanding of polar bear fasting physiology and endurance, influencing forecasts of how this species will respond to continued ice loss.

Arctic - Mammals

Changes in Ice Seal and Pacific Walrus Sighting Rates from Vessels Supporting Petroleum Exploration Activities in the Alaskan Arctic

Heather M Patterson
LGL Alaska Research Associates, Inc., hpatterson@lglalaska.com
Lauren N Bisson
LGL Alaska Research Associates, Inc., lbisson@lglalaska.com
Darren S Ireland
LGL Alaska Research Associates, Inc., direland@lgl.com

Activities associated with offshore oil and gas exploration produce various types of underwater sound that are commonly categorized as pulsed (e.g., seismic surveys) or continuous (e.g., use of dynamic positioning thrusters). Results from monitoring programs during previous exploration activities in the Alaskan Arctic suggest that pinnipeds are not likely to show strong avoidance reactions to pulsed or continuous sounds. Large and small scale avoidance of pinnipeds to drilling and related activities have not been studied extensively.

Data were collected in the Alaskan Chukchi and Beaufort seas by protected species observers (PSOs) stationed onboard seismic source and monitoring vessels in 2006–2011 and 2013, and drilling units and support vessels in 2012 and 2015. For each sighting, PSOs recorded species, closest point of approach, observable reaction of animal, as well as seismic status or operational activity at the time of the sighting. During seismic periods, the ice seal sighting rate was higher from monitoring vessels than from source vessels ($G=34.98$, $df=1$, $p<0.001$). Seal sighting rates from both types of vessels were higher during non-seismic periods than during seismic periods ($G=741.67$, $df=1$, $p<0.001$). The sighting rate of Pacific walrus from source vessels was higher during non-seismic periods than seismic periods ($G = 14.01$, $df = 1$, $p<0.001$).

During drilling activities, fleet-wide sighting rates of pinnipeds during anchor handling and dynamic positioning scenarios were not significantly different from sighting rates during idle periods. However, when only anchor handling vessels were considered, sighting rates of seals and Pacific walrus were lower during anchor handling than during idle periods ($G=19.5$ $df=1$, $p<0.01$ for ice seals, $G=6.55$, $df=1$, $p=0.01$ for Pacific walrus). Similarly, the ice seal sighting rate was lower during dynamic positioning than during idle periods ($G=47.76$, $df=1$, $p<0.01$).

These combined results are consistent with short-range avoidance by ice seals and Pacific walrus of active seismic vessels and vessels conducting specific activities in support of drilling operations. Results showing the scale of pinniped avoidance of seismic surveys, anchor handling, and dynamic positioning thruster utilization may inform impact assessments and management decisions concerning offshore exploration operations.

Spotted Seal (*Phoca largha*) Spatial Use, Dives, and Haul-Out Behavior in the Beaufort, Chukchi, and Bering Seas (2012-2016)

Aaron Morris
North Slope Borough, amorris03@hamline.edu
Andrew Von Duyke
North Slope Borough, andrew.vonduyke@north-slope.org
David Douglas
U.S. Geological Survey, Alaska Science Center, ddouglas@usgs.gov
Rowenna Gryba
Stantec, Inc., rowenna.gryba@stantec.com
Jason Herreman
Alaska Department of Fish & Game, jason.herreman@alaska.gov

Spotted seals (*Phoca largha*) are pagophilic and likely to experience biological disruptions due to declining sea-ice and increasing Arctic shipping and industrialization. The implications of such changes are difficult to assess given the generally sparse data available on ice-seals. To develop a better baseline understanding, we captured spotted seals (n = 29) in the Chukchi and Beaufort Seas near Barrow, AK. We mounted Argos satellite transmitters on each seal's back (a Wildlife Computers SPLASH model or Sea Mammal Research Unit tag) and rear flipper (WC SPOT model). Data on their daily movements, dives, and haul-out behavior were used to identify seasonal patterns in spotted seal spatial ecology. Tagged seals ranged widely from the Beaufort Sea to Bristol Bay. Though some seals were associated with coastal regions in the winter, most were pelagic. Continental shelf (<100m) occupancy ranged from a summer low of ~50%, to a winter high of >81%. Occupancy of coastal areas (<10 km from shore) dropped from summer (48%) to winter (12%), but increased again in spring (20%). Shelf break habitat (100-300 m) was sometimes occupied (7-13%) during the winter and spring, but seals were never located beyond the 300m isobath. Ice-free habitat occupancy dropped from >99% in summer to 16% in winter. Pack (>50% concentration) and marginal ice (15-50%) habitat occupancy increased during fall (30%, 13%) and winter (68%, 16%), but fell in spring (27%, 11%). Dive depths were variable all year, but depths increased from a summer mean of 17.7 m (σ = 17.2) to about 47 m in the winter and spring (σ_{win} = 34.5; σ_{spr} = 42.6). Winter and spring dive histograms were bi-modal, with shallow dives typical of nearshore seals and possibly those in transit, while deeper dives typically corresponded to bathymetry, suggesting most foraging dives were benthic. Haul-out times were variable throughout the year, but peaked in May and were the lowest during the fall and winter daytime hours. The new baseline information provided by this study will serve to guide decision-makers tasked with managing Arctic wildlife populations in an era of unprecedented climatic, economic, and social change.

Field Methods: Study of Oil and Dispersant on Mysticete Whale Baleen

Todd Sformo
North Slope Borough, todd.sformo@north-slope.org
Gary Shigenaka
NOAA Office of Response & Restoration, gary.shigenaka@noaa.gov
Michael Moore
Woods Hole Oceanographic Institution, mmoore@whoi.edu
Jason Kapit
Woods Hole Oceanographic Institution, jkapit@whoi.edu
Tom Lanagan
Woods Hole Oceanographic Institution, tlanagan@whoi.edu
Craig George
North Slope Borough, Craig.George@north-slope.org
Teri Rowles
NOAA National Marine Fisheries Service, Teri.Rowles@noaa.gov
Alexander Werth
Hampden-Sydney College, Hampden-Sydney, VA, AWerth@hsc.edu

This poster examines methods used to study effects of oil and dispersed oil on the functional characteristics of *mysticete* whale baleen. The objectives were to quantitatively assess drag in baleen (control) and to study the potential change in drag when North Slope crude oil and Corexit 9500A dispersant are introduced. To secure the baleen for movement through water in the OHMSETT tank, a lever arm was fabricated at WHOI consisting of a baleen clamp, load cell, and pivot. The baleen clamp was mounted on a turntable that has 20 different positions to allow baleen to be rotated. Two Omega load cells were used (500 and 100 lbs), and load cell and bridge speed data were recorded. Baleen from bowhead, right, and humpback whales (N=7) ranged from 0.5 to 2.7 meters in length and from 9 to 56 plates. Baleen was positioned at 90 and 54 ° orientation, and each baleen sample was run through water from 0.2 to 1.6 knots at 0.2 knot increments for a total of 127 runs. For oil treatment, we submerged baleen with a crane, and applied fresh oil to the surface within a containing hoop. The baleen was then lifted through the oil. For dispersed oil treatment, Corexit 9500A was premixed with oil and dispensed through a series of underwater nozzles.

Decadal Shifts in Autumn Migration Timing by Pacific Arctic Beluga Whales are Related to Delayed Annual Sea Ice Formation

Donna Hauser
University of Washigton, dhauser@uw.edu
Kristin Laidre
University of Washigton, klaidre@uw.edu
Kate Stafford
University of Washigton, kate2@uw.edu
Harry Stern
University of Washigton, harry@apl.washington.edu
Robert Suydam
North Slope Borough, Robert.Suydam@north-slope.org
Pierre Richard
Fisheries and Oceans Canada, richardpr@gmail.com

Migrations are often influenced by seasonal environmental gradients that are increasingly being altered by climate change. The consequences of rapid changes in Arctic sea ice have the potential to affect migrations of a number of marine species whose timing is temporally matched to seasonal sea ice cover. This topic has not been investigated for Pacific Arctic beluga whales (*Delphinapterus leucas*) that follow matrilineally-maintained autumn migrations in the waters around Alaska and Russia. For the sympatric Eastern Chukchi Sea ('Chukchi') and Eastern Beaufort Sea ('Beaufort') beluga populations, we examined changes in autumn migration timing as related to delayed regional sea ice freeze-up since the 1990s, using two independent data sources (satellite telemetry data and passive acoustics) for both populations. Comparing dates of migration between 'early' (1993-2002) and 'late' (2004-2012) tagging periods, Chukchi belugas had significantly delayed migrations (by 2 to >4 weeks, depending on location) from the Beaufort and Chukchi seas in the late period. Spatial analyses also revealed that departure from Beaufort Sea foraging regions by Chukchi whales was postponed in the late period. Chukchi beluga autumn migration timing occurred significantly later as regional sea ice freeze-up timing became later in the Beaufort, Chukchi, and Bering seas. In contrast, Beaufort belugas did not shift migration timing between periods, nor was migration timing related to freeze-up timing, other than for southward migration at the Bering Strait. Passive acoustic data from 2008-2014 provided independent and supplementary support for delayed migration from the Beaufort Sea (4 d/y) by Chukchi belugas. Here we report the first phenological study examining beluga whale migrations within the context of their rapidly transforming Pacific Arctic ecosystem, suggesting flexible responses that may enable their persistence yet also complicate predictions of how belugas may fare in a changing Arctic.

Prenatal Development of the Bowhead Whale and its Evolutionary Implications

Hans Thewissen
Ohio Medical School, thewisse@neomed.edu
Raphaela Stimmelmayr
North Slope Borough, Raphaela.Stimmelmayr@north-slope.org
Craig George
North Slope Borough, craig.george@north-slope.org
Robert Suydam
North Slope Borough, robert.suydam@north-slope.org
Gay Sheffield
University of Alaska Fairbanks School of Fisheries, gay.sheffield@alaska.edu

This study reviews and characterizes fetal developmental landmarks of bowhead whales (*Balaena mysticetus)*. The subsistence harvest of bowhead whales in Northern Alaska takes place during the Spring and Fall, and, occasionally, pregnant females are taken. Bowheads gestation is approximately 14 months, and hence, prenatal specimens collected from this harvest sample three ontogenetic periods: around 2 months, 8 months, and near full-term. These specimens elucidate morphological development that is reminiscent of the evolution of cetaceans. For instance, the tail of the smallest specimens in our collection is circular in cross-section, similar to the tail of land mammals as well the tail of ancestral whales such as *Pakicetus*. In slightly older fetuses, the tail expands laterally, and forms a diamond-shape. This is not a shape that is found in in fossil whales, where some early cetaceans, such as *Kutchicetus*, had a long, narrow, and flattened tail. Fetuses caught in fall as well as full term fetuses have a triangular fluke, similar to postnatal animals. In evolution, this shape of fluke originated approximately 45 million years ago, in the family Protocetidae. Spring caught Bowhead whale fetuses show that more than 40 tooth buds are present in each jaw. These tooth buds develop and are probably mineralized (as indicated by other baleen whales), but are then resorbed. Adults of the fossil mysticete *Aetiocetus polydentatus* had a similar numbers of teeth when it lived 35 million years ago. After the tooth buds disappear, baleen forms, and bowheads are born with baleen approximately 10 cm long. In most cetaceans, hind limb buds are formed early in ontogeny. Our early fetuses already show the presence of internal cartilaginous precursors of pelvis, femur, and tibia. In adult bowhead whales, pelvis and femur ossify, and a synovial joint occurs between them, whereas the tibia usually remains cartilaginous. Occasionally, in postnatal bowhead whales, the hind limb remnants are visible on the abdominal skin, which may show a low welt, or an aberrant pigmentation pattern. Hind limbs were fully developed in most Eocene cetaceans, and underwent a quick reduction in size and numbers of elements in the late Eocene basilosaurids.

Out of Ice and Time – PATOU, the Mummified Ice Seal

Anne Jensen
North Slope Borough, anne.jensen@uicscience.org
Aaron Morris
North Slope Borough, Amorris03@hamline.edu
Andrea Gonzalez
Tufts Conservation Medicine Masters Program, andrea.rios_gonzalez@tufts.edu
Lara Horstman
University of Alaska Fairbanks School of Fisheries, lara.horstman@alaska.edu
Raphaela Stimmelmayr
North Slope Borough, Raphaela.Stimmelmayr@north-slope.org

Mummified specimens of pinnipeds are extremely rare and have only previously been reported from the Antarctic. During the 2016 summer archeological excavation of the Walakpa site, Alaska (Walakpa-Archaeological-Salvage-Project) several mummified ringed seals were discovered in an traditional Inupiaq *Sigiuaq* [ice cellar). We report on the initial forensic necropsy findings of "Patou", as they relate to cause of death, carcass desiccation patterns, in-situ and x-ray anatomy. Laboratory diagnostic findings including carbon dating, harmful algae bio-toxins, disease agents, and stable isotope analysis are pending. Briefly, external morphology (i.e. pelt, size, shape and rings of claws, absence of a baculum) was congruent with a 5-6 year old female adult ringed seal. Whole body x-rays revealed a dense metallic body [blunt nosed bearing riffling copper jacketed 22 gage bullet] located in the neck shoulder region. Cause of death was the probable gunshot related trauma to the head (unilateral skull bone defect -right parietal occipital region). The desiccation pattern (i.e. organ size reduction and weight changes) observed differed based on tissue structure, function and water content of body tissues (i.e. body weight ~ 11kg, lung weight ~ 150 gr etc.) The chest cavity was greatly reduced in size with the diaphragm being pulled forward. Heart and lung lobes were colored dark brown to black. The lung lobes were compressed paper thin –like and an appearance like a 3-D topographic map; folds appeared to be arranged where pulmonary vessels and bronchi were situated. The abdominal plug, cigar shaped extended deeply into the chest cavity with rib impressions clearly noted on the diaphragm and liver lobes. Liver lobes were greatly reduced in size and the stomach and intestines were collapsed with an associated paper-thin mesentery. Kidney tissue was located at the proper anatomical site, however no bladder or reproductive structure were located. The mummified specimens from the Walakpa archeological site, present a unique opportunity to travel back in recent Arctic times and expand our understanding of processes of mummification under an Arctic climate, and provide important recent baseline data for life history and health aspects of an important Alaskan native ice seal subsistence species.

Non-Invasive Genetic Sampling of Polar Bears (*Ursus maritimus*) Along the Chukchi Sea Coast of Alaska

Kimberly Titus
Alaska Department of Fish & Game, kim.titus@alaska.gov
Kelly Nesvacil
Alaska Department of Fish & Game, kelly.nesvacil@alaska.gov
Andrew Von Duyke
North Slope Borough, andrew.vonduyke@north-slope.org

Estimating polar bear (*Ursus maritimus*) abundance in the Chukchi Sea is vital for setting an annual sustainable harvest quota as required under the US-Russia Bilateral Polar Bear Agreement. Remote and challenging conditions make data collection difficult and costly, and no reliable abundance estimate exists for establishing the quota. There is ongoing concern over invasive study methods among stakeholders, researchers, and agencies. Recognizing that polar bear conservation, management, and research would benefit from alternative approaches that are less costly and invasive, we adapted and assessed hair snag methods more widely used for black and brown bear genetic sampling. DNA from hair follicles can genetically identify individuals, which may be useful for estimating the number of polar bears moving by coastal communities, and to augment large datasets used for spatial mark-recapture abundance estimates. Prior to starting, we sought and received support from the Alaska Nanuuq Commission, Barrow Whaling Captains, the Alaska Eskimo Whaling Commission, coastal village community leaders, and the Scientific Working Group of the US-Russia Polar Bear Commission. With help from local hunters, we deployed 9 portable hair snare stations on shorefast ice near Barrow from 11-March to 15-May, and 10 stations near Pt. Lay from 14-April to 5-May. Stations used barb wire to snag hair and visual and scent attractants to draw in bears. Stations were checked twice per week. Poor ice conditions near Pt. Lay limited station location placement and likely negatively affected performance. Over 127 trap nights along the beach near Pt. Lay we obtained 0 polar bear hair samples and 6 brown bear samples. In Barrow, we had 22 hair capture events at single trap stations, with 45 total samples over 340 trap nights. Several hair samples were likely duplicates. Visits by bears to stations increased with nearby whaling activities. We also experimented with “bucket snags” near Barrow. This method used steel bristle pipe brushes to snag hair and collected substantially more hair per event than barb wire. Wire brushes were easier to use and had better public perception than barb wire. This project will expand in 2017 across more coastal areas with longer sampling periods.

Skull Shape and Morphometry of ~ 1800-Year-Old Alaskan Polar Bear Skull: Evidence for a New Polar Bear Subspecies?

Raphaela Stimmelmayr
North Slope Borough, Raphaela.Stimmelmayr@north-slope.org
Aaron Morris
North Slope Borough, Amorris03@hamline.edu
Billy Adams
North Slope Borough, billy.adams@north-slope.org
Anne Jensen
North Slope Borough, anne.jensen@uicscience.org

The evolutionary history of the polar bear is not well known and fossil records of the polar bear are scarce. Very few specimens have been found in North America. The general scarcity is attributed to polar bears "for the most part live and die on the pack ice, making their preservation in terrestrial sediments exceptional". In 2014, a well-preserved skull of a polar bear (Ursus maritimus Phipps, 1774) was discovered after a cave in and wash out at Walakpa, Alaska. Carbon dating places the skull at ~ 1850 years BP (before present). This is to our knowledge the oldest complete polar bear skull remains ever discovered in Alaska. Genetic sexing is pending but we speculate the skull is from a fully-grown male based on well-known sexual dimorphism in polar bears. Our findings on skull morphometrics and comparative skull shape analysis suggest marked differences between this skull and modern day and last century SBS and Chukchi polar bear skull specimens. Our specimen is among the largest polar bear skulls ever reported. Briefly, the skull is overall slender and it differs in height of the sagital crest, nasal width, breadth at canines, breadth of palatine, length of the maxilla, the palatine and sphenoid bone to name a few of the differences. Inuvialuit TEK discusses differences in polar bear types namely "stubby bears versus Weasel bears". The latter are rarely encountered and characterized by great size > 11 ' and slender built of head and neck. Evidence for geographic variations in polar bears skull size has been put forth by Manning (1969) for circumpolar stocks and subsequently by Wilson (1974) for Alaskan stocks, but discussion on subspecies recognition of polar bear stocks remains an open discussion. Phylogenetic DNA analysis of the Alaskan specimen is needed to further clarify the relationship to modern day polar bears.

Arctic - Mammals

Dive Behavior of Bowhead Whales within the Cape Bathurst Polynya

John Citta
Alaska Department of Fish & Game, john.citta@alaska.gov
Lori Quakenbush
Alaska Department of Fish & Game, lori.quakenbush@alaska.gov
Steven Okkonen
University of Alaska Fairbanks, srokkonen@uaf.edu
Matthew Druckenmiller
National Snow and Ice Datacenter, mldruk@gmail.com
Lois Harwood
Fisheries and Oceans Canada, Lois.Harwood@dfo-mpo.gc.ca
John "Craig" George
North Slope Borough, craig.george@north-slope.org
Mads Peter Heide-Jorgensen
Greenland Institute of Natural Resources, mhj@ghsdk.dk

Each spring, the majority of bowhead whales (*Balaena mysticetus*) of the Bering-Chukchi-Beaufort (BCB) stock leave their wintering grounds in the Bering Sea and migrate northeast towards the Canadian Arctic. Satellite tagging studies indicate that most of these whales migrate to the Cape Bathurst polynya within the entrance of Amundsen Gulf, Canada. These whales leave the Bering Sea prior to the spring ice retreat in April and May, shortly before the Bering Sea becomes one of the most productive seas in the world, and it is unknown if foraging conditions in May and June are better for whales at their destination within the Cape Bathurst polynya than if they had remained within the Bering Sea. Although we know that satellite tagged whales migrate to the Cape Bathurst polynya, the diving behavior of whales within the polynya has yet to be formally examined. Here we examine the diving behavior of 17 bowhead whales tagged with satellite-linked transmitters between 2008 and 2015. To allow us to comment on the likelihood that whales are feeding within the polynya each spring, we characterize the dive behavior of these whales, summarizing dive depths, the time whales spend at depth, and the frequency of diving, both within the polynya and under adjacent sea ice. We also use paired measurements of depth and temperature for two tags (1 in 2014 and 1 in 2016) to describe the water masses whales frequent.

Update of Hunter-Assisted Seal Tagging and Traditional Knowledge Studies of Pacific Arctic Seals, 2016 and Beyond

Justin Crawford
Alaska Department of Fish & Game, justin.crawford@alaska.gov
Mark Nelson
Alaska Department of Fish & Game, mark.nelson@alaska.gov
Lori Quakenbush
Alaska Department of Fish & Game, lori.quakenbush@alaska.gov
Andrew Von Duyke
North Slope Borough, andrew.vonduyke@north-slope.org
Merlin Henry
Subsistence hunter, no@email.com
Alexander Niksik Jr.
Subsistence hunter, alexniksik@rocketmail.com
Albert Simon
Subsistence hunter, albertpaimiut@yahoo.com
John Goodwin
Subsistence hunter, johnpearlgoodwin@gmail.com
Alex Whiting
Kotzebue IRA, alex.whiting@qira.org
Kathy Frost
University of Alaska Fairbanks, kjfrost@hawaii.rr.com
Josh London
NOAA Alaska Fisheries Science Center, josh.london@noaa.gov
Peter Boveng
OAA Alaska Fisheries Science Center, peter.boveng@noaa.gov

Ringed (*Pusa hispida*), bearded (*Erignathus barbatus*), and spotted (*Phoca largha*) seals use sea ice for pupping, nursing, molting, and resting. Decreases in the extent of sea ice and lengthening of the open water season have eased access to the Arctic, expediting the need to plan development activities to minimize effects on seals. Our understanding of seal habitats, behavior, and timing of movements by all species, age, and sex classes, however, is limited. We expanded upon a cooperative satellite telemetry study of Pacific Arctic seals with hunter-taggers and biologists in Kotzebue Sound, first through a National Marine Fisheries Service (NMFS) funded project, and currently through the merger of two studies, funded separately by the Bureau of Ocean Energy Management and Office of Naval Research, further fostering collaborations among the Alaska Department of Fish and Game, North Slope Borough, NMFS, Ice Seal Committee, and subsistence seal hunters. We worked with hunter-taggers from five villages along the Bering, Chukchi, and Beaufort seas to deploy transmitters on seals to study habitat use, timing of movements, seasonal site fidelity, and association and use of sea ice and oceanographic features. By tagging seals in multiple locations and seasons, we minimize the biases from deploying all of the tags at the same location during the same season. In

2016, four bearded and one ringed seal tagged in 2014 and 2015 wintered in the Bering Sea and Norton Sound. Seven bearded, three ringed, and seven spotted seals were tagged near Barrow, Koyuk, and St. Michael. Seals tracked during 2016 ranged in all three Arctic seas from Bristol Bay in the Bering Sea, to the north and west (near Wrangel Island, Russia) in the Chukchi Sea, and east to Kaktovik, Alaska in the Beaufort Sea. Local and traditional knowledge enhances our understanding of how seals and hunters may respond to changing sea ice conditions. Reports generated from interviews of subsistence users in Barrow, Elim, St. Michael, Stebbins, Kivalina, Kotzebue, Shishmaref, Pt. Lay, and Wainwright were summarized in a publication in 2016. Future plans include training more hunter-taggers and tagging additional seals from coastal villages.

Final Results from Hunter-Assisted Sampling of Walruses Near Saint Lawrence Island, Alaska, 2012–2014 and 2016

Anna Bryan
Alaska Department of Fish & Game, anna.bryan@alaska.gov
Lori Quakenbush
Alaska Department of Fish & Game, Lori.Quakenbush@alaska.gov
Jonathan Snyder
U.S. Department of Fish & Wildlife Service, Jonathan_Snyder@fws.gov
Harold Kiyuklook
Savoonga resident, no@email.com
Sheena Anningayou
Gambell resident, no@email.com
Mark Nelson
Alaska Department of Fish & Game, Mark.Nelson@alaska.gov

Declining sea ice in the Chukchi Sea in summer is expected to cause an increase in energy needed by female and young Pacific walruses (*Odobenus rosmarus*) to travel from terrestrial haulouts to feeding areas when there is no ice to haul out on. Increased energetic costs can cause decreased body condition and reproductive capacity, and an increase in disease prevalence. Walruses are harvested each spring for subsistence purposes by Alaska Natives in the Bering and Chukchi seas. Samples provided by hunters allow us to examine parameters that reflect population health. Hunters sampled 225 walruses (106 females, 115 males, and 4 unknowns) during spring 2012–2014 and 2016. Hunters classified the health of 208 walruses; 98% were of average or very good health. During 2012–2014, 79–87% of the adult females sampled had calves of the year (or near term fetuses). This percentage is above the expected 33–50%, which indicates hunter selectivity and parturient female availability to hunters. Contaminant concentrations (organochlorines and trace elements) for 42 walruses were similar to or lower than concentrations found in Alaskan ice seals (which are lower than Canadian ice seals). Blood (sera) from 151 walruses was screened for disease exposure (morbillivirus, brucella, herpes, leptospira, and toxoplasma); exposures were low except for herpes, which is common and expected. Stomach and intestinal contents were examined for prey; contents were similar to previously published studies and included marine worms, clams, snails, crabs, shrimp, and a few fish. Algal toxins (domoic acid and saxitoxin) produced by harmful algae blooms (HABs) were identified in stomachs, intestines, and urine at higher concentrations than expected. Concentrations of domoic acid ranged from 2.5–6,457.4 ng/g for stomachs and intestines and 0.6–49 ng/g for urine. Saxitoxin concentrations ranged from 3.8–1,161.8 ng/g for all matrices. HABs are known to concentrate in benthic invertebrates such as clams, a common walrus prey. Although none of the walruses appeared symptomatic; concentrations of HABs at these levels have had negative neurological effects on California sea lions (*Zalophus californianus*).

Cryptorchidism and Associated Testicular Cancer in an Adult Male Spotted Seal: A Case Report

Hannah Braden
Lincoln Memorial University College of Veterinary Medicine, hannah.braden@lmunet.edu
Raphaela Stimmelmayr
North Slope Borough, Raphaela.Stimmelmayr@north-slope.org
Andrea Rios Gonzalez
Tufts University Conservation Medicine Masters Program, Andrea.Rios_Gonzalez@tufts.edu

The incidence of neoplasia in marine mammals continues to be low, but as previously reviewed by Smith and Newman (2006) “the literature documenting marine mammal neoplasia is expanding gradually”. Among the pinnipeds, case reports about Arctic ice seals are scarce, with only one case of an adenocarcinoma being reported in a ringed seal (Phoca hispida). We report the first case of a unilateral testicular cancer in a cryptorchid adult male spotted seal (Phoca largha). Briefly, in 2015, the animal was found freshly dead at Peard Bay, Alaska (70°50’43”N 158°48’39”W.). As part of our Arctic Marine Mammal Stranding Response efforts, the seal carcass was brought back to Barrow for post-mortem examination. The animal was in excellent body condition and had completed molt. During necropsy the right greatly enlarged testicle was located in the abdominal cavity. Associated retroperitoneal lymph nodes and intra-thoracic lymph nodes were enlarged. In humans, cryptorchidism is an established risk factor for the development of testicular germ cell tumors (TGCT). We will present an overview of gross and histopathological findings of this unique case report.

Scenarios Use to Inform Observing Priorities in Changing Arctic Landscapes

Olivia Lee
University of Alaska Fairbanks, oalee@alaska.edu
Juan Carlos Vargas Moreno
GeoAdaptive LLC, jcvargus@geoadaptive.com
Hajo Eicken
University of Alaska Fairbanks, heicken@alaska.edu
John Payne
North Slope Science Initiative, jfpayne@mtu.edu

Management of Arctic marine fisheries currently takes a precautionary approach where Federal waters of the Arctic remain closed to commercial fisheries. However other human activities in Arctic waters such as shipping and oil and gas exploration may have significant impacts on marine ecosystems. Future development activities are difficult to predict and therefore it can be challenging to develop research and monitoring plans that build much needed baseline data to support management and decision-making. The recently completed North Slope Science Initiative scenarios project used a participatory scenarios approach to identify three scenarios of energy and resource development on the North Slope and adjacent seas. Scenarios are becoming a more widely accepted tool for natural resource management, and this project highlights the first time this approach was used to help provide guidance to NSSI member agencies. The focus on creating spatially explicit scenarios with mapped data on the scenario implications provides a rich source of information for managers to consider important areas to invest in research and monitoring while also considering the various uncertainties that may affect the future landscape on the North Slope. Key drivers of change identified in the scenarios process were used to develop observing indicators. These indicators can be used to develop robust and adaptable research strategies and increase coordination among management agencies in developing an observing network. Analysis of the relationships, uncertainties and levels of knowledge for the drivers of change was used to prioritize the observing indicators. The suite of observing indicators are useful for tracking scenario trajectories and also help with monitoring important trends at local and global scales that could have significant impacts on future of Arctic activities.

Arctic - Humans

NOAA Seafloor Mapping Update

Amy Holman
NOAA, amy.holman@noaa.gov
Timothy Smith
NOAA National Ocean Service, timothy.m.smith@noaa.gov

This poster provides an update on NOAA's hydrographic surveying in Alaska. Areas of focus this year were:

- **Yukon River**, Alaska, was partially surveyed to validate a new charting approach using satellite-derived bathymetry.
- **Etolin Strait**, Alaska, surveys here also validated satellite-derived bathymetry data, as well as established a survey corridor between Nunivak Island and mainland Alaska. This project will provide data for some of the new charts identified in the U.S. Arctic Nautical Charting Plan.
- **Dutch Harbor**, Alaska, benefited from a shore-based survey operation simultaneous with a NOAA Fishpac project, as the ship's smaller launches worked for a month to survey Unalaska Bay
- **Kodiak Island**, Alaska, where surveying continued in this critical area to support increasing fishing and tourism.
- **Prince of Wales Island**, Alaska, surveyed to improve charts to Tlevak Strait, expanding to Sukkwan Strait and Howkan Narrows.
- **Behm Canal**, Alaska, a third year of survey work to circumnavigate Revillagigedo Island as well as George and Carol Inlet, Alaska.

Visit us and see highlights of what was accomplished, where we will be going next, what data is available for marine scientists and how to get it.

Arctic Integrated Ecosystem Survey Phase II

Ed Farley
NOAA Alaska Fisheries Science Center, ed.farley@noaa.gov
Carol Ladd
NOAA Pacific Marine Environmental Laboratory, carol.ladd@noaa.gov
Kristin Cieciel
NOAA Alaska Fisheries Science Center, kris.cieciel@noaa.gov
Louise Copeman
Oregon State University, lcopeman@coas.oregonstate.edu
Alex DeRobertis
NOAA Alaska Fisheries Science Center, alex.derobertis@noaa.gov
Jeff Guyon
NOAA Alaska Fisheries Science Center, jeff.guyon@noaa.gov
Kathy Kuletz
U.S. Fish and Wildlfie Service, kathy_kuletz@fws.gov
Libby Logerwell
NOAA Alaska Fisheries Science Center, libby.logerwell@noaa.gov
Franz Mueter
University of Alaska Fairbanks, franz.mueter@uaf.edu
Ron Heintz
NOAA Alaska Fisheries Science Center, ron.heintz@noaa.gov
Chris Wilson
NOAA Alaska Fisheries Science Center, chris.wilson@noaa.gov
Janet Duffy-anderson
NOAA Alaska Fisheries Science Center, janet.duffy-anderson@noaa.gov
Lisa Eisner
NOAA Alaska Fisheries Science Center, lisa.eisner@noaa.gov
David Kimmel
NOAA Alaska Fisheries Science Center, david.kimmel@noaa.gov
Michael Lomas
Bigelow Laboratory for Ocean Sciences, mlomas@bigelow.org
Ryan McCabe
University of Washigton, rmccabe@ocean.washington.edu
Calvin Mordy
University of Washigton, mordy@uw.edu
Phyllis Stabeno
NOAA Pacific Marine Environmental Laboratory, phyllis.stabeno@noaa.gov

The Chukchi and Beaufort seas are undergoing dramatic sea ice reductions and temperature increases, but resultant biological and trophic responses are poorly understood. The goal of Arctic Integrated Ecosystem Survey Phase II (Upper and Lower Trophic Level Teams) is to improve understanding of processes that structure the Arctic ecosystem and influence the distribution, abundance, and life history of lower (phytoplankton, zooplankton) and upper trophic level species (invertebrates, fishes,

seabirds, mammals), and their vulnerability to the rapidly changing environment. The LTL component aims to better understand the climatological, physical, chemical, and biological processes that influence energy flow from primary producers to zooplankton and ichthyoplankton, and the UTL component will work to describe and understand how lower trophic processes reverberate through the food web to influence invertebrate, fish, and seabird communities. We will conduct comprehensive ecosystem surveys of Chukchi Sea and Beaufort Sea physics, chemistry, biogeochemistry, and biology using an integrated network of moored arrays (year-round), autonomous vehicles (year-round), and shipboard observations (~65 DAS in each of 2017, 2019 summer and autumn). The integrated ecosystem research forms a partnership between Arctic IES Phase II, the ASGARD program (focusing on spring sampling), marine mammal acoustic surveys, and social science work that addresses core research themes of NPRB's new Arctic Integrated Ecosystem Research Program.

Collaboration and Communication in Arctic & Northern Marine Science: Networking Scientists, Communities, Educators, and Stakeholders

Betsy Turner-Bogren
Arctic Research Consortium of the U.S. (ARCUS), betsy@arcus.org
Lisa Sheffield Guy
Arctic Research Consortium of the U.S. (ARCUS), lisa@arcus.org
Helen Wiggins
Arctic Research Consortium of the U.S. (ARCUS), helen@arcus.org
Janet Warburton
Arctic Research Consortium of the U.S. (ARCUS), janet@arcus.org
Robert Rich
Arctic Research Consortium of the U.S. (ARCUS), bob@arcus.org

Rapid changes observed in the Arctic warrant a coordinated and strategic approach to science and knowledge exchange across boundaries of discipline, geography, and perspective. Interdisciplinary collaboration is essential to leverage resources, provide holistic understanding, and develop adaptation strategies to address these changes. The Arctic Research Consortium of the United States (ARCUS) is a nonprofit membership organization with more than 25 years of experience in creating productive networks. ARCUS' efforts in Alaskan marine ecosystems have contributed to several successful and highly collaborative projects. This poster will highlight best practices and success stories related to: the Study of Environmental Arctic Change (SEARCH) program that advances scientific understanding of Arctic environmental change, including the Arctic sea ice and marine systems; the Sea Ice Prediction Network (SIPN) that synthesizes sea ice predictions and communicates this knowledge to stakeholders; the Sea Ice for Walrus Outlook that provides weekly reports of spring sea ice conditions relevant to walrus and walrus hunting in the northern Bering Sea and southern Chukchi Sea; and the PolarTREC and The Arctic in the Classroom programs, which connect researchers with teachers, classrooms, and local communities.

Small and Large-Scale Variability in Chukchi Sea Epibenthos – Recommendations for Monitoring Design

Katrin Iken
University of Alaska Fairbanks, kbiken@alaska.edu
Jacqueline Grebmeier
University of Maryland, jgrebmei@umces.edu
Lee Cooper
University of Maryland, cooper@cbl.umces.edu
Seth Danielson
University of Alaska Fairbanks, sldanielson@alaska.edu

Epibenthic communities contribute high biomass, abundance, diversity, and ecological function to the Chukchi Sea shelf ecosystem. Despite this, epibenthic communities are not consistently included in long-term observing programs that are designed to illuminate the processes driving key system variables and how these might change in light of climatic and anthropogenic pressures. The Arctic Marine Biodiversity Observing Network (AMBON) monitors biodiversity in the Arctic from microbes to whales, including the epibenthos. Part of the AMBON spatial coverage overlaps with two lines of the internationally coordinated Distributed Biological Observatory (DBO), specifically DBO line 3 in the southeastern Chukchi Sea and DBO line 4 in the northeastern Chukchi Sea. These DBO transects lines are less spatially extensive than the sampling being undertaken as part of the AMBON. The two different sampling programs in 2015 allowed us to compare patterns in epibenthic biomass, abundance and diversity across the different spatial scales and environmental conditions. Epibenthic community composition correlated well with some physical characteristics, such as bottom temperature, over the large (AMBON) and smaller (DBO) spatial coverages, the latter of which was mainly driven by strong gradients along the DBO4 line. In contrast, the strong primary productivity gradient from the seasonally high offshore values to low values near the Alaskan coast along the DBO3 line did not influence the epibenthic community patterns. Some striking epibenthic community features observed within the larger AMBON coverage were locations of extremely high biomass but low diversity, which were not adequately captured in the DBO sampling scheme. Placement of the more northern DBO4 line seems well suited to capture many of the important epibenthic community patterns, but sampling closer to shore is needed to fully represent the epibenthic community attributes that were apparent from the larger AMBON coverage.

Hanna Shoal Year-Round: New Results from the Chukchi Ecosystem Observatory

Seth Danielson
University of Alaska Fairbanks, sldanielson@alaska.edu
Silvana Gonzalez
University of Washigton, silgonz@uw.edu
Claudine Hauri
University of Alaska Fairbanks, chauri@alaska.edu
Russ Hopcroft
University of Alaska Fairbanks, rrhopcroft@alaska.edu
John Horne
University of Washigton, jhorne@u.washington.edu
Catherine Lalande
Université Laval, Catherine.Lalande@takuvik.ulaval.ca
Andy Mahoney
University of Alaska Fairbanks, armahoney@alaska.edu
Andrew McDonnell
University of Alaska Fairbanks, amcdonnell@alaska.edu
Kate Stafford
University of Washigton, stafford@apl.washington.edu
Peter Winsor
University of Alaska Fairbanks, pwinsor@alaska.edu

In 2015, President Barack Obama withdrew the Hanna Shoal region inside the 40 m isobath from outer continental shelf oil and gas exploration, a move the White House noted was designed to protect areas of “critical importance … for marine mammals, other wildlife, and wildlife habitat”. Arctic regions are projected to strongly reflect impacts of an altered climate. Subsurface moored observations are essential for understanding time-dependent marine processes that are likely to change in unanticipated ways. The moored Chukchi Ecosystem Observatory (CEO) is located in 45 m of water on the southern flank of Hanna Shoal just a few kilometers south of the newly protected wilderness area. The CEO moorings were recovered and then redeployed for a third consecutive year of observations in August 2016. Concurrent measurements include physical, nutrient and carbonate chemistry, particulate, phytoplankton, zooplankton, fisheries and marine mammal data sets, thereby providing an unprecedented multi-disciplinary view into the mechanistic workings of the Chukchi shelf ecosystem. The first two deployment years did not carry the complete instrumentation suite that the presently deployed fully built-out mooring hosts. However, the CEO data that we do have in hand is already expanding our ability to understand physical, chemical and biological seasonality on Arctic shelves in general, processes that contribute to short (seconds to days) and long (seasons to years) time scale variations at the CEO site, and reasons that Hanna Shoal is of particular

importance to walrus and other wildlife. In this presentation we characterize fundamental aspects of conditions and processes that the moored measurements have documented or partially revealed to date. These observations include consequences of wind and wave activity on ocean currents and water column hydrography, the annual cycle of nutrient draw-down and replenishment, the timing and composition of particulate matter settling and marine mammal activity, the distribution of ice keels, and the timing and location of sound scatterers in the water column. These observations are helping guide development of a new conceptual model that describes the functioning and importance of the Hanna Shoal region.

Tales from ASGARD: Upcoming in 2017 and 2018

Seth Danielson
University of Alaska Fairbanks, sldanielson@alaska.edu
Arny Blanchard
University of Alaska Fairbanks, alblanchard@alaska.edu
Sarah Hardy
University of Alaska Fairbanks, smhardy@alaska.edu
Russ Hopcroft
University of Alaska Fairbanks, rrhopcroft@alaska.edu
Kathy Kuletz
U.S. Fish and Wildlfie Service, Kathy_Kuletz@fws.gov
Mike Lomas
Bigelow Laboratory for Ocean Sciences, mlomas@bigelow.org
Andrew McDonnell
University of Alaska Fairbanks, amcdonnell@alaska.edu
Brenda Norcross
University of Alaska Fairbanks, bnorcross@alaska.edu
Kate Stafford
University of Washigton, stafford@apl.washington.edu
Dean Stockwell
University of Alaska Fairbanks, dastockwell@alaska.edu

In recent years, our understanding of the composition and structure of the Chukchi ecosystem has exploded, yet our knowledge outside of summer and fall months and year-round of the rates at which fundamental processes operate remains sorely lacking. We describe a pair of upcoming late spring cruises to the northern Bering and southern Chukchi seas in 2017 and 2018 as part of NPRB's Arctic Integrated Ecosystem Research Project to conduct a closely integrated set of multi-disciplinary process studies at poorly-sampled locations and times of year. These will reveal new insights about the transfer and fate of organic carbon in this highly productive and strongly advective region. The Arctic Shelf Growth, Advection, Respiration and Deposition (ASGARD) measurements are designed to quantify: the physical and chemical environments (e.g., water mass, heat, salt, and nutrient concentrations); particulate sinking, deposition and advection rates; planktonic and benthic microbial communities, including benthic infauna (composition, abundance and biomass), and; phytoplankton growth and microzooplankton grazing rates; mesozooplankton growth, reproduction, feeding and respiration rates; organic quantity, quality, and degradation rates of sediments; and benthic respiration rates. Mid-water and epibenthic trawls to sample fish and seafloor invertebrates, together with marine mammal and bird observations, will document the presence/absence of benthic macrofauna and upper trophic level consumers with respect to food availability and environmental conditions. Year-round biophysical and biogeochemical moorings - including passive acoustic recorders to measure marine

mammal and anthropogenic underwater sounds - will provide temporal context for select parameters at sites along the primary advective pathways and within multiple water masses and biogeographical realms.

Managed Retreat: Lessons from Alaska for Hawaii and Coastal Communities

Oceana Francis
University of Hawaii, oceanaf@hawaii.edu
Karl Kim
University of Hawaii, karlk@hawaii.edu

Extreme weather events and climate induced sea-level rise are permanently displacing the inhabitants of many coastal communities throughout Alaska and Hawaii. Finding a permanent solution has become increasingly important for Alaska and Hawaii coastal communities. In our presentation, we investigate strategies for climate-induced community relocation. We share the background motivation, showcase past experiences for Alaska and what can be learned in moving forward with managed retreat for Alaska and Hawaii, approaches, and legal, economic and socio-political/cultural considerations needed for implementation.

Synthesis of Arctic Research (SOAR) – Physics to Marine Mammals in the Pacific Arctic, Phase II

Thomas Van Pelt
University of Washington, thomas.vanpelt@noaa.gov
Sue Moore
NOAA Fisheries, sue.moore@noaa.gov
Phyllis Stabeno
NOAA Pacific Marine Environmental Laboratory, phyllis.stabeno@noaa.gov

The Synthesis of Arctic Research (SOAR) brings together a multidisciplinary group of Arctic scientists and Alaskan coastal community representatives to explore and integrate information from completed and ongoing marine research in the Pacific Arctic (www.arctic.noaa.gov/soar). SOAR was initiated in 2011 with funding from the Bureau of Ocean Energy Management (BOEM) to increase scientific understanding of the relationships among oceanographic conditions (physics, chemistry, sea ice), benthic organisms, lower trophic pelagic species (forage fish and zooplankton), and higher trophic species (i.e., seabirds, walrus, whales) in the Pacific Arctic. The first phase of the synthesis resulted in a special issue of *Progress in Oceanography* comprised of 17 papers (http://www.sciencedirect.com/science/journal/00796611/136). The second phase of SOAR is building upon this initial synthesis with a second special issue in *Deep Sea Research II – Topical Studies in Oceanography*. This issue is being framed by the same three overarching themes: (1) The 'New State' of the Pacific Arctic sector: Observations and models of sea ice loss, effects on primary production and acoustic ecology; (2) Responses of mid-level trophic species to the 'New State' of the Pacific Arctic: Benthic and pelagic invertebrates and forage fishes; and (3) Responses of upper-trophic species to the 'New State' of the Pacific Arctic: Marine mammal and seabird distribution, relative abundance, and phenology. On behalf of participating authors and co-authors, we will present synopses of papers appearing in the *Deep Sea Research II* special issue, including an overview of syntheses both within and among the papers included in that volume.

The Role of the Northern Bering Sea in Modulating the Arctic Marine Environment - Towards International Interdisciplinary Efforts

Matthew Baker
North Pacific Research Board, Matthew.Baker@nprb.org
Lisa Eisner
NOAA Alaska Fisheries Science Center, lisa.eisner@noaa.gov
Kirill Kivva
Russian Federal Research Institute of Fisheries and Oceanography (VNIRO), kirill.kivva@gmail.com

The northern Bering Sea influences the state of the southern Chukchi Sea ecosystem as well as the processes and functioning of other arctic regions, including the central Arctic Basin. The Pacific Arctic Region has received considerable attention from the scientific community during recent years, particularly in relation to climate change. Research in the area includes intensive field sampling and surveys, remote sensing, and numerical modeling. Currently, scientific efforts in the Northern Bering – Southern Chukchi Sea are mostly conducted at the national level. While there have been efforts to coordinate efforts, research is not jointly developed and data sharing remains limited. To leverage existing efforts and discuss opportunities for cooperative research at the international level in these marine systems, we convened a targeted workshop at the PICES (North Pacific Marine Science Organization) Annual Meeting in San Diego, CA, in November 2016. PICES is the intergovernmental scientific organization established to promote and coordinate marine research in the North Pacific and intended to unite Canada, Japan, the People's Republic of China, the Republic of Korea, the Russian Federation, and the United States in their intention to better understand marine environment. The workshop was designed to leverage existing research efforts and bring together researchers representing multiple national and international institutions and scientific disciplines to share data and knowledge, build collaboration, further outreach, and discuss opportunities for further scientific cooperation in the northern Bering Sea and Arctic. The workshop covered the following areas: 1) physical oceanography and chemical fluxes, 2) plankton distribution and ecology, 3) fisheries and ecosystem dynamics, 4) modeling efforts across the northern Bering Sea region, and 5) the influence of the changing environment on ecosystem function. Participants were encouraged to provide data and metadata describing past and present research efforts and to submit applicable Ecological Time Series Observations (ETSOs) relevant to the North Pacific Ecosystem Status Report. This talk presents results from this workshop. We anticipate a second workshop to be held at the PICES 2017 annual meeting in Vladivostok, Russia and welcome ideas related to issues to discuss and mechanisms for collaborative research to propose at that venue.

Seven Years of integrative Arctic Research

Jessica Crance
NOAA National Marine Fisheries Service, Jessica.Crance@noaa.gov
Catherine Berchok
NOAA National Marine Fisheries Service, Catherine.Berchok@noaa.gov
Phyllis Stabeno
NOAA Pacific Marine Environmental Laboratory, Phyllis.Stabeno@noaa.gov
Jeff Napp
NOAA National Marine Fisheries Service, Jeff.Napp@noaa.gov
Brenda Rone
NOAA National Marine Fisheries Service, Brenda.Rone@noaa.gov
Amy Kennedy
University of Washigton, amy.kennedy@noaa.gov
Chris Clark
Bioacoustics Research Program, cwc2@cornell.edu

Through several inter-agency agreements with the Bureau of Ocean Energy Management, the Chukchi Acoustics, Oceanography, and Zooplankton (CHAOZ), CHAOZ-Extension, and Arctic Whale Ecology (ArcWEST) studies have conducted integrative marine mammal, oceanographic, and zooplankton research in the Alaskan Arctic since 2010. Upon its conclusion in 2015, the CHAOZ study branched into CHAOZ-X and ArcWEST. These three projects combined have allowed for seven continuous years of field surveys, real-time summer sampling, and long-term data collection. At multiple locations in the Alaskan Chukchi Sea, year-long mooring deployments have collected passive acoustic, oceanographic, and zooplankton data. Since 2010, 113 year-long passive acoustic recorder deployments have yielded spatio-temporal information on marine mammal occurrence, as well as environmental and anthropogenic noise sources. A total of 81 year-long oceanographic moorings provide a 7-year time series on ice, currents, and seven different parameters. As an additional measure of currents, 36 ARGOS drifters were deployed over five years. In addition to long-term mooring deployments, short-term *in situ* sampling was conducted during the surveys. In total, 381 CTD casts and 358 zooplankton net tows were conducted at various transect lines throughout the Chukchi. In 2016, an underway water sampling system and an acrobat towfish collected oceanographic measurements over ~1500 nm and ~245 nm, respectively. While underway in all years, opportunistic visual (~4800 nm) and passive acoustic (894 sonobuoys) surveys for marine mammals and seabirds occurred. Finally, a near-real time passive acoustic auto-detection buoy was deployed in three separate years for a total of ~150 days of recordings. The 2015 CHAOZ final report analyzed this extensive, integrative dataset and provided an initial, ecosystem-wide synthesis of the Chukchi Sea. With the inclusion of the additional years from the ArcWEST and CHAOZ-X projects, a fully integrative seven-year time series will provide a more comprehensive

understanding of marine mammal distribution in the Alaskan Chukchi Sea as it relates to oceanographic variables and indices of prey availability.

Effective Communication Strategies with Alaska Native Communities: Lessons Learned 2008-2016

Sheyna Wisdom
Fairweather Science, sheyna.wisdom@fairweather.com
Ella Ede
Fairweather Science, ella.ede@fairweather.com
Willow Hetrick
Fairweather Science, willow.hetrick@fairweather.com

The Arctic Ocean is a hot topic in the U.S. in terms of research, policy, resource development, and environmental conservation. Unlike the Antarctic region, the Arctic has been home to humans for over 40,000 years who continue to live a subsistence lifestyle. In particular, Alaskan coastal communities depend on marine mammals. As the Arctic becomes increasingly accessible to oil and gas development, shipping, tourism, and scientific research, substantial potential arises for conflicts with community subsistence activities. For the last 40 years, interactions between the communities and resource development companies, regulatory agencies, and researchers have continued to evolve and develop. With the heightened interest in the last 10 years, community outreach has become a priority in national policy. Olgoonik Fairweather, a joint venture between Olgoonik Oilfield Services (the Alaska Native Owned Corporation for the Village of Wainwright) and Fairweather Science LLC, has provided marine research program management for oil companies, universities, agencies, and private companies since 2008, including the operation of several research vessels. From 2008-2016, we have worked with Alaskan Arctic stakeholders to develop strategies for providing research opportunities without causing conflict with subsistence harvest activities. Here we discuss methods that have been successful in cultivating strong relationships: both successful strategies with Alaskan Arctic communities, as well as methods requiring substantial improvement but which provided valuable learning experiences. Maintaining a healthy balance between a subsistence lifestyle and ongoing cultural changes from outside influences requires careful and effective coordination. With the continued increase in potential for conflicts, the need for development of long-term relationships and open communication strategies with community members and agencies is imperative for the continued existence of Alaska Native communities.

Community-Based Monitoring of the Marine Ecosystem in Kotzebue Sound

Adrian Gall
ABR, Inc., agall@abrinc.com
Robert Shaeffer
Kotzebue, bobby@otz.net
Noah Naylor
Northwest Arctic Borough, NNaylor@nwabor.org
Tawna Morgan
ABR, Inc., tmorgan@abrinc.com
Ashley Hovis
ABR, Inc., ahovis@abrinc.com

Seabirds and marine mammals can serve as indicators of the productivity and changes in the marine environment, particularly when scientific studies of their distribution and abundance at sea are paired with indigenous knowledge. Despite the strong reliance of residents on the marine ecosystem of Kotzebue Sound, systematic boat-based surveys for seabirds and marine mammals have not been conducted there for more than 30 years. We conducted surveys of seabirds and oceanography and interviewed Kotzebue residents to understand how upper-trophic-level predators use Kotzebue Sound. This pilot study was designed to test the feasibility of using local vessels for long-distance (~30 NM) systematic surveys in Kotzebue Sound during June and July. The density of seabirds was similar between June and July. Seabirds generally were more abundant within 15 km of Cape Krusentern and Cape Espenberg. These areas were characterized by water that was colder and saltier than elsewhere in northern Kotzebue Sound. Species-composition differed between months, with murres more abundant in June than in July and auklets and Glaucous Gulls more abundant in July than in June. We had more incidental observations of seals in June than in July. Indigenous knowledge shared by 4 Kotzebue residents affirmed that birds are most abundant at-sea near the capes. The hunting season for bearded seals is occurring earlier as ice melts sooner in the spring, and beluga whale populations have not rebounded from a major die-off in the 1980s. Systematic surveys of seabirds and oceanography from local vessels was not only feasible but was successful and a possible model for long-term, community-based monitoring of Kotzebue Sound. The Science Program of the Northwest Arctic Borough is collecting these data to inform policy and management decisions about food security, resource development, and infrastructure.

Building Better Marine Maps: The 2017 Ecological Atlas of the Bering, Chukchi, and Beaufort Seas

Melanie Smith
Audubon Alaska, masmith@audubon.org
Max Goldman
Audubon Alaska, msgoldman@audubon.org
Erika Knight
Audubon Alaska, eknight@audubon.org
Daniel Huffman
University of Wisconsin - Madison, daniel.p.huffman@gmail.com
Jon Warrenchuk
Oceana
Molly Zaleski
Oceana

As the breadth of knowledge regarding Arctic marine ecology grows alongside increased national and global involvement in the Arctic region, there is a need to synthesize and disseminate information to the public, policy makers, and scientists in a format that is useful and accessible. The goal of the Ecological Atlas of the Bering, Chukchi, and Beaufort Seas is to create a comprehensive, trans-boundary atlas that represents the current state of knowledge on a wide array of subjects, from physical oceanography to species ecology to human uses. The Ecological Atlas consists of many maps integrating disparate datasets into concise, cohesive, and complementary data layers that visually describe seasonal use, activity, and movement through the project area over the course of a year. Through maps and written summaries, the atlas provides a cumulative picture of what is happening in the region to better help us understand ecological patterns and to inform people making land use decisions in communities; federal, state, and local governments; and other arenas.
Our process involved intensive research and consultation with experts in order to gather and analyze the most recent and best data available. Along the way, we developed robust standards for data integration and cartographic design. We will introduce some of our new maps and discuss our data-to-design process. The redesigned and much-expanded second edition of the atlas will be published in 2017. We will describe lessons learned in the seven years between the first and the second editions of the atlas, and provide insights looking forward for future trans-boundary integrative mapping.