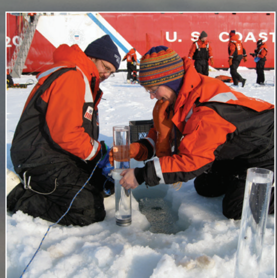
ALASKA MARINE SCIENCE SYMPOSIUM

JANUARY 19-23, 2015

Alaska Marine Science Symposium

HOTEL CAPTAIN COOK & EGAN CENTER • ANCHORAGE, ALASKA



Simone Welch


Alexandra Ravelo


Andrew Trites


Gerry Sanger

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

S.A.Ulrich

alaskamarinescience.org

2015 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 2015 AMSS Keynote and Plenary speaker abstracts
are presented in chronological order

Poster presentations are grouped per LME category and day

Contents

Workshops and Keynote Speakers: Monday, January 19

TIME	TITLE	PRESENTER	SECTION
8:00 - NOON	2015 Communicating Ocean Sciences Workshop: Upping Your Game	Marilyn Sigman	WORKSHOP
1:00 - 1:30 PM	Welcome		
1:30 - 2:15 PM	Looking Back to the Future: 5 Years of Ocean Acidification Research In Alaska	Jeremy Mathis	Keynote
2:15 - 3:00 PM	Colonizers and Biological Legacies: Their Role In The Early Ecosystem Recovery of Kasatochi Volcano	Anthony DeGange	Keynote
3:00 - 3:30 PM	BREAK		
3:30 - 4:15 PM	Rapid Arctic Warming and Extreme Weather Events in Mid-latitudes: Are They Connected?	Jennifer Francis	Keynote
4:15 - 5:00 PM	Planning for the Arctic: This panel will feature speakers highlighting federal, state and regional efforts to prepare Alaska and the U.S. for a changing Arctic.	TBD	Arctic Panel
6:00 - 8:30 PM	**POSTER SESSIONS**		

Keynote Abstracts

Monday, January 19

Keynote

Looking Back to the Future: 5 Years of Ocean Acidification Research In Alaska

Jeremy T. Mathis
Pacific Marine Environmental Laboratory – NOAA, Ocean Environment Research Division,
jeremy.mathis@noaa.gov

Over the last few years, ocean acidification (OA) has emerged as one of the most prominent issues in marine research and has entered the public consciousness as an existential threat. However, not all regions experience OA at the same level and regional hotspots have emerged where more pronounced expressions of OA can be observed. This is particularly true in the coastal oceans around Alaska, where the intensity, duration and extent of OA events have been greater than in many other ocean basins. Given the pace of the observed changes due to OA around Alaska, the area is commonly referred to as a bellwether for the transitions that are occurring and the proverbial “canary in the coalmine” for the rest of the global ocean. We will take a look back at how quickly the scientific understanding of OA has increased and what we need to do now and in the future to deal with this potential threat to Alaska marine resources.

Biography:
Jeremy T. Mathis is the Director of the Ocean Environment Research Division at NOAA-PMEL and the founding Director of the Ocean Acidification Research Center at UAF. Jeremy has published over 75 research articles on ocean acidification and the global carbon cycle and he leads a number of national and international efforts to coordinate ocean acidification research. Jeremy is an avid traveler, and has visited dozens of communities around Alaska to see firsthand what the impacts of ocean acidification and climate change could be for people around the state.

Keynote

Colonizers and Biological Legacies: Their Role in the Early Ecosystem Recovery of Kasatochi Volcano

Anthony R. DeGange
U.S. Geological Survey – retired, tdegange@usgs.gov

Recently disturbed ecosystems are often so rapidly colonized by propagules that the role of biological legacies (survivors) is obscured. The eruption of Kasatochi Volcano in the Central Aleutian Islands on August 8, 2008 provided an unusual opportunity to examine the influences of geomorphologic and edaphic processes and the role of colonizers and legacies in the early ecosystem recovery of the island. The catastrophic eruption completely covered the island in thick deposits of pyroclastic flows and ash and buried the near shore zone and kelp community. The legacy concept was most applicable to terrestrial invertebrates and plants that survived in pockets of pre-eruption soils that were exposed quickly through post-eruption erosion. The legacy concept can also be applied to seabirds, such as auklets, and sea lions that survived the eruption by leaving the island, but returned rapidly as soon as conditions allowed. The role of biological legacies in the marine environment is less clear, but we speculate that survivors may have been overwhelmed by the rapid invasion of vagile propagules from nearby populations. Future monitoring of Kasatochi will enable us to determine the extent and rate of return to the original biological communities and whether novel communities will replace them.

Biography:
Anthony DeGange studied at the University of Connecticut and the University of South Florida before moving to Alaska in 1976. During a career that spanned 38 years with the U.S. Fish and Wildlife Service and U.S. Geological Survey he was involved in research and management of a variety of species including seabirds and sea otters, and most recently led an interdisciplinary research team that continues to study the aftermath of the eruption of Kasatochi Volcano in the central Aleutian Islands. He recently retired from the U.S. Geological Survey where he supervised the Ecosystems and Geography research programs.

Keynote

Rapid Arctic Warming and Extreme Weather Events in Mid-latitudes: Are They Connected?

Jennifer Francis
Rutgers Institute of Marine and Coastal Sciences, francis@imcs.rutgers.edu

I will discuss the hypothesis proposed by Francis and Vavrus (2012) that links rapid Arctic warming (so-called Arctic amplification) to changes in the large-scale atmospheric circulation in the northern hemisphere that favors more persistent weather patterns and a higher likelihood of extreme weather events such as droughts, cold spells, flooding, heavy snows, and heat waves. This hypothesis has been a topic of considerable controversy in recent months, particularly regarding its relationship to the unusual weather conditions that persisted in the winter of 2013-2014. I will discuss various aspects of this linkage, what we know and don't know, and present new related research.

Biography:
Jennifer Francis earned a B.S. in Meteorology from San Jose State University in 1988 and a Ph. D. in Atmospheric Sciences from the University of Washington in 1994. As a professor at Rutgers University since 1994, she has taught courses in satellite remote sensing and climate-change issues, and also co-founded and co-directed the Rutgers Climate and Environmental Change Initiative. Presently she is a Research Professor with the Rutgers Institute of Marine and Coastal Sciences and studies Arctic climate change and Arctic-global climate linkages. She has served on many national committees and boards; presently she's a member of the Polar Research Board at the National Academies of Science, the Board for the Metcalf Institute at the University of Rhode Island School of Oceanography, and the advisory board for the UMass-Lowell Department of Environmental Earth, and Atmospheric Sciences.

Plenary Sessions: Tuesday, January 20 -- Gulf of Alaska

TIME	TITLE	PRESENTER	SECTION
8:00 - 8:15 AM	Long-term Observations of Alaska Coastal Current	Stabeno	Climate and Oceanography
8:15 - 8:30 AM	Influence of Gap Winds on Oceanography of the Gulf of Alaska	Ladd	Climate and Oceanography
8:30 - 8:45 AM	From the Glacier to the Gulf: Land Ice Melt Influences on Carbon Uptake and $CaCO_3$ Corrosivity in a Sensitive Marine Ecosystem	Evans	Climate and Oceanography
8:45 - 9:00 AM	Interannual Variability in Lower Trophic Levels on the Alaskan Shelf	Batten	Lower Trophic Levels
9:00 - 9:15 AM	Zooplankton Temporal and Spatial Variability in the Gulf of Alaska: Consequences to Resource Availability	Hopcroft	Lower Trophic Levels
9:15 - 9:45 AM	BREAK		
9:45 - 10:00 AM	Delayed Discard Mortality Studies for the Giant Pacific Octopus, *Enteroctopus dofleini*, in Alaska Waters	Conrath	Fish and Invertebrates
10:00 - 10:15 AM	Development of Biochemical Measures of Age in the Alaskan Red King Crab: Validation, Refinement, and Initial Assessment	Pinchuk	Fish and Invertebrates
10:15 - 10:30 AM	Importance of Antibody -- Producing Cells as a Marker for Successful Spawning in Sockeye Salmon	Zwollo	Fish and Invertebrates
10:30 - 10:45 AM	A Bayesian Assessment Model of Prince William Sound Herring	Muradian*	Fish and Invertebrates
10:45 - 11:00 AM	Size-at-age and Diet Composition of Pacific Halibut (*Hippoglossus stenolepis*) in Cook Inlet, Alaska	Webster*	Fish and Invertebrates
11:00 - 11:15 AM	Alaskan Groundfish Habitat Maps: High Latitudes on a Low Budget	Zimmerman	Fish and Invertebrates
11:15 - 11:30 AM	Long-term Trends of Seabird Density and Biomass in the North Pacific (1975-2012)	Drew	Seabirds
11:30 - 1:00 PM	BREAK - LUNCH PROVIDED		

* Masters; ** Doctorate

Plenary Sessions: Tuesday, January 20 -- Gulf of Alaska

TIME	TITLE	PRESENTER	SECTION
1:00 - 1:15 PM	Kittlitz's Murrelet -- a Leading Indicator of Ecological Changes in Three Alaska Marine Ecosystems?	Piatt	Seabirds
1:15 - 1:30 PM	In Cold Blood: Evidence of Sleeper Shark Predation on Steller Sea Lions from Life History Transmitter Implants	Horning	Mammals
1:30 - 1:45 PM	Foraging Decisions by Steller Sea Lions: Unexpected Consequences of Prey Distribution on Foraging Efficiency	Goundie*	Mammals
1:45 - 2:00 PM	Space Use of Northern Sea Otters Within an Exploited and Growing Population	Hoyt*	Mammals
2:00 - 2:15 PM	Individual Differences in Humpback Whale Foraging Behavior at Salmon Hatchery Release Sites	Chenoweth**	Mammals
2:15 - 2:30 PM	Exploring Spatial Changes in Sport Fishing Areas Using Interview and Historical Data in Southeast Alaska	Nga Chan**	Human
2:30 - 3:00 PM	BREAK		
3:00 - 3:15 PM	"Just Look at the Harbor": Fisheries Privatization, Social Transitions, and Well-Being in Kodiak, Alaska	Carothers	Human
3:15 - 3:30 PM	Widespread Kelp Carbon Assimilation by Pelagic and Benthic Nearshore Fishes	von Biela**	Ecosystem Perspectives
3:30 - 3:45 PM	Where Have All the Starfish Gone: An Examination of Sea Star Wasting in Alaska	Markis	Ecosystem Perspectives
3:45 - 4:15 PM	Gulf Watch Alaska: Monitoring the Pulse of the Gulf of Alaska's Changing Ecosystems	Holderied	Ecosystem Perspectives
4:15 - 4:45 PM	GOAIERP: Into the Home Stretch	Ormseth	Seabirds

* Masters; ** Doctorate

6:00 - 8:30 PM	POSTER SESSIONS

Plenary Session Abstracts

Tuesday, January 20

Long-term Observations of Alaska Coastal Current

Phyllis Stabeno
NOAA, Pacific Marine Environmental Laboratory, phyllis.stabeno@noaa.gov
Wei Cheng
University of Washington (UW), wei.cheng@noaa.gov
Seth Danielson
University of Alaska Fairbanks, sldanielson@alaska.edu
Nancy Kachel
UW, nancy.kachel@noaa.gov
Calvin Mordy
UW, calvin.mordy@noaa.gov

While the Alaska Coastal Current (ACC) is evident along much of the coast of Alaska from Chatham Strait to Samalga Pass, it is not a continuous feature. Disruptions in the flow occur at the exit to Cross Sound, from Icy Point to Yakutat, and at Kayak Island. The ACC, however, is a continuous, well-defined system extending for ~1,700 km along the coast of Alaska from Seward to Samalga Pass in the Aleutian Islands. The magnitudes of transports along the path of the ACC were derived using data collected at >20 mooring sites (a total of > 180 deployments) and from > 400 satellite-tracked drifters. While not continuous, the data spans a 30 year period (1984 – 2014). The transports measured using current measurements on four lines (Seward, Gore Point, Kennedy and Stevenson Entrances, and the exit to Shelikof Strait) were significantly correlated with alongshore winds, although the correlation at the Seward Line was weak. The largest mean transport occurred at Gore Point (1.4×10^6 m^3 s^{-1} in winter and 0.6×10^6 m^3 s^{-1} in summer). Integration of recently collected current-meter data (Gulf of Alaska Integrated Ecosystem Research Program and NOAA/EcoFOCI) with historical data sets provides a map of seasonal (May – mid-September and mid-September – April) transport in the ACC from southeast Alaska to Samalga Pass. The interaction of the ACC with topography results in mixing and prolonged summer production around Icy Point, Kodiak Archipelago, and Shelikof Strait.

Influence of Gap Winds on Oceanography of the Gulf of Alaska

Carol Ladd
NOAA, Pacific Marine Environmental Laboratory (PMEL), carol.ladd@noaa.gov
Wei Cheng
University of Washington, Wei.Cheng@noaa.gov
Sigrid Salo
PMEL, sigrid.a.salo@noaa.gov

Frequent gap winds, defined here as offshore-directed flow channeled through mountain gaps, have been observed blowing into the Gulf of Alaska (GOA). We examine the influence of these localized, high speed wind events on regional oceanography using QuikSCAT wind data, mooring observations, and ocean circulation modeling. Due to strong gradients in the along-shelf direction, these wind events can result in vertical velocities in the ocean of over 20 m d^{-1} due to Ekman pumping. Strong wind mixing can entrain higher nutrient water into the mixed layer, potentially enhancing primary production. Two regions with frequent gap winds are compared: Cross Sound (eastern GOA) and the Iliamna Lake gap near Kodiak Island (western GOA).

In the Cross Sound region, interannual variability in the frequency of gap wind events is correlated with El Niño. During gap wind events, the spatial scales of high off-shore directed winds reach almost 200 km offshore and 225 km along the shelf break, suggesting that the winds directly influence both the shelf (20 – 65 km wide) and the offshore waters. A model experiment suggests that Ekman pumping during a gap wind event can result in eddy formation. An association between El Niño events and eddy formation has been previously reported and gap wind forcing may be one mechanism explaining this association.

Gap winds from the Iliamna Lake gap have larger spatial extent than in the Cross Sound region, influencing the entire shelf width (> 200 km) northeast of Kodiak Island and extending an additional ~150 km off-shelf. Interannual variability is correlated with the Pacific North America Index and shows a linear trend, increasing by 1.35 days per year. The wind events in this region disrupt flow of the Alaska Coastal Current (ACC), resulting in decreased flow down Shelikof Strait and increased flow on the outer shelf. Disruption of the ACC has implications for freshwater transport into the Bering Sea. Recruitment of arrowtooth flounder (*Atheresthes stomias*) is negatively correlated, and Pacific cod (*Gadus macrocephalus*) positively correlated, with interannual frequency of Iliamna gap wind events, suggesting that oceanographic response to gap winds may influence the survival of larval fishes.

Gulf of Alaska - Climate and Oceanography

From the Glacier to the Gulf: Land Ice Melt Influences on Carbon Uptake and CaCO3 Corrosivity in a Sensitive Marine Ecosystem

Wiley Evans
NOAA, Pacific Marine Environmental Laboratory (PMEL), wiley.evans@noaa.gov
Jeremy Mathis
PMEL, jeremy.mathis@noaa.gov
Chris Meinig
PMEL, christian.meinig@noaa.gov
Noah Lawrence-Slavas
PMEL, noah.lawrence-slavas@noaa.gov
Scott Stalin
PMEL, scott.e.stalin@noaa.gov
Nicholas Delich
PMEL, nicholas.delich@noaa.gov
Geoff Lebon
PMEL, geoffrey.t.lebon@noaa.gov
Stacy Maenner
PMEL, stacy.maenner@noaa.gov
Jessica Cross
PMEL, jessica.cross@noaa.gov
Natalie Monacci
University of Alaska Fairbanks, nmonacci@alaska.edu

Melt from marine-terminating glaciers has been shown to be highly corrosive to calcium carbonate ($CaCO_3$) biominerals in coastal ocean settings including Prince William Sound (PWS). In addition to this trait, glacial melt plumes have also been described as strong sinks for atmospheric CO_2; setting up the potential for a positive feedback whereby $CaCO_3$ corrosivity is enhanced through air-sea CO_2 exchange. Up to now these observations have been based on sparse sampling conducted from bi-annual cruises focused on the Seward Line and from select stations within PWS. An open question is to what extent do glacial melt plumes impact the broader productive ecosystems of PWS and the adjacent northern Gulf of Alaska (GOA). To address this question, we initiated a multi-platform monitoring project to track coastal ocean corrosivity in PWS and the adjoining continental shelf from May through September of 2014. In conjunction with the bi-annual cruises and a previously established high-latitude mooring, we deployed 2 Carbon Wave Gliders and 1 Slocum Glider, as well as instrumented a glacier tour vessel with sensors to track $CaCO_3$ corrosivity. The Carbon Wave Gliders track corrosivity via direct measurements of the marine carbonate system, whereas data from the Slocum Glider was forced through regionally specific multiple linear regression algorithms to track corrosivity indirectly throughout the upper 200 m of the water column. Cumulatively, the 3 gliders transited ~10,000 km of horizontal distance over their ~135 day deployment collecting over 500,000 measurements, with the Slocum glider executing more than 5,000 dives during the longest high-latitude ocean carbon glider mission to date. The dataset obtained by these platforms illustrates: 1) the ability to

Interannual Variability in Lower Trophic Levels on the Alaskan Shelf

Sonia Batten
Sir Alister Hardy Foundation for Ocean Science, soba@sahfos.ac.uk
Dionysios Raitsos
Plymouth Marine Laboratory, dra@pml.ac.uk
Russ Hopcroft
University of Alaska Fairbanks (UAF), rrhopcroft@alaska.edu
Ken Coyle
UAF, coyle@ims.uaf.edu

The south Alaskan shelf region that encompasses the large inlets of Cook Inlet (CI) and Prince William Sound (PWS) and the outer shelf of the northern Gulf of Alaska is a productive, dynamic, subarctic shelf system supporting numerous valued marine resources such as commercially-harvestable fish (e.g., herring, salmon, groundfish), large marine mammals (e.g., beluga whales, humpback whales), and seabirds. Lower trophic level productivity underpins this ecosystem but our understanding of plankton variability in this region is still somewhat limited. This paper reports results from the first 13 years of the Continuous Plankton Recorder (CPR) program that has sampled the lower trophic levels (restricted to larger, hard-shelled phytoplankton and robust zooplankton taxa) with complementary data from the Seward Line. CPR sampling took place along a transect from the open ocean across the shelf (into CI from 2004 to 2012 and to the entrance to PWS from 2000 to 2003) to provide plankton abundance data, spring through autumn of each year. We have found that warm years had generally higher abundances of the larger phytoplankton cells retained by the CPR, particularly of diatoms. Diatom spring phenology (timing) revealed an influence by water column conditions such as salinity, which is important in setting up water column stability. There was also a strong correlation with the North Pacific Gyre Oscillation (NPGO) index, which is known to explain salinity variability further south in the California Current system. Total mesozooplankton biomass was shown to be strongly positively correlated with diatom abundance, and less strongly but still positively, was the abundance of major zooplankton groups. Zooplankton community composition was also influenced by temperature with changes not as dramatic as a replacement of many species by others, but rather a change in relative abundances with temporary occurrences of some rare species. These CPR data thus support the hypothesis that the physical environment of the Gulf of Alaska shelf (in this case SST and salinity) influences the phytoplankton (diatom abundance and phenology), which in turn controls the quantity of mesozooplankton. We can therefore speculate that higher trophic levels such as fish will be influenced.

Zooplankton Temporal and Spatial Variability in the Gulf of Alaska: Consequences to Resource Availability

Russell Hopcroft
University of Alaska Fairbanks (UAF), rrhopcroft@alaska.edu
Ken Coyle
UAF, kocoyle@alaska.edu

The Gulf of Alaska program allowed extensive sampling of the Gulf of Alaska shelf in 2011 and 2013. Using the Seward Line as reference, during 2011 zooplankton assemblages were anomalously depressed from southeast Alaska to Kodiak due to a strong salp bloom, while 2013 appears relatively typical. We examine the specifics of the cross-shelf and along-shelf patterns in the zooplankton community for the narrow shelf in Southeast and the broad shelf in the northern Gulf of Alaska. The consequences of these differences in the size-spectra of prey available to larval-fish is considered, as well as the potential productivity differences between regions.

Delayed Discard Mortality Studies for the Giant Pacific Octopus, *Enteroctopus dofleini*, in Alaska Waters

Christina Conrath
NOAA, Alaska Fisheries Science Center (AFSC), Christina.Conrath@noaa.gov
Nicholas Sisson
AFSC, Nick.Sisson@noaa.gov

The giant Pacific octopus (*Enteroctopus dofleini*) is the most abundant octopus species found on the continental shelf of Alaska and it dominates the commercial catch of octopus within Alaska waters. There is no fishery directly targeting octopus, but they are taken as bycatch in trawl, longline, and pot fisheries throughout Alaska, with the majority of catch coming from the Pacific cod (*Gadus macrocephalus*) pot fishery. Recent changes to management of octopus within this region necessitate a more complete understanding of the fate of octopus captured and eventually released during fishing operations. Previous research conducted by on-board fisheries observers and from short-term delayed mortality studies, indicated a low level of fishery induced mortality (< 10%). Until now, there were no experimental data on delayed mortality beyond a few days after release. A study of long-term, delayed discard mortality was initiated at the Kodiak Laboratory seawater facility beginning in January 2014 with octopus captured in the Gulf of Alaska cod pot fishery. In these experiments octopus were held for at least 24 days after capture. Preliminary results from this delayed mortality study support the conclusion that giant Pacific octopus experience a low level of mortality (10-25%) when captured during these fishing operations. This research will aid in the management of octopus within this region by providing better estimates of fishery induced mortality on this non target species.

Development of Biochemical Measures of Age in the Alaskan Red King Crab: Validation, Refinement and Initial Assessment

Alexei Pinchuk
University of Alaska Fairbanks (UAF), aipinchuk@alaska.edu
Rodger Harvey
Old Dominion University, rharvey@odu.edu
Ginny Eckert
UAF, gleckert@alaska.edu

Age determination of marine organisms is a central metric for understanding the timing and magnitude of spawning, recruitment and habitat use, juvenile duration, and population age structure. For the commercially important red king crab (RKC) (*Paralithodes camtschaticus*) size-based models are used in lieu of age-based models for estimating population dynamics and for fishery management. Yet we know that crab growth and thus size is not a linear process, but typically is seen as a step function with intermittent molts of varied periodicity which complicates the estimation of population dynamics and timing of key life history parameters using carapace size alone. We have developed an alternative approach based on analysis of specific age pigments (lipofuscins) in neural tissues to assess RKC age and allow a more robust metric of age than carapace size measurements alone. A preliminary validation of the presence and utility of these biochemical markers for known age animal (0-4 years) in combination with a long term experimental assay to assess the effect of temperature on age pigment accumulation rates in juvenile RKC hatched in captivity has shown very promising results to address a variety of questions for management of the fishery.

Importance of Antibody-producing Cells as a Marker for Successful Spawning in Sockeye Salmon

Patty Zwollo
College of William and Mary, pxzwol@wm.edu

During the spawning phase, salmon undergo drastic, hormonally driven changes in their physiology, including elevated levels of cortisol, which are known to suppress the immune system. Specific antibodies are a major source of protective immunity in salmon, but spawning fish have a reduced capacity to generate new antibodies. However, we recently discovered the existence of so-called "long-lived antibody-producing plasma cells", which are generated in juvenile fish, and then stored in the anterior kidney for the remainder of their lifetime. As adult fish need to survive their long journey back to the spawning grounds, we hypothesized that these long-lived antibody-producing cells are essential for pre-spawning survival. Hence, the abundance of such cells might provide a good marker not just for pre-spawning survival, but also for the production of viable offspring. For this study, the presence of long-lived antibody-producing cells was measured in immune tissues from migrating sockeye salmon, using real-time qPCR and flow cytometry. Immune tissue samples were collected from salmon from the Kenai River drainage, Main Bay, and Prince William Sound. Our results reveal that migrating fish retain high levels of the antibody-producing cells in their anterior kidney throughout the spawning journey. Antibody was also detected in the eggs of salmon at their spawning site and prior to spawning. Furthermore, we show that antibody-producing cells remain abundant in post-spawning sockeye salmon, even when other immune cells are lost. This suggests that in order for a sockeye salmon to be successful, it needs to retain its long-lived antibody-producing cells throughout the spawning journey and post-spawning.

A Bayesian Assessment Model of Prince William Sound Herring

Melissa L. Muradian
University of Washington (UW), murad17@uw.edu
Trevor A. Branch
UW, tbranch@uw.edu

The Pacific herring (*Clupea pallasii*) population in the Prince William Sound crashed in 1992-93 and has yet to recover, affecting food web dynamics in the Sound. The commercial herring fishery has been closed for 18 years due to low biomass, resulting in approximately $230 million in lost income to Alaskan communities. Today many questions persist about what caused the crash and the future of the population. Was it toxicity or habitat loss from the *Exxon Valdez* Oil Spill in 1989, an increase in disease mortality, or an increase in whale predation that caused the crash? Are these the same factors contributing to recent low abundance or have new pressures been introduced? To explore these questions we used a Bayesian assessment model which combines multiple data sets with prior knowledge to provide estimates of key ecological metrics with uncertainty, as well as probabilities of alternative hypotheses or states of the herring population. Herring biomass in 2013 was estimated to be between 28,000 and 79,000 t (95% credibility interval). There was a > 99% probability that biomass in 2013 was above the management threshold of 20,000 t required before the fishery is reopened, but mean current estimates are lower than those prior to the collapse. This model will be used in a simulation study to explore which data types are most informative for estimating status. This research provides critical information about how to prioritize current and future monitoring efforts to better understand the past and future ecology of the species.

Size-at-Age and Diet Composition of Pacific halibut (*Hippoglossus stenolepis*) in Cook Inlet, Alaska

Sarah Webster
Alaska Pacific University (APU), swebster@alaskapacific.edu
Brad Harris
APU, bharris@alaskapacific.edu
Jeffery Welker
University of Alaska Anchorage, jmwelker@uaa.alaska.edu

Declining Pacific halibut (*Hippoglossus stenolepis*) size-at-age in southcentral Alaska remains unexplained and the mechanisms driving slower growth have not been assessed. The decrease in size-at-age may be diet-driven so during the summers of 2012-2013 we implemented a "*pre-dumpster, post-mortem*" port-sampling method in the port of Homer, AK, to record sex, length, location, and stomach contents, and to collect muscle tissue and otoliths from the carcasses of halibut landed in the sport fishery. Our objectives were to: 1) compare halibut size-at-age in Lower Cook Inlet with International Pacific Halibut Commission's survey samples; 2) describe the stable isotope ($d^{13}C$ and $d^{15}N$) ratios of halibut prey; 3) evaluate halibut diet composition using gut contents and stable isotopes; 4) determine if diet composition varied with size, age, sex and location; and 5) determine if diet was correlated with size-at-age. Sampling was size-based and targeted at least 30 individuals from each 10-cm size group for males and females. Fish were aged using otoliths. The presence-absence of prey items in fish stomachs was assessed and assimilated dietary proportions established using stable isotope mixture models implemented in a Bayesian framework. The 703 (222 male, 481 female) halibut we sampled were larger on average than fish sampled by the IPHC Area 3A survey. Nearly 25% of stomachs sampled were empty, 40% contained fishes, 37% crabs, 9% cephalopods, and 9% identifiable bait. Halibut muscle tissue (568 samples) had a wide range of stable isotope values (δ13C = -18.73‰ to -14.75‰, δ15N = 13.43‰ to 19.62‰) and (after fractionation adjustment) overlapped the values of prominent prey. Prominent prey (fish, crabs, cephalopods, zooplankton) had unique isotopic signatures of $d^{13}C$ and $d^{15}N$ (MANOVA, $F(3, 179) = 34.76$, $p < 0.001$). Based on stable isotope ratios in halibut muscle, diet varied significantly by size, age, location and sampling date for both males and females and for sex (MANOVAs, $p < 0.01$). Further, among 80 – 89 cm females, age was negatively correlated with both mean δ13C ($r^2 = 0.68$) and δ15N ($r^2 = 0.91$); on average, faster growing fish were more enriched in $d^{13}C$ ($p < 0.001$) and $d^{15}N$ ($p < 0.001$). This supports the hypothesis that diet may be driving size-at-age.

Alaskan Groundfish Habitat Maps: High Latitudes on a Low Budget

Mark Zimmermann
NOAA, National Marine Fisheries Service, mark.zimmermann@noaa.gov
Megan Prescott
Ocean Associates, Inc., megan.prescott@noaa.gov

Alaskan marine waters lack adequate information, including depth and sediment type, to produce groundfish habitat maps, which are needed for a variety of research and management purposes. Groundfish habitat information can be produced with modern surveying techniques, such as multibeam, sidescan sonar and seafloor video surveys, but these methods are very expensive and time consuming. Smooth sheets - the precursors to the less-detailed navigational charts - are a cheaper alternative that include more soundings, substrates, shoreline and feature information which can be used for groundfish habitat mapping and other applications. Smooth sheets were used to supply the information for the juvenile groundfish habitat suitability modeling in the Gulf of Alaska Integrated Ecosystem Research Program (GOAIERP), site comparisons between GOAIERP inshore study sites, coral and sponge predictive modeling, trawlability analysis, geological substrate mapping, tide modeling and wetting/drying algorithms. Careful editing of the smooth sheet bathymetry has revealed significant shoreline changes and previously unknown details of significant seafloor features. We have published data sets for the Aleutian Islands and Cook Inlet - other areas, such as the central Gulf of Alaska, are in progress (http://www.afsc.noaa.gov/RACE/groundfish/bathymetry/).

Long-term Trends of Seabird Density and Biomass in the North Pacific (1975-2012)

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

Seabirds are highly visible and well-distributed marine predators, and can be useful indicators of marine ecosystem status, and changes in seabird ecology have frequently been linked to local or regional food resources and oceanographic conditions. Our recent compilation of more than 350,000 standardized at-sea survey transects collected over 40 years into the North Pacific Pelagic Seabird Database (NPPSD, Ver. 2) now provides us with the ability to detect trends and/or resolve patterns at large marine ecosystem or basin scales using seabirds as indicators. We explored the use of the NPPSD to address large-scale ecological questions by binning the data into 100 km × 100 km cells and applying a series of filters; selecting only cells with long sample records. This time-series of data, geographically spanning from the western Aleutian Islands to British Columbia Canada in the east, was tested for general trends in biomass and density. Results indicate there has been a decrease in overall seabird density (# birds/km2) and biomass (kg/km2) in the North Pacific over the last 4 decades. This result agrees with the general negative trends of various marine top predators in the Northern Gulf of Alaska and Bering Sea since 1990.

Kittlitz's Murrelet - a Leading Indicator of Ecological Changes in Three Alaska Marine Ecosystems?

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

Kittlitz's murrelet (*Brachyramphus brevirostris*), a small seabird in the auk family, evolved in Beringia during the Pleistocene and thrives in icy-cold environments. Present-day breeding populations are associated with glaciated coastal areas of the Gulf of Alaska (GOA) and Bering Sea. During summer, murrelets nest in these areas and lay a single egg on bare rocks on alpine mountain slopes up to about 2,000 m in elevation and 50 km inland. Nesting adults forage away at sea on energy-rich prey such as sand lance, capelin and krill, typically in cold or glacially-modified marine waters where such prey are abundant. Satellite tagging and isotopic diet studies suggest that after breeding, murrelets from the GOA migrate up to 3,500 km into the Bering, Chukchi and Beaufort seas, probably in search of dense forage fish schools to sustain a flightless molt and add fat reserves for winter. Many murrelets then overwinter in polynyas or along the sea-ice edge of the Bering Sea. Compared to other alcids, murrelets have a more limited capacity to buffer against food shortages, and the annual odyssey of Kittlitz's murrelets among three marine ecosystems— and within extreme cold corners of those ecosystems— must be challenging. How have they fared during recent warm climate cycles? Evidence suggests that as water temperatures warmed in the GOA and Bering Sea after the 1976 regime shift, murrelet populations declined markedly until the mid- 2000s. These declines coincided with large-scale changes in biogeography of forage species in the GOA and Bering Sea that were in turn linked with multi-decadal climate cycles. Effects may resonate across seas and seasons. For example, the decline of murrelets in Prince William Sound between 1989 and 2007 was correlated with an increase in average trophic level and northward spatial displacement of fish communities on the SE Bering Sea shelf. As conditions returned to normal (cold) in the SE Bering Sea and GOA after the mid-2000s, murrelet populations started increasing again for the first time in 30 years. Thus it appears that murrelet population dynamics may provide an integrated and leading indicator of foraging conditions in three different marine ecosystems of Alaska.

In Cold Blood: Evidence of Sleeper Shark Predation on Steller Sea Lions from Life History Transmitter Implants

Markus Horning
Oregon State University, markus.horning@oregonstate.edu
Jo-Ann Mellish
University of Alaska Fairbanks, joannm@alaskasealife.org

Temperature data transmitted post-mortem from 15 of 36 juvenile Steller sea lions (*Eumetopias jubatus*) with implanted Life History Transmitters (LHX tags, Wildlife Computers) suggest all 15 animals died by predation. In three cases at least one of two LHX tags was ingested by a cold-blooded predator and tags recorded temperatures corresponding to deep-water values after death. These tags were ejected 5 – 11 days later and transmitted after sensing light and air while floating at the surface, reporting temperatures corresponding to regional sea surface estimates. A fourth case is ambiguous, and eleven cases recorded immediate tag liberation that did not allow inferences of predator species. Among reported predators of Steller sea lions, only sleeper sharks are known to have body core temperatures near ambient. Our data suggests that Pacific sleeper sharks (*Somniosus pacificus*) need to be considered as a possible source of juvenile Steller sea lion mortality in the Gulf of Alaska region. In contrast, published studies of sleeper shark stomach contents near rookeries provided no evidence of sea lion tissue. However, estimates revealed a less than 5% likelihood of sampling such tissue amongst 200 sharks, while the probability of detecting sleeper shark attacks from LHX tags implanted into 36 sea lions is near 100%.

Foraging Decisions by Steller Sea Lions: Unexpected Consequences of Prey Distribution on Foraging Efficiency

Elizabeth Goundie
University of British Columbia (UBC), e.goundie@fisheries.ubc.ca
David Rosen
UBC, rosen@zoology.ubc.ca
Andrew Trites
UBC, a.trites@fisheries.ubc.ca

Reduced prey availability is hypothesized to be contributing to the decline of Steller sea lions (*Eumetopias jubatus*) in the Gulf of Alaska and Bering Sea. Resulting potential changes in foraging strategies could also have dramatic effects on an individual's energy balance and subsequent survival. We tested the effects of changes in prey availability on sea lion foraging behavior and efficiency by measuring diving metabolic rate, dive durations and food intake of 4 trained Steller sea lions diving in the open ocean on prey patches of different densities. We created simulated prey patches at two depths (10 and 40 m) with high and low prey encounter rates. Each sea lion completed bouts of 5 consecutive dives in which they chose dive duration and time at the surface. We found that the rate of energy expenditure did not change under any of the imposed foraging conditions (mean ± SD: 0.22 ± 0.02 kJ min^{-1} kg^{-1}), but that the proportion of time spent consuming prey increased with prey patch density due to changes in diving patterns. At both depths, sea lions spent a greater proportion of the dive bout foraging on prey patches with high prey encounter rates, which led to high rates of energy gain (4.3 ± 0.96 kJ min^{-1} kg^{-1}) and high foraging efficiency (cost:benefit – 1:20). In contrast, sea lions spent a smaller proportion of their dive bout actively feeding at prey patches with low prey encounter rates, and consequently had a lower energetic gain (0.91 ± 0.29 kJ min^{-1} kg^{-1}) and foraging efficiency (1:4)—beyond what was expected simply due to the decrease in food availability. Our results suggest that sea lions faced with reduced prey availability are also much less efficient foragers, making it more difficult for them to reach their daily energy requirements. This has implications for population recovery, as individual sea lions will either be at a lower nutritional plane, or will have to spend more time foraging—making them more susceptible to predation and taking away time and energy for other essential activities, such as maternal care.

Space Use of Northern Sea Otters Within an Exploited and Growing Population

Zac Hoyt
University of Alaska Fairbanks (UAF), znhoyt@alaska.edu
Verena Gill
Bureau of Ocean Energy Management, verena.gill@boem.gov
Ginny Eckert
UAF, gleckert@alaska.edu
Tim Tinker
U.S. Geological Survey, ttinker@usgs.gov

The distribution of the growing sea otter (*Enhydra lutris*) population in southeast Alaska is most influenced by hunting pressure and habitat segregation between non-territorial males and females. The understanding of space use by the expanding sea otter population in southeast Alaska is critical due to conflict between sea otters and commercial fisheries and increased harvest of sea otters by coastal Alaska Natives. To investigate space use we monitored the movements of 30 sea otters tagged with VHF transmitters from May 2011-April 2014 near Kake, Alaska, which was the distributional edge of an expanding population during a 2010 survey. We collected a total of 1,056 geo-locations from these animals using aerial and ground-based telemetry. We then evaluated habitat selection and generated models of occurrence based on a bivariate normal probability distribution function, as well as the following covariates: 1) hunting pressure, 2) exposure, 3) canopy kelp coverage, 4) bathymetry, 5) distance to shore, and 6) sea otter survey strata for females, territorial males and non-territorial males. Because sea otter harvest drastically increased around Kake during the study (from 10 annual reported takes prior to 2012, to 188 annual takes for 2012-2013), we compared space use before (2011-2012) and after (2012-2014) this increase in hunting. Exposure was found to be the primary factor influencing resource selection by non-territorial male sea otters, while the primary factor for females was canopy kelp coverage. The best-fit models indicated segregation of space use between females and non-territorial males. Covariates influencing territorial males were more variable, and showed overlap in selection parameter estimates with both female and non-territorial males. Space use from pre- to post-hunting time periods was reduced by 18.7% for females and 25.3% for non-territorial males, suggesting reduction in the area occupied by this population as a function of hunting, while space use remained relatively unchanged for territorial males throughout the study.

Individual Differences in Humpback Whale Foraging Behavior at Salmon Hatchery Release Sites

Ellen Chenoweth
University of Alaska Fairbanks, emchenoweth@alaska.edu
Janice Straley
University of Alaska Southeast, jmstraley@uas.alaska.edu
D. Nevé Baker
Whitman College, bakerdn@whitman.edu
Steve Reifenstuhl
Northern Southeast Regional Aquaculture Association, steve.reifenstuhl@gmail.com

During late spring in southeast Alaska, hatcheries release juvenile salmon (*Oncorhynchus* spp.) from holding pens close to shore. Since 2008, humpback whales (*Megaptera novaeangliae*) have targeted these salmon releases resulting in potential economic implications for fisheries and risk of entanglement for humpback whales. This study was piloted in 2010 with visual predator surveys at five hatchery release sites on eastern Baranof Island. In 2014, we intensified field effort at Hidden Falls and Takatz release sites. Using photographic identification, we documented a minimum of 24 unique individuals during 43 encounters across 28 field days. All sightings per individual per day were considered as one encounter. Four whales were feeding on juvenile salmon, as confirmed by subsurface videography and collection of target prey. Each these whales, and no others, were observed surface lunging and/or single animal bubble-net feeding within 4 m of shore or a holding pen. Whales were documented feeding in this manner during all parts of the diurnal cycle. Among these four whales, were the two most frequently sighted (10 and 5 days). The other two were first sighted on the second to last day of the study. In the population at large, the average number of days sighted was 1.8, but most whales, (78%, n = 18) were sighted only once. The location and season of the study suggests that these whales could have been migrating to primary feeding areas elsewhere. Indeed, some of the whales had been sighted in different feeding areas throughout Southeast Alaska in previous years. In addition to salmon fry, we collected three known types of humpback whale prey: herring (*Clupea pallasii*), sand lance (*Ammodytes hexapterus*), and krill (Euphausiacea). Echosounders surveys near some feeding whales suggesting adult herring were being targeted. There appears to be individual differences in prey selection at hatchery release sites with few whales targeting juvenile salmon but demonstrating higher site fidelity and distinctive behaviors.

Exploring Spatial Changes in Sport Fishing Areas Using Interview and Historical Data in Southeast Alaska

Maggie Nga Chan
University of Alaska Fairbanks (UAF), nlchan@alaska.edu
Anne Beaudreau
UAF, abeaudreau@alaska.edu

This poster explores spatial changes in fishing areas for Pacific halibut (*Hippoglossus stenolepis*) and salmon (*Oncorhynchus* spp.) in southeast Alaska. This poster presents preliminary findings based on interviews with sport charter operators in May 2014 in Sitka, Alaska. Respondents were asked to mark fishing locations for halibut and salmon over his or her charter fishing experience. Additional open-ended questions asked respondents to describe drivers of changes in where they fish. Spatial data from interviews were compared with historical maps displaying halibut and salmon sport fishing areas. Interview and historical maps were digitized in ArcGIS. Changes in location and size of fishing areas were examined over time. Research into spatial changes in fishing areas may help identify local trends to fish populations, such as changes to distribution.

"Just Look at the Harbor": Fisheries Privatization, Social Transitions, and Well-Being in Kodiak, Alaska

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

Scholars and fishermen alike view the privatization of fishing rights as a fundamental driver of social change in fishing communities. This paper presents the results of a mixed-methods ethnographic study in Kodiak, Alaska, exploring how fisheries privatization processes remake fishery systems. Findings from this study suggest that a diverse range of fishery participants share core values about the social dimensions of fishery systems. Support or opposition to past privatization processes tended to be articulated in reference to how these core values (e.g., hard work, opportunity, and fairness) were perceived to have been strengthened or eroded by such processes. Data from this study suggest that while still widespread in the Kodiak fishing community, core social values in fishing may be changing as a result of privatization processes. While ethnographic and survey data showed a range of perspectives on the effects of privatization on fishing and the Kodiak community, study participants tended to talk about privatization as a significant change that had divisive, negative impacts in the community. Crew members and the next generation of fishermen were identified as disproportionately affected by privatization processes. Ethnographic data detail important shifts in the power, status, and livelihoods of crew members. Nearly all Kodiak fishery participants interviewed expressed concern about the future of fisheries access in the community for the next generation, in large part because of the substantial financial barriers to entry generated by privatization of fisheries access. Many discussed the need for more entry-level opportunities necessary for access in all fisheries.

Widespread Kelp Carbon Assimilation by Pelagic and Benthic Nearshore Fishes

Vanessa von Biela
U.S. Geological Survey (USGS), Alaska Science Center, vvonbiela@usgs.gov
Seth Newsome
University of New Mexico, newsome@unm.edu
James Bodkin
USGS, Alaska Science Center, jbodkin@usgs.gov
Gordon Kruse
University of Alaska Fairbanks, gordon.kruse@alaska.edu
Christian Zimmerman
USGS, Alaska Science Center, czimmerman@usgs.gov

Use of multiple energy pathways by predators may lead to enhanced food web stability by providing resilience to disruptions caused by declines in any one source. When predators use multiple energy pathways, the result of declining availability in any one source may be balanced by continued availability of another source. To explore the relative use of phytoplankton and kelp sources of carbon in nearshore marine fish predators, we measured carbon isotope values ($d^{13}C$) in epaxial muscle sampled from benthic-foraging kelp greenling (*Hexagrammos decagrammus*) and pelagic-foraging black rockfish (*Sebastes melanops*) at eight sites spanning ~35 – 60°N across the California Current (upwelling system) and Alaska Coastal Current (downwelling system) in the northeast Pacific Ocean. Muscle $d^{13}C$ values were expected to be highest for fish primarily assimilating carbon from kelp, lowest for those primarily assimilating carbon from phytoplankton, and intermediate for those assimilating a combination of both. The $d^{13}C$ values were higher in benthic-feeding kelp greenling than in pelagic-feeding black rockfish at most sites, indicating more kelp carbon use for greenling (paired t-tests, 7 of 8 locations, $P < 0.001$). Nevertheless, isotope mixing models suggested that both black rockfish and kelp greenling consistently use both kelp- and phytoplankton-derived carbon at all study sites and revealed moderate to high kelp carbon use. Kelp carbon use varied by location ranging from 51-98% in kelp greenling and 54-80% in black rockfish. We conclude that these two nearshore fishes routinely combine kelp and phytoplankton carbon pathways across coastal upwelling and downwelling systems. This pattern of dual-source carbon use, taken together with findings from other studies, appears to reflect a pervasive mechanism that could foster resilience of nearshore marine food webs to climate and human disturbances.

Where Have All the Starfish Gone: An Examination of Sea Star Wasting in Alaska

Joel Markis
University of Alaska Southeast (UASE), joel.markis@uas.alaska.edu
Marnie Chapman
UASE, mdchapman@uas.alaska.edu
Taylor White
Sitka Sound Science Center, twhite@sitkascience.org
Melissa Miner
University of California (UC), Santa Cruz, cmminer@ucsc.edu
Peter Raimondi
UC, Santa Cruz, raimondi@ucsc.edu

Sea star (Asteroidea) wasting syndrome is a term used to describe a group of symptoms that include lesions, tissue decay, body fragmentation, and eventual death leading to mass die-off of sea star populations. Cases were first detected in June of 2013 along the Olympic Coast in Washington. Since then the syndrome has been detected from Mexico to Alaska. We present an initial look at the status of the syndrome in Alaska as well as a detailed examination of an outbreak and mass die-off detected in Sitka Sound. We document changes in surface morphology, sequential syndrome progression from species to species and the timeframe from largely asymptomatic populations to mass appearance of symptoms to mass die-off for several species affected in intertidal and subtidal habitats. Neither the cause of this syndrome nor its transmission vectors are understood. The ecological implications of removing top level predators from intertidal and subtidal habitats will be profound. If the syndrome transitions to other echinoderm species it could also have severe economic impacts to commercial dive fisheries.

Gulf Watch Alaska: Monitoring the Pulse of the Gulf of Alaska's Changing Ecosystems

Kris Holderied
NOAA, National Ocean Service (NOS), kris.holderied@noaa.gov
Molly McCammon
Alaska Ocean Observing System (AOOS), McCammon@aoos.org
Katrina Hoffman
Prince William Sound Science Center, khoffman@pwssc.org
Tammy Neher
NOS, tammy.neher@noaa.gov
Tom Weingartner
University of Alaska Fairbanks (UAF), tjweingartner@alaska.edu
Russ Hopcroft
UAF, rrhopcroft@alaska.edu
Mandy Lindeberg
NOAA, Alaska Fisheries Science Center, mandy.lindeberg@noaa.gov
Brenda Ballachey
U.S. Geological Survey, Alaska Science Center, bballachey@usgs.gov

Gulf Watch Alaska, the long-term ecosystem monitoring program of the *Exxon Valdez* Oil Spill Trustee Council, integrates efforts of 15 field monitoring projects within the northern Gulf of Alaska from Prince William Sound to Katmai National Park and Preserve. Over 40 scientists participate in the collection and distribution of data ranging from physical ocean conditions and nearshore habitats to species distributions and lingering oil exposure. The program fosters collaboration across research specialties with a focus on providing integrated physical and biological information to support management of spill-affected species. The program also uses conceptual modeling to guide synthesis efforts and identify potential data gaps and sources of variability. Several data sets within the program extend across decades and are being used to focus process studies, examine the long-term effects of the spill, and identify potential drivers of ecosystem change in the context of a changing climate. We review recent results from several of the monitoring projects and discuss highlights from the initial Gulf Watch Alaska science synthesis completed in 2014. We also highlight program resources including publicly available data sets, visualization tools, and recent publications.

GOAIERP: Into the Home Stretch

Olav Ormseth
NOAA, Alaska Fisheries Science Center (AFSC), olav.ormseth@noaa.gov
Russ Hopcroft
University of Alaska Fairbanks (UAF), rrhopcroft@alaska.edu
Carol Ladd
NOAA, Pacific Marine Environmental Laboratory, carol.ladd@noaa.gov
Franz Mueter
UAF, fmueter@alaska.edu
Kalei Shotwell
AFSC, kalei.shotwell@noaa.gov

The Gulf of Alaska Integrated Ecosystem Research Program (GOAIERP) is entering its final stages. The goal of the GOAIERP (duration 2010-2015) is to use coordinated investigations at multiple trophic levels to better understand the dynamics of the GOA ecosystem and the forces that influence the survival of juvenile fishes. Researchers have now completed retrospective data analysis, two intensive years of field work, laboratory studies, and numerous biophysical model runs (including nutrient-phytoplankton-zooplankton ocean-circulation models and individual-based models). As we analyze and interpret the vast amount of data generated during the GOAIERP, significant findings are beginning to emerge. The first year of life appears to be very different for each of the five focal fish species, resulting from interactions between species' behaviors and consequent differences in their environmental exposure. We have identified a consistent breakpoint between the eastern and central GOA that occurs across many physical and biological components of the ecosystem, and have identified potential mechanisms to explain this result. The two main field years, 2011 and 2013, were very different at multiple trophic levels and we are exploring potential drivers of that variability. Our results also suggest that in the GOA, localized processes (e.g. the influence of Cross Sound in southeast Alaska) may be just as important as larger-scale ecosystem drivers. The research conducted during GOAIERP is expected to generate 50+ peer-reviewed papers, indicating just how productive an integrated ecosystem approach can be. Planning is underway for an extended synthesis period through 2017 that will further enhance the level of integration and expand on some of the key themes of the GOAIERP. This talk will present a summary of findings to date and specifically address the value of the IERP approach.

Plenary Sessions: Wednesday, January 21 -- Bering Sea

TIME	TITLE	PRESENTER	SECTION
8:00 - 8:15 AM	The Bering Sea CO_2 sink: New Autumn and Winter Observations of a Seasonally Ice-covered Continental Shelf	Cross	Climate and Oceanography
8:15 - 8:30 AM	The Relative Importance of Advective versus In situ Processes to Mesozooplankton Biomass on the Eastern Bering Sea Shelf	Gibson	Lower Trophic Levels
8:30 - 8:45 AM	Do Modeled Zooplankton Abundances Increase the Hindcast and Prediction Strength of Fish Recruitment Models?	Holsman	Fish and Invertebrates
8:45 - 9:00 AM	An Exploratory Assessment of Thiamine Status in Yukon River Chinook salmon (*Oncorhynchus tshawytscha*)	Honeyfield	Fish and Invertebrates
9:00 - 9:15 AM	Impact of Climate Variability and Change on Winter Survival of Bristol Bay Sockeye Salmon	Yasumiishi	Fish and Invertebrates
9:15 - 9:30 AM	Small- scale Atka Mackerel Population Abundance and Movement in the Western Aleutian Islands, an Area of Continuing Steller Sea Lion Decline	Mcdermott	Fish and Invertebrates
9:30 - 10:00 AM	BREAK		
10:00 - 10:15 AM	Atka Mackerel Essential Fish Habitat on a Local Scale in the Aleutian Islands, Alaska	Levine	Fish and Invertebrates
10:15 - 10:30 AM	Movement, Size Composition, Potential Essential Habitat, and Handling of Norton Sound Red King Crab *Paralithodes camtschaticus*	Bell	Fish and Invertebrates
10:30 - 10:45 AM	Capturing Effects of Alternative Groundgear for the Bering Sea Pollock Fishery	Hammond	Fish and Invertebrates
10:45 - 11:00 AM	The Assessment of Benthic Impacts of Raised Groundgear for the Eastern Bering Sea Pollock Fishery	Zagorski	Fish and Invertebrates
11:00 - 11:15 AM	Increasing Variability of Ecological Response by Beringian Endemic Seabirds to Rapid Environmental Change	Causey	Seabirds
11:15 - 11:30 AM	Effects of Marine Debris: Phthalate and PCB Contamination in Seabirds from the Western Aleutian Islands	Padula*	Seabirds
11:30 - 1:00 PM	BREAK		

* Masters; ** Doctorate

Plenary Sessions: Wednesday, January 21 -- Bering Sea

TIME	TITLE	PRESENTER	SECTION
1:00 - 1:15 PM	Seabird Die-off Detected During a Major Coccolithophore Bloom in the Bering Sea in 2014	Labunski	Seabirds
1:15 - 1:30 PM	Retrospective Study of Walrus Foraging and Movement Patterns During a Major Ecosystem Shift	Newsome	Mammals
1:30 - 1:45 PM	Pre-weaning Growth and Blubber Deposition in Pacific Walruses	Noren	Mammals
1:45 - 2:00 PM	The Origin of Feces: Does Diet Diversity Matter More Than Prey Quality for Northern Fur Seals?	Diaz Gomez	Mammals
2:00 - 2:15 PM	Flying Beneath the Clouds at the Edge of the World: Using an Unmanned Aircraft System to Survey the Endangered Steller Sea Lions in the Aleutian Islands	Sweeney	Mammals
2:15 - 2:30 PM	Blow as an Alternative Matrix and Non-invasive Tool for Measuring Cortisol in Wild Belugas During Population Health Assessments in Bristol Bay, AK	Thompson	Mammals
2:30 - 3:00 PM	BREAK		
3:00 - 3:15 PM	First Record of Diving Behavior of Resident-type Killer Whales in the Aleutian Islands and Documentation of a 2,500 km Southward Movement and Return in Three Weeks	Wade	Mammals
3:15 - 3:30PM	Managing Leviathan: The Current Status of Large Whale Populations in the North Pacific	Clapham	Humans
3:30 - 3:45 PM	Variability in Mean Weight Per Fish: How Much Does it Matter?	Cahalan	Mammals
3:45 - 4:00 PM	Smart Fishing in the Bering Sea: Conservation Engineering Outreach	Simpson*	Humans
4:00 - 4:15 PM	Marine Vessel Traffic and Shoreline Vulnerability in the Aleutian Archipelago	Robards	Humans
4:15 - 4:30 PM	Addressing Climate Change Vulnerabilities in the Aleutian and Bering Sea Islands	Tyler	Ecosystem Perspectives
4:30 - 4:45 PM	**Best Student Poster Presentation Winners Announced**		

* Masters; ** Doctorate

Plenary Session Abstracts

Wednesday, January 21

The Bering Sea CO_2 Sink: New Autumn and Winter Observations of a Seasonally Ice-covered Continental Shelf

Jessica Cross
University of Alaska Fairbanks (UAF), jncross@alaska.edu
Jeremy Mathis
UAF, jtmathis@alaska.edu
Karen Frey
Clark University, kfrey@clarku.edu
Cathy Cosca
NOAA, Pacific Marine Environmental Laboratory (PMEL), cathy.cosca@noaa.gov
Seth Danielson
UAF, sethldanielson@alaska.edu
Nicholas Bates
Bermuda Institute of Ocean Sciences, nick.bates@bios.edu
Richard Feely
PMEL, richard.a.feely@noaa.gov
Taro Takahashi
Lamont-Doherty Earth Observatory, Columbia University, taka@ldeo.columbia.edu
Wiley Evans
UAF, wiley.evans@alaska.edu

The eastern Bering Sea is a dynamic region that supports some of the highest rates of primary productivity in the global oceans. As a result, the coastal ocean in this area is typically believed to be a moderate to strong sink for atmospheric CO_2 on the annual scale. However, this assumption is based primarily on CO_2 fluxes observed during the growing season, as winter observations have previous been limited. Recently, new high-resolution data collected through several programs have greatly increased the spatiotemporal resolution of CO_2 flux data in the Bering Sea, including the first autumn and winter observations on this scale. Using data from 2008-2012, here we constructed monthly climatologies of sea-air CO_2 fluxes for the period between April and December. While CO_2 fluxes during autumn and winter have historically been assumed to be zero due to the mechanical inhibition of gas exchange by ice cover, we found that the Bering Sea behaves as a source of CO_2 to the atmosphere during autumn and winter months as weakening primary production and strengthening respiration processes cause CO_2 to accumulate in the water column. After accounting for the moderating impacts of wintertime cooling and the mechanical inhibition of CO_2 flux by ice cover, we estimated that winter efflux balance 65% of spring and summer CO_2 uptake by the oceans. Overall, we estimate that the Bering Sea shelf is an annual CO_2 sink of ~6.8 Tg C yr-1. In a changing climate, we expect that warming sea surface temperatures, reduced ice cover, and greater wind speeds with enhanced gas exchange will decrease the size of this CO_2 sink by augmenting conditions favorable for greater wintertime outgassing.

The Relative Importance of Advective Versus In-situ Processes to Mesozooplankton Biomass on the Eastern Bering Sea shelf

Georgina Gibson
University of Alaska Fairbanks (UAF), ggibson@iarc.uaf.edu
Albert Hermann
NOAA, Alaska Regional Office, Albert.J.Hermann@noaa.gov
Kate Hedstrom
UAF, kshedstrom@alaska.edu
Enrique Curchitser
Rutgers University, enrique@marine.rutgers.edu

Biomass of large crustacean zooplankton on the eastern Bering Sea varies quite substantially inter-annually and appears negatively correlated with temperature. The mechanisms giving rise to these changes are not yet well understood, including whether changes are due to bottom-up processes driven by physical processes, or by top-down effects due changes in predation pressure. Using model estimates, we have explored the mechanisms, timing, and location of the transport of zooplankton onto and over the eastern Bering Sea shelf. Results indicate that the timing of on-shelf transport and the distribution of oceanic zooplankton on the shelf can vary substantially between one year and another. The Bering, Pribilof, and Zhemchug canyons and Cape Navarin appear to be regions of elevated on-shelf transport and wind direction is the primary factor controlling inter-annual variability in the timing, amount, and location of the on-shelf zooplankton transport. The response of both zooplankton production and on-shelf advection to environmental changes in the Bering Sea will likely not be uniform as the north and south appear to respond in opposite directions to environmental variability. In-situ production by zooplankton appears to be generally more important to biomass accumulation than the transport of zooplankton biomass by advective processes. However, advection of zooplankton biomass may be an important contributor to standing stock biomass in some regions at certain times of year – notably the northern and southern middle shelf regions.

Do Modeled Zooplankton Abundances Increase the Hindcast and Prediction Strength of Fish Recruitment Models?

Mette Skern-Mauritzen
Institute of Marine Research (IMR), mette.mauritzen@imr.no
Mike Sigler
NOAA, Alaska Fisheries Science Center (AFSC), mike.sigler@noaa.gov
Solfrid Hjøllo
IMR, solfrid.hollo@imr.no
Kirstin Holsman
University of Washington (UW), kirstin.holsman@noaa.gov
Cecilie Hansen
IMR, cecilie.hansen@imr.no
Jan Arge Jacobsen
Faroe Marine Research Institute, janarge@hav.fo
Guðmundur Óskarsson
MRI, gjos@hafro.is
Kjell Rong Utne
IMR, kjell.rong.utne@imr.no
Kerim Aydin
AFSC, kerim.aydin@noaa.gov
Albert Hermann
UW, Albert.J.Hermann@noaa.gov
Georgina Gibson
University of Alaska Fairbanks, ggibson@iarc.uaf.edu

The recruitment of many fish stocks is highly variable because of large interannual fluctuations in survival during early life stages. Prediction of year-class strength is critical in fisheries management, and may improve if the effects of environmental factors that influence pre-recruit mortality are accounted for in recruitment models. However, recruitment predictions are often challenged by non-stationary recruitment-environment correlations, indicating that the environmental correlates used only partially reflect the causal mechanisms involved. Typically, environmental correlates tested in recruitment models reflect ocean climate, primary production and/or predator abundances, whereas information on food availability is rarely available due to the inability to sample zooplankton at relevant locations and spatio-temporal scales. Here we examine if zooplankton fields from coupled ROMS-NPZ models are positively associated with the recruitment of 9 stocks in the Bering, Norwegian and the Barents Seas, and if such zooplankton fields increase the hindcast and prediction strength of the fish recruitment models. Preliminary results support positive associations between modeled seasonal zooplankton abundances and fish recruitment.

An Exploratory Assessment of Thiamine Status in Yukon River Chinook Salmon (*Oncorhynchus tshawytscha*)

Dale Honeyfield
U.S. Geological Survey, honeyfie@usgs.gov
James Murphy
NOAA, Alaska Fisheries Science Center (AFSC), jim.murphy@noaa.gov
Kathrine Howard
Alaska Department of Fish & Game (ADFG), kathrine.howard@alaska.gov
Sean Larson
ADFG, sean.larson@alaska.gov
Lawrence Schaufler
AFSC, lawrence.schaufler@noaa.gov
Wesley Strasburger
AFSC, wes.strasburger@noaa.gov
Angela Matz
U.S. Fish and Wildlife Service, angela_matz@fws.gov

Thiamine (vitamin B_1) status in Yukon and Kuskokwim rivers Chinook salmon (*Oncorhynchus tshawytscha*) was examined through egg thiamine concentration from returning females and the presence of thiaminase (an enzyme that destroys thiamine) was also explored in juvenile muscle and liver tissues collected from the northern Bering Sea. In 2012, 74% of the females had egg thiamine concentrations associated with secondary effects of thiamine deficiency (1.5 – 8.0 nmol/g), while three percent of the returning females had egg thiamine concentrations low enough to produce overt fry mortality (< 1.5 nmol/g); only 23 % of the eggs were thiamine replete (> 8.0 nmol/g). Egg thiamine in Chinook salmon from upper Yukon River was higher in 2001 (11.7) than in 2012 (6.2). In 2001, Chinook and chum (*O. keta*) salmon egg thiamine concentrations were similar at the Bethel, Kuskokwim River site. Average Yukon River Chinook salmon egg thiamine concentrations decreased with migratory distance of females in 2012. Thiamine concentrations in juvenile muscle tissue were all above critical levels (> 3 nmol/g) and varied with dietary thiaminase-positive prey fish. Total thiamine concentrations (nmol/g) in juvenile Chinook salmon muscle (3.8) were similar to coho salmon (*O. kisutch*) (4.15), but lower than chum salmon (8.9) and pink salmon (*O. gorbuscha*) (9.6). Thiaminase was present in Chinook salmon (73%) and coho salmon (54%) diets, and was lower in diets of chum salmon (4%) and pink salmon (11%). These results provide evidence that insufficient thiamine may contribute to the poor production levels observed in Yukon River Chinook salmon.

Impact of Climate Variability and Change on Winter Survival of Bristol Bay Sockeye Salmon

Ed Farley
NOAA, Alaska Fisheries Science Center (AFSC), ed.farley@noaa.gov
Greg Ruggerone
Natural Resources Consultants, Inc., gruggerone@nrccorp.com
Ellen Yasumiishi
AFSC, ellen.yasumiishi@noaa.gov
Phil Mundy
AFSC, phil.mundy@noaa.gov
Bev Agler
Alaska Department of Fish & Game (ADFG), bev.agler@alaska.gov
Lorna Wilson
ADFG, lorna.wilson@alaska.gov

Overwinter survival of Pacific salmon (*Oncorhynchus* spp.) is believed to be a function of size and energetic status they gain during their first summer at sea. We test this hypothesis for Bristol Bay sockeye salmon (*O. nerka*), utilizing data from large-scale fisheries and oceanographic surveys conducted during mid-August to September 2002 to 2007. Specifically, we compared distributions of mean circuli spacing during the first year at sea between juvenile salmon and adult sockeye salmon scales to evaluate the magnitude of size-selective mortality during this life stage. A probability curve of size-selective mortality in relation to length (mm) of juvenile salmon was constructed. The juvenile size (length) was then compared to summer/fall oceanographic characteristics on the eastern Bering Sea shelf that may impact their growth rates and probability of survival during winter. This analysis is placed within the context of previously published results on summer/fall and winter marine ecology of Bristol Bay sockeye salmon and how continued warming on the eastern Bering Sea shelf may impact their future growth (during summer and fall) and survival during winter.

Small-scale Atka Mackerel Population Abundance and Movement in the Western Aleutian Islands, an Area of Continuing Steller Sea Lion Decline

Susanne McDermott
NOAA, Alaska Fisheries Science Center (AFSC), susanne.mcdermott@noaa.gov
James Ianelli
AFSC, jim.ianelli@noaa.gov
Kimberly Rand
AFSC, kimberly.rand@noaa.gov
Mike Levine
Lab Temps under contract to the Alaska Fisheries Science Center, mike.levine@noaa.gov
Elizabeth Logerwell
AFSC, libby.logerwell@noaa.gov
Todd Loomis
North Pacific Fisheries Foundation, tloomis@oceanpeaceinc.com

Groundfish stocks in Alaska are managed at large scales, however important ecological interactions, such as predation, spawning and habitat selection occur on local scales. Furthermore, commercial fishing is an activity with potential for localized effects. Improved understanding of the local abundance and movement of fish is critical to understanding the potential for localized depletion by fishing. In 2000, the National Marine Fisheries Service concluded that the Alaska groundfish fishery posed a threat to the recovery of the endangered Steller sea lion (*Eumetopias jubatus*) population. Protection measures were put in place, including Trawl Exclusion Zones in Critical Habitat around sea lion rookeries and haulouts. The designation of these zones mitigates against the possibility that competition between fisheries and sea lions occurs at local scales. Thus, advances in Alaska groundfish fisheries management with regard to their impacts on Steller sea lions require information on local abundance and movement of sea lion prey. Our project assessed the small-scale abundance and local exploitation rates of Atka mackerel (*Pleurogrammus monopterygius*), the dominant prey of sea lions in the Aleutian Islands, in three local areas in the Aleutian Islands, Seguam Pass, Tanaga Pass and Petrel Bank. We accomplished this goal through tagging, releasing and recovering Atka mackerel at each of the study sites and analyzing the data using an integrated mark-recapture model. The model estimated that Atka mackerel population sizes at Seguam Pass and Petrel Bank were approximately 190,000 metric tons, whereas Tanaga Pass was only 29,000 metric tons. Exploitation rates in all 3 areas were below 7%, well below the projected fishing mortality in the stock assessment. In general, the results from this study indicate that Atka mackerel abundance, movement and fishing patterns are variable throughout the Aleutian Islands. It is therefore important to understand fishery dynamics at this scale to assess the variable effect of fishing Atka mackerel subpopulations. This study was the result of NPRB #1007.

Atka Mackerel Essential Fish Habitat on a Local Scale in the Aleutian Islands, Alaska

Mike Levine
Lab Temps under contract to the Alaska Fisheries Science Center, mike.levine@noaa.gov
Susanne McDermott
NOAA, Alaska Fisheries Science Center (AFSC), susanne.mcdermott@noaa.gov
Kimberly Rand
AFSC, kimberly.rand@noaa.gov

This study aims to characterize the habitat of Atka mackerel (*Pleurogrammus monopterygius*), one of the primary prey items for the endangered western Steller sea lions (*Eumetopias jubatus*). This study examines 3 Aleutian Island locales in Alaska: Seguam Pass, Tanaga Pass, and Petrel Bank. During Atka mackerel tagging studies (2011-2012), biological data were collected which included length, weight, sex, maturity, and stomach fullness (proxy for feeding intensity). To characterize the environment, we examined oceanographic conditions using conductivity, temperature and depth (CTD) casts, and the substrate associated with fish presence using underwater camera tows. Seguam is a productive, dynamic pass with ample rocky substrate. Atka mackerel at Seguam were consistently larger by size and weight than those from Tanaga or Petrel. In addition, Seguam had the highest proportion of ripe male Atka mackerel, and the largest number of males in spawning coloration. Stomach fullness was not remarkably higher at Seguam than at Tanaga or Petrel. However, it was consistent during all study periods, indicating that access to prey at Seguam may be seasonally reliable. At Tanaga Pass, near-surface water temperature and salinity values were intermediate between those at Seguam and Petrel; because these measures are associated with upwelled (and, therefore, productive) water, Tanaga may be an area of intermediate productivity at the time of the research charters. Atka mackerel from Tanaga are considerably smaller than those captured at Seguam. This may be due to seasonally limited food availability, or food quality. Petrel Bank is a narrow underwater ridge that is situated far offshore. It rises very quickly from deep (> 300 m) water to a plateau at 100 m - 200 m. We observed the highest average surface water temperatures and lowest salinity at Petrel. Atka mackerel were shorter in length and lighter in weight at Petrel than fish at either Tanaga or Seguam. Future studies will incorporate nearshore habitat characterization (e.g., near sea lion rookeries and haulouts) and how this relates to Atka mackerel life history and abundance. This study was the result of NPRB #1007.

Movement, Size Composition, Potential Essential Habitat, and Handling of Norton Sound Red King Crab *Paralithodes camtschaticus*

Jenefer Bell
Alaska Department of Fish & Game (ADFG), jenefer.bell@alaska.gov
Hamachan Hamazaki
ADFG, toshihide.hamazaki@alaska.gov

We examined spring/summer movement, size composition, potential essential habitat, and handling of Norton Sound red king crab (*Paralithodes camtschaticus*). During 2012–2014, a total of 19,489 crab were tagged and released, of which 1,384 were recovered over 3 years by crab fishermen and observers. Examination of tag recovery locations suggests Norton Sound red king crab is a single population that is harvested throughout regional commercial fishing areas. Contrary to prior understanding, our evidence suggests not all legal crab move from nearshore winter habitat to offshore summer habitat in a given year. Consequently, brood stock remaining in nearshore waters may be protected from harvest because regulatory closures prohibit summer commercial fishing within nearshore waters. We examined size composition data and found the proportions of legal crab within size classes were consistent with prior assumptions. However, we collected growth information over 2 years and have demonstrated sublegal crab have a larger molt increment than legal crab, which may help redefine the carapace lengths used to establish pre-recruit size classes to more accurately predict future recruitment into the fishery. We have identified potential essential habitat and locations of higher abundances of non-target crab: waters around Cape Nome and between Topkok Head and Rocky Point have higher incidences of sublegal and females crab than other areas in eastern Norton Sound suggesting possible breeding/rearing areas. We have also located areas with higher abundances of non-target crab on the commercial fishing grounds. Incorporation of this information into fisheries management may enable us to refine fishing locations to minimize the handling of non-target red king crab.

Capturing Effects of Alternative Groundgear for the Bering Sea Pollock Fishery

Carwyn Hammond
NOAA, Alaska Fisheries Science Center (AFSC), carwyn.hammond@noaa.gov
Craig Rose
AFSC, craig.rose@noaa.gov
Bradley Harris
Alaska Pacific University (APU), bharris@alaskapacific.edu
Scott McEntire
AFSC, scott.mcentire@noaa.gov
Susan Zagorski
APU, szagorski@alaskapacific.edu

In the United States, federally managed fisheries need to minimize both bycatch and the adverse impacts of fishing on Essential Fish Habitat while maintaining commercially viable catch efficiencies of target species. Like many other large scale commercial fisheries, the Alaska pollock (*Gadus chalcogrammus*) fishery operations are increasingly constrained by efforts to avoid bycatch (salmon (*Oncorhynchus* spp.), crab and halibut (*Hippoglossus stenolepsis*)) and the rising cost of fuel. The Alaska pollock fishing industry, in collaboration with scientists at Alaska Pacific University, the Alaska Fisheries Science Center, and members of the fishing gear design and fabrication industry are actively pursuing new trawl designs to address these bycatch and seabed contact issues while maintaining a viable pollock capture efficiency. Adult Alaska pollock aggregate on or near the seafloor, particularly during the day (e.g., Mecklenburg, et al. 2002, Tsuji, S. 1989). Conventional pollock trawls use simple chain footropes that have continuous contact across portions contacting the seafloor. We tested several trawl groundgear configurations designed to capture pollock aggregated near the seafloor while reducing bycatch and impacts to the benthic habitat. Most of the weight of these footropes was concentrated in short sections designed to raise the rest of the footrope, divided into 7 - 90 foot sections, several inches above the seafloor. We tested six different pollock trawl footrope configurations with these long sections made up of different materials with varying weights per foot and diameters (elevated and non-elevated 2” combination wire, elevated and non-elevated 2” Blue line, and ¾’ spectra). A total of 14 trawl tracks were laid down parallel to each other. We used altimeters and tilt meters to monitor seafloor clearance at various points across the footropes. After a week’s time, we ran 10 transects perpendicular to the trawl tracks using a camera/sonar sled. Imagery from the DIDSON sonar on that sled allowed direct observation of the component-specific (e.g., footrope) seabed contact for each groundgear configuration. Acceptance of any alternative footrope would also require that they not foul excessively during setting and retrieval. Experience handling the footropes indicated that any such problems would likely be tractable.

The Assessment of Benthic Impacts of Raised Groundgear for the Eastern Bering Sea Pollock Fishery

Susie Zagorski
Alaska Pacific University (APU), szagorski@alaskapacific.edu
Bradley Harris
APU, bharris@alaskapacific.edu
Craig Rose
NOAA, Alaska Fisheries Science Center (AFSC), fishnextresearch@gmail.com
Carwyn Hammond
AFSC, carwyn.hammond@noaa.gov
Scott McEntire
AFSC, scott.mcentire@noaa.gov

The Alaska pollock (*Gadus chalcogrammus*) fishery is working programmatically with scientists from Alaska Fisheries Science Center and Alaska Pacific University, as well as net manufacturers to develop less impactful trawls for capturing pollock near the seafloor. Six groundgear configurations were tested during spring 2014 fieldwork, to compare seafloor contact characteristics and benthic impacts. The aim is to determine the nominal, contact adjusted and susceptibility adjusted swept areas of each new configuration and compare impacts at the component specific level. The nominal swept area, based on the spread of the net while fishing, is the total possible affected area whether or not impact to the seafloor occurred. Contact adjusted swept area is based on actual groundgear encounters with the seafloor; it's determined using a contact index, calculated from seafloor track measurements. The susceptibility adjusted swept area is based on the condition of biological features after contact with groundgear. It's determined using a susceptibility index, calculated by comparing conditions in the affected area to the control area. Contact and susceptibility adjusted swept areas are more accurate calculations of habitat impact than nominal swept area. This entire evaluation is conducted in the context of a fishery habitat impacts assessment that addresses bycatch and essential fish habitat concerns of the North Pacific Fishery Management Council. DIDSON sonar observations, tow length and net mensuration equipment measurements are used to systematically evaluate the seabed contact and ultimately nominal and contact adjusted swept areas. Video observations are used to collect biological feature condition observations to calculate susceptibility adjusted swept area. These evaluations are performed for each new groundgear configuration and every component individually. The component specific comparisons allow for new configurations of less impact to be conceptually designed. We expect the new raised groundgear to have significantly less seabed contact and enough clearance from the seafloor between contact points to limit susceptibility of biological features and thus a smaller adverse impact on benthic habitats than the nominal swept area might otherwise indicate. This presentation focuses on the direct observations of affected seafloor with video cameras and the DIDSON sonar, and applicability of results to habitat impacts assessments.

Increasing Variability of Ecological Response by Beringian Endemic Seabirds to Rapid Environmental Change

Douglas Causey
University of Alaska Anchorage (UAA), dcausey@alaska.edu
Veronica Padula
University of Alaska Fairbanks, vmp2011@gmail.com
McKenna Hanson
UAA, mckhanson@live.com

Understanding the complex dynamics of environmental change in northern latitudes is particularly critical for arctic avian communities, which are integral components that maintain biological teleconnections between the mid- and northern latitudes. We report on studies done 2009 - 2014 in the far Western Aleutians focused on the coastal dynamics related to climate change of marine bird communities. We use several data sources and analysis techniques, including diet data, stable isotopes, and Bayesian inference, to understand the relationships between increased freshwater runoff from glacier melt, inshore oceanographic change, and ecological response. Our preliminary results indicate that the community-wide spatial and temporal dynamics of marine bird ecosystems are far greater in our study period than in previous decades. In particular, we show that the ecological foraging patterns observed for key Beringian endemics as Red-faced Cormorants (*Phalacrocorax urile*), Tufted Puffins (*Fratercula cirrhatus*), and auklets (Alcidae) are strongly perturbed on very small geographic and temporal scales of 10 km and subdecadal years. Moreover, we find that the variance in observed ecological response to change is increasing rapidly over time. We hypothesize that these fine-scale changes are related to mid-scale oceanographic and trophic-level changes, in addition to larger-scale perturbations possibly related to a cascade of climate-related factors.

Effects of Marine Debris: Phthalate and PCB Contamination in Seabirds from the Western Aleutian Islands

Veronica Padula
University of Alaska Fairbanks, vmpadula@alaska.edu
Douglas Causey
University of Alaska Anchorage (UAA), dcausey@alaska.edu
Sydney Stewart
UAA, smstewart5@alaska.edu
Birgit Hagedorn
UAA, bhagedorn@uaa.alaska.edu
John Kennish
UAA, jmkennish@uaa.alaska.edu

We are investigating the levels of phthalates and polychlorinated biphenyls (PCBs) in various seabird species inhabiting the far western Aleutian Islands. This is the first contaminants work ever done in the most western region of the Aleutian archipelago, thus establishing baseline contaminant levels in an isolated region. This is also the first study quantifying phthalates – the plasticizing chemicals that coat plastic objects – in any seabird species globally. Currently these islands have no point sources of contamination, but they are influenced by ocean currents carrying contaminants and debris from other regions of the Pacific Ocean. We are using species from different trophic levels in our analyses: crested auklets (*Aethia cristatella*) (planktivores), tufted puffins (*Fratercula cirrhata*) (mid-trophic), and pelagic and red-faced cormorants (*Phalacrocorax urile*) (upper trophic). Differences in contaminant levels in tissues from these species may be indicative of biomagnification of phthalates and PCBs through the food chain. Finally, research shows that plastic debris not only carries phthalate pollution to wildlife, but plastics also absorb organic pollutants like PCBs. We will use our data to investigate associations between elevated phthalate levels and elevated PCB levels in tissues from seabirds.

Seabird Die-off Detected During a Major Coccolithophore Bloom in the Bering Sea in 2014

Elizabeth Labunski
U.S. Fish and Wildlife Service (USFWS), Elizabeth_Labunski@fws.gov
Kathy Kuletz
USFWS, Kathy_Kuletz@fws.gov
Ed Farley
NOAA, Alaska Fisheries Science Center (AFSC), Ed.Farley@noaa.gov
Alex Andrews
AFSC, Alex.Andrews@noaa.gov
Lisa Eisner
AFSC, Lisa.Eisner@noaa.gov

In mid- to late August 2014, we found evidence of a seabird die-off event in the southeastern Bering Sea, during a year with unusually warm ocean temperatures. Dead birds were encountered during U.S. Fish & Wildlife surveys for marine birds in conjunction with National Oceanic and Atmospheric Administration's (NOAA) Bering-Aleutian Salmon International Survey (BASIS). Surveys were conducted from western Bristol Bay to St. Lawrence Island from 18 August – 3 October, 2014. The seabird die-off was detected on 19-21 August, on 11 transects totaling 222 km (66.6 km^2), during which we recorded 31 dead birds, mainly murres (*Uria* spp.) within 300 m of the vessel and an additional 20 birds off-transect. During the same period we recorded only 64 live murres. The main seabird die-off event covered an estimated area of 16,616 km^2, and was centered at 57° N latitude, 163° W longitude. The average density of dead birds in this region was 0.47 birds km^{-2}. By extrapolation to the potentially affected area, approximately 7,800 dead birds could have been present, although mortality was likely higher due to low carcass detectability > 100 m from the vessel. During the BASIS survey, corresponding oceanographic and fisheries data documented unusual conditions in the Bering Sea, including a shift in distribution of age-0 pollock similar to that observed during the last warm period (2002 – 2005). In addition, a major coccolithophore (*Prymnesiophyceae* spp.) bloom was detected ~20 km northeast of the main seabird die-off area. Coccolithophores are nontoxic small (~ 5 µm) phytoplankton with calcium carbonate plates which give the water a cloudy/milky appearance. This taxa can flourish in the presence of nutrient poor waters, and has previously been associated with warm water, and seabird die-off event, possibly due to poor foraging conditions. The extent of the coccolithophore bloom was monitored by ship-based surveys and MODIS satellite imagery. Due to the vastness of the bloom, seabirds could have been impacted beyond our survey area.

Retrospective Study of Walrus Foraging and Movement Patterns During a Major Ecosystem Shift

Seth Newsome
University of New Mexico, newsome@unm.edu
Patrick Lemons
U.S. Fish and Wildlife Service (USFWS), patrick_lemons@fws.gov
Daniel Monson
U.S. Geological Survey, Alaska Science Center, dmonson@usgs.gov
Joel Garlich-Miller
USFWS, joel_garlichmiller@fws.gov
James Lovvorn
Southern Illinois University, lovvorn@siu.edu
Lori Quakenbush
Alaska Department of Fish & Game, lori.quakenbush@alaska.gov

Recent work suggests that anthropogenic climate change has caused a shift from arctic to subarctic conditions in the Bering Sea, which has resulted in replacement of ice-dominated benthic ecosystems with pelagic-dominated ecosystems. Some have hypothesized that this northward shift of benthic ecosystems is influencing walrus movement and diet, as well as the ecology of other benthic predators. Few studies have explored this question, however, because addressing it requires the collection of ecological data on movement and diet patterns of benthic consumers from time periods prior to the observed ecosystem shift. Using Pacific walrus (*Odobenus rosmarus divergens*) teeth collected during subsistence harvests on Saint Lawrence Island, we produced a historic 50-year time series of carbon (d^{13}C) and nitrogen (d^{15}N) isotope values with annual resolution for female and male walruses in the northern Bering Sea. Isotope data collected from 1995–2005 (n = 45) show that d^{13}C and d^{15}N values are negatively correlated, a pattern that mirrors north-to-south baseline gradients in the isotopic composition of their primary prey (bivalves). Isotope data for teeth collected from 1950–1960 (n = 27) are also negatively correlated, but most individuals have higher d^{13}C values than walrus from 1995–2005. Isotope data for teeth collected from 1965–1985 (n = 69) are more variable with no obvious trend. Many individuals from 1965–1985 have higher d^{15}N values relative to walruses from the other time periods, suggesting a dietary expansion to high trophic level prey that included carnivorous gastropods and decapods. We also analyzed vibrissae collected from recently harvested female and male walrus (n = 66) to create a sub-annual isotopic record of diet and movement patterns. Similar to teeth, vibrissae isotope values are negatively correlated and males have significantly higher d^{13}C but lower d^{15}N values than females. Overall, our data suggest that walrus d^{13}C and d^{15}N values are primarily driven by north-to-south baseline isotopic gradients in this region, however, increased variation in d^{13}C and d^{15}N values in tooth collagen collected during the 1965–1985 time period are best explained

Pre-Weaning Growth and Blubber Deposition in Pacific Walruses

Shawn Noren
University of California, Santa Cruz, snoren@ucsc.edu
Mark Udevitz
U.S. Geological Survey, Alaska Science Center (USGS), mudevitz@usgs.gov
Chadwick Jay
USGS, cjay@usgs.gov

Walruses (*Odobenus rosmarus*) may be challenged to meet daily energetic demands in their changing Arctic ecosystem. Immature walruses, with limited ability to capture prey, may be vulnerable as they transition from a complete reliance on their mother's milk for nutrition. Mature walruses have the ability to buffer short term energetic deficits by using energy stored as blubber, but little is known about caloric intake or the sequestration and mobilization of blubber in immature walruses. Two orphaned wild walrus calves raised in human care provided the opportunity for controlled study of daily caloric intake and body mass, as well as quarterly measurements of morphology and blubber thickness (21 body sites). During the two year study, the animals increased body mass 2.9 - 5.1-fold and body length 1.3 - 1.4-fold. Caloric intake ranged from 0 to 27,777 kcal day^{-1}, with mass-specific intake decreasing with age. Blubber thickness varied topographically (range: 1.45 - 6.60 cm), with average blubber depth generally increasing with age. Estimates of the proportion of blubber indicated that the 0-2 year-old walruses were comprised of 24 - 30% fat. The influence of caloric intake on body condition in dependent young may have important implications for population dynamics because body condition is related to survival and first year survival is among the most important density-dependent demographic parameters. These food consumption and body morphology data will provide useful inputs to construct bioenergetics models for free-ranging walruses.

The Origin of Feces: Does Diet Diversity Matter More Than Prey Quality for Northern Fur Seals?

Mariana Diaz Gomez
University of British Columbia (UBC), m.diazgomez@fisheries.ubc.ca
David Rosen
UBC, rosen@zoology.ubc.ca
Andrew Trites
UBC, a.trites@fisheries.ubc.ca

The steady decrease in population numbers of northern fur seals (*Callorhinus ursinus*) on the Pribilof Islands may be due to reduced quality and diversity of prey available to them in the Bering Sea. However, it is unknown how important diet diversity is compared to prey quality in terms of the abilities of the fur seals to absorb energy and nutrients and whether the interplay between all of these factors could provide insights into the population decline. We therefore investigated how efficiently six captive female fur seals absorbed nutrients and energy when subjected to eight, three-week feeding trials. Diets were composed of four prey species consumed by fur seals in the Bering Sea (pollock (*Gadus chalcogrammus*), herring (*Clupea pallasii*), capelin (*Mallotus villosus*), and commander squid (*Berryteuthis magister*)), fed alone or in combination. We estimated assimilation efficiency (AE) of energy, protein and lipids; as well as net energy gain by quantifying three pathways of digestive energy loss: fecal and urinary energy loss, and heat increment of feeding. This study is the first to measure the heat increment of feeding of fur seals and results show that it varied from 4 - 12% of the gross energy fed. Our results indicated that fur seals assimilated more of the available energy and fat from fattier diets than from learner diets (AE of energy was 95.3 - 97.1% and AE of lipids was 95.3 – 98.6%). However, fur seals assimilated protein with similar efficiency across all diets regardless of diet composition (AE was 95.5 – 96.6%). The highest net energetic gains were from eating the herring diet (80.6%), the lowest was from the capelin diet (53.3%), while the pollock diet was intermediate (76.5%). Additionally, there appeared to be a higher than expected absorption rate for mixed species diets than was predicted from their individual prey components. Overall, our results demonstrate that prey quality is more important than prey diversity in terms of nutritional and energetic gain, but diet diversity does appear to provide an additional advantage. Hence, changes in the quality of prey available to fur seals in the wild will have a significant impact on their ability to attain their daily requirements, which may ultimately impact population fitness.

Flying Beneath the Clouds at the Edge of the World: Using an Unmanned Aircraft System to Survey the Endangered Steller Sea Lions in the Aleutian Islands

Kathryn Sweeney
NOAA, Alaska Fisheries Science Center (AFSC), kathryn.sweeney@noaa.gov
Van Helker
AFSC, van.helker@noaa.gov
Wayne Perryman
NOAA, Southwest Fisheries and Science Center, wayne.perryman@noaa.gov
Don LeRoi
Aerial Imaging Solutions, dleroi@aerialimagingsolutions.com
Lowell Fritz
AFSC, lowell.fritz@noaa.gov
Thomas Gelatt
AFSC, tom.gelatt@noaa.gov
Robyn Angliss
AFSC, robyn.angliss@noaa.gov

Surveying endangered Steller sea lions (*Eumetopias jubatus*) using manned aircraft presents unique challenges in the remote Aleutian Islands of Alaska. Long distances between the three airfields along the 1,000 mile Island chain, inclement weather (i.e., fog and low ceilings) during the summer breeding and survey season, and dangerous winds at sites adjacent to cliffs combine to severely limit flying opportunities. Aerial photography taken from these flights has proven to be the best method to conduct accurate counts of animals. There is a pressing fishery management concern for up-to-date and accurate trend information for the regions of the Aleutian Islands due to a persistent population decline. This decline abundance has persisted since 2000 for unknown reasons. To address these challenges we used a small unmanned aircraft system (UAS; APH-22 hexacopter) to supplement the NOAA manned aircraft (Twin Otter) surveys in Alaska. During June-July 2014, NMFS biologists working off the USFWS R/V *Tiĝlâx* assessed 34 sites, 12 of which were surveyed with the hexacopter, from Attu Island to the Delarof Islands. This area is served by only a single airport on Shemya Island (Eareckson Air Force Base) for manned aircraft surveys. Simultaneously, the Twin Otter crew surveyed sites east of the Delarof Islands, which is served by 4 airfields. This combined approach resulted in the most complete aerial survey in one field season of adult, juvenile, and newborn Steller sea lions in the Aleutian Islands since the 1970s. Additionally, we were able to sight permanently marked juvenile and adult individuals from high resolution images captured by the hexacopter. NOAA Fisheries plans to continue this multi-platform approach to survey Steller sea lions in Alaska devoting the hexacopter to the Aleutians while relying on manned aircraft for the rest of the range. Furthermore, the hexacopter platform may be utilized for future studies such as, using photogrammetric methods to collect Steller sea lion morphology information, to sight permanently marked individuals, capture mosaics of northern fur seal rookery-space use in the Pribilof Islands, and supplement current methods for estimating fur seal abundance.

Blow as An Alternative Matrix and Non-invasive Tool for Measuring Cortisol in Wild Belugas During Population Health Assessments in Bristol Bay, AK.

Laura Thompson
Mystic Aquarium, a division of Sea Research Foundation Inc (MYSTIC)., lthompson@searesearch.org
Tracy Romano
MYSTIC, tromano@searesearch.org

Glucocorticoids (e.g., cortisol) are often used in wildlife health and conservation efforts as indices of fitness and stressor load; providing information concerning individual or population responses to potential stressors. Typical methodology, however, involves blood sampling which can be invasive, stressful, or unfeasible in free-ranging animals. Recently, alternative matrices for hormone measurements have received a lot of interest, including collection of exhaled breath condensate (blow) from marine mammals. Methodology for collecting blow from belugas (*Delphinapterus leucas*) for cortisol measurement has previously been validated in our lab, and was applied to belugas in Bristol Bay, AK, during live-capture health assessments from 2012-2014. For sample collection, a petri dish covered with precision woven nylon membrane was held inverted over the blowhole for 2 - 4 repeated exhales. Samples were collected at the onset of examination (Pre) as well as just prior to release (Post). In 2014, intermediate plates were also taken throughout the examination. Blow was recovered from membranes by centrifugation and shipped to Mystic Aquarium on dry ice for analysis, or plates were shipped intact on ice packs. Cortisol was measured in samples using a commercially available EIA from Cayman Chemical. Blow samples from a total of 22 whales are included in this study. Pre samples were taken approximately 20-40 minutes from entanglement. There was a slight increase in cortisol between Pre- and Post-samples, though this was not statistically significant. In fact, a decrease in cortisol was detected in several animals. Cortisol appeared to be lowest for Pre- to Post-times < 60 min as compared with > 60 min. However in 2014 alone, cortisol values showed a decreasing trend with increased time. Samples taken throughout examination during 2014 suggest variability in individual responses to handling and sampling, and neither Pre nor Post samples necessarily represent the peak in cortisol response. Ongoing work includes investigating methods to standardize results from variation in dilution. This work demonstrates the usefulness of blow sampling as a tool to measure the cortisol response of belugas and can be applied to sampling stranded belugas and potentially free-ranging belugas such as the endangered population in Cook Inlet.

First Record of Diving Behavior of Resident-type Killer Whales in the Aleutian Islands and Documentation of a > 2,500 km Southward Movement and Return in Three Weeks

Paul Wade
NOAA, Alaska Fisheries Science Center (AFSC), paul.wade@noaa.gov
John Durban
NOAA, Southwest Fisheries and Science Center, john.durban@noaa.gov
Russ Andrews
Alaska SeaLife Center , RussA@alaskasealife.org
Tom Gelatt
AFSC, Tom.Gelatt@noaa.gov

Two satellite LIMPET tags (Wildlife Computers SPLASH10-292A model) were deployed on the dorsal fins of Resident-type killer whales (*Orcinus orca*) in Aleutian Islands. Both tags were programmed to transmit up to 600 times each day coinciding with coverage from the Argos satellite system. One tag was deployed on an adult male near Shemya Island in the western Aleutians on 22 June 2014; a second tag was deployed on 30 June 2014 on an adult female near the Delarof Islands in the central Aleutians while her group was observed feeding on Atka mackerel (*Pleurogrammus monopterygius*). Both foraged in the coastal regions where they were tagged for a period of 14 and 19 days, respectively, until the male's tag ceased transmitting and the female's tag began duty cycling (1 day on 4 days off). During this foraging, dive data from the tags documented both whales occasionally diving > 500 m (max depth = 551m and 535m for the male and female respectively; max duration = 10.4 mins and 9.5 mins), but most of the dive activity was in the top 200 m. After spending more than 2 weeks foraging in coastal waters the tagged female left the Seguam Pass area of the central Aleutians and moved in a straight track ~1,000 km south of the Aleutians to ~ 42° S. The whale then turned around and headed north along a similar track, returning to the Aleutians at Amchitka Pass then moving east back into the Delarof Islands. The final tag transmission was within 35 km of the tag deployment location; the round-trip from the Aleutians into the North Pacific transition zone covered > 2,500 km and took a little over 3 weeks (total tag duration = 49 days). This rapid round-trip is remarkably similar to the fast migrations to the sub-tropics documented for killer whales tagged in Antarctica, which have been hypothesized to facilitate physiological maintenance, specifically allowing skin regeneration in warmer waters without the high cost of heat loss that would occur in colder waters. We suggest that similar demands may require killer whales that forage in the Aleutian Islands to periodically travel to the warmer waters of the North Pacific transition zone.

Managing Leviathan: The Current Status of Large Whale Populations in the North Pacific

Phillip Clapham
NOAA, Alaska Fisheries Science Center (AFSC), phillip.clapham@noaa.gov
Yulia Ivashchenko
AFSC, yulia.ivashchenko@noaa.gov

In the North Pacific, large whales were extensively hunted by commercial whaling operations beginning in the late 18th century. More than 560,000 animals of nine species were killed between 1900 and 1999, including 195,000 taken (many illegally) by the former U.S.S.R. Here, I review the current status of mysticetes and sperm whales (*Physeter macrocephalus*) in this ocean, together with the management challenges that have largely replaced whaling. The species that remain the most heavily impacted by whaling include both populations of the North Pacific right whale (*Eubalaena japonica*), Okhotsk Sea bowheads (*Balaena mysticetus*), blue whales (*Balaenoptera musculus*), sei whales (*Balaenoptera borealis*), and sperm whales. Blue whales were apparently extirpated from Japan and perhaps the Aleutians, although they are recovering well in the eastern North Pacific. Sperm whales represented the single largest 20th century catch, with 315,000 taken (primarily by Japan and the U.S.S.R.); their current status is unclear. Soviet whaling likely removed the majority of right whales from the eastern North Pacific, where the population is today estimated in only the tens of animals, and where there is an urgent need for surveys in both the Bering Sea and the Gulf of Alaska. Other species have fared relatively well, notably the humpback whale (*Megaptera novaeangliae*) (currently estimated by the large-scale SPLASH study at 21,000 animals) and the California gray whale (*Eschrichtius robustus*). The latter remains the only large whale to be delisted under the U.S. Endangered Species Act, although delisting is expected to be proposed for some humpback whale stocks in light of recent data suggesting strong recovery. Although Bering-Chukchi-Beaufort bowheads are the subject of a well-managed native subsistence hunt in Alaska, this stock is clearly large and growing. Although most whaling has now ceased, other threats remain; these include entanglement in fishing gear, ship strikes, noise pollution and various potential effects of climate change. The latter include possible impacts from increased trans-polar vessel traffic resulting from loss of sea ice in the Arctic, habitat and prey shifts, and the unknown consequences of ocean acidification.

Variability in Mean Weight Per Fish: How Much Does It Matter?

Jennifer Cahalan
Pacific States Marine Fisheries Commission, jcahalan@psmfc.org
Jason Gasper
NOAA, Alaska Regional Office, jason.gasper@noaa.gov

The mean weight of individual fish is a critical measurement that can have substantial influence on catch estimates used for fisheries management in Alaska. These catch estimates are used by the NOAA Fisheries, Alaska Region, to regulate catch allocation and to insure overfishing does not occur. In addition, the mean weight per fish is used in the stock assessment process where models are often based on numbers of fish while allowable catches are based on weights of fish. Both natural and sampling variation affect the estimated mean weight per fish. Natural variation in weight per fish results from differences in individual fish size and growth rates while sampling variation results from the sample procedure. While sample variation can often be controlled by increasing sample sizes, estimating the natural variation of weights may be biased if data for a given spatial and/or temporal scales are unavailable and proxy weight data are used. This is of particular concern for situations where onboard observers cannot be deployed such as potential electronic monitoring programs.

Weight data routinely collected by the North Pacific Groundfish and Halibut Observer Program from commercial fishery catches are used to assess the variability associated with a variety of commercially harvested species. We used two sources of data: the average weight per fish computed from aggregate fish weight collected by observers from samples of catch and individual fish weight data taken from within sample to evaluate the effects of using proxy data to supplement estimation. The potential impact to catch estimation procedures of the variability in mean weigh per fish and the use of proxy data are discussed in this paper.

Bering Sea - Humans

Smart Fishing in the Bering Sea: Conservation Engineering Outreach

Christine Simpson
Alaska Pacific University (APU), csimpson@alaskapacific.edu
Bradley Harris
APU, bharris@alaskapacific.edu

The purpose of this project was to 1) develop, 2) instruct, 3) evaluate, and 4) revise a 5^{th}-12^{th} grade fisheries conservation engineering outreach program titled “Smart Fishing and the Bering Sea” (SFBS).

Fishery resources are important to Alaska and Alaskans, but present complex conservation challenges including user conflicts and concerns about unsustainable fishing practices. Alaska residents’ environmental literacy will enhance natural resource management decisions regarding fisheries. The intent of the SFBS program is to introduce students to ecological and economical factors that drive conservation engineering in the Bering Sea pollock fishery. I instructed the SFBS program to 93 students from four different public and private institutions in Anchorage, Alaska. My observations and participants’ pre- and post-program concept maps were used to evaluate the effectiveness of the SFBS curriculum. Participants gained content knowledge from this fishery outreach program about the Bering Sea and commercial fishing. Program evaluation analysis and results were used to revise the curriculum and make suggestions to SFBS stakeholders.

Marine Vessel Traffic and Shoreline Vulnerability in the Aleutian Archipelago

Martin Robards
Wildlife Conservation Society, mrobards@wcs.org
Douglas Burn
Aleutian and Bering Sea Islands Landscape Conservation Cooperative (ABSILCC), douglas_burn@fws.gov
Aaron Poe
ABSILCC, aaron_poe@fws.gov

Although the Aleutian archipelago is one of the most remote landscapes in the U.S., it is nonetheless subject to an intense amount of commercial shipping activity. Each year, several thousand vessels make the voyage along great circle routes between North America and Asia. The purpose of our study was to provide spatial and temporal information about this vessel traffic for use by resource managers and stakeholders. Development of decision support tools to help mitigate risks from international shipping requires a quantitative and spatially explicit understanding of vessel traffic across the entire region. Current efforts using just ground-based data from the Automatic Identification System (AIS) provide high precision data, but only for the immediate areas around the limited number of ground-based receivers. Consequently, large gaps in coverage for vessel traffic exist, particularly in the western Aleutians and south of the Aleutian chain, many of which coincide with areas of value for conservation or fisheries. To fill these gaps, we used three years of satellite-based AIS data, ranging from July 2010 through August 2013 that covers the southern Bering Sea and northern Gulf of Alaska. We implemented novel analytical techniques that allowed us to use over 90% of the over 73 million vessel locations, linked each spatial point with additional data to provide ship information, and then connected points through time to produce line features of individual transits. We summarize those transits, identifying vessel routings by month and vessel type that make up the primary routes north and south of the Aleutians. Key findings include the surprisingly close transits to land on several of the great circle routes in the western Aleutians, the extent of traffic passing close along the northern Gulf of Alaska coast, and the profound seasonality in vessel use of different passes and routings. Our efforts have filled critical gaps in knowledge about vessel traffic in the Aleutian archipelago, helped promote better production of metadata for the scientific use of AIS data, and are now being used to inform shoreline vulnerability analyses based on the trajectories of stricken vessels on key routes.

Addressing Climate Change Vulnerabilities in the Aleutian and Bering Sea Islands

Aaron Poe
Aleutian and Bering Sea Islands Landscape Conservation Cooperative, Aaron_Poe@fws.gov
Ellen Tyler
Alaska Ocean Observing System (AOOS), Tyler@aoos.org
Jeremy Littell
U.S. Geological Survey, Alaska Science Center, jlittell@usgs.gov
Tom Van Pelt
AOOS, tom@xboundary.org
Nick Bond
University of Washington, nicholas.bond@noaa.gov
John Walsh
University of Alaska Fairbanks, jwalsh@iarc.uaf.edu
Tuula Hollme
Alaska SeaLife Center , tuulah@alaskasealife.org

Climate change is already affecting the Bering Sea and Aleutian Island region. Past and present marine research across a broad spectrum of disciplines is shedding light on what sectors of the ecosystem and the human dimension will be most impacted. In a grassroots approach to extend existing research efforts, leveraging recently completed downscaled climate projections for the Bering Sea and Aleutian Islands region, we convened a team of 30 researchers -- with expertise ranging from anthropology to zooplankton to marine mammals-- to assess climate projections in the context of their expertise. This Aleutian-Bering Climate Vulnerability Assessment (ABCVA) began with researchers working in five teams to evaluate the vulnerabilities of key species and ecosystem services relative to projected changes in climate. Each team identified initial vulnerabilities for their focal species or services, and made recommendations for further research and information needs that would help managers and communities better understand the implications of the changing climate in this region. Those draft recommendations were shared during two focused, public sessions held within two hub communities for the Bering and Aleutian region: Unalaska and St. Paul. Qualitative insights about local concerns and observations relative to climate change were collected during these sessions, to be compared to the recommendations being made by the ABCVA team of researchers. Finally, we used a Structured Decision Making process to prioritize the recommendations of participating scientists, and integrate the insights shared during our community sessions. This work brought together residents, stakeholders, scientists, and natural resource managers to collaboratively identify priorities for addressing current and expected future impacts of climate change. Recommendations from this project will be incorporated into future research efforts of the Aleutian and Bering Sea Islands Landscape Conservation Cooperative (ABSI LCC), the Alaska Ocean Observing System (AOOS), and the Alaska Climate Science Center.

Plenary Sessions: Thursday, January 22 -- Arctic

TIME	TITLE	PRESENTER	SECTION
8:00 - 8:15 AM	Inter-annual Variability in Surface Circulation in the Chukchi and Beaufort Seas: Satellite-tracked Drifter Measurements	Sousa	Climate and Oceanography
8:15 - 8:30 AM	Chukchi Sea Ice Observations by Upward Looking Sonars, 2008-2014	Mudge	Climate and Oceanography
8:30 - 8:45 AM	Lateral Mixing Across Meltwater Fronts of the Chukchi Sea Shelf	Lu**	Climate and Oceanography
8:45 - 9:00 AM	The Arctic Tracer Release Experiment (ARCTREX) - Applications for Mapping Spilled Oil in Arctic	Winsor	Climate and Oceanography
9:00 - 9:15 AM	Composition, Diversity and Vertical Structure of the Zooplankton Community in the Beaufort Sea	Smoot*	Lower Trophic Levels
9:15 - 9:30 AM	Phylogeography and Connectivity of Four Sibling Species of Pseudocalanus (Copepoda; Calanoida) in the North Pacific and Arctic Oceans	Questel**	Lower Trophic Levels
9:30 - 10:00 AM	BREAK		
10:00 - 10:15 AM	Lower Trophic Level Food Web Structure on the Eastern Beaufort Sea Shelf and Slope	Bell*	Lower Trophic Levels
10:15 - 10:30 AM	Growth and Production of the Dominant Alaska Arctic Brittle Stars: *Ophiura sarsii* and *Ophiocten sericeum*	Ravelo**	Lower Trophic Levels
10:30 - 10:45 AM	Snow Crab (*Chionoecetes opilio*) Ecology in the Alaskan Arctic	Divine**	Fish and Invertebrates
10:45 - 11:00 AM	SHELFZ Project: Environmental Drivers of Benthic Fish Distribution In and Around Barrow Canyon in the Northeastern Chukchi Sea	Logerwell	Fish and Invertebrates
11:00 - 11:15 AM	Ontogenetic, Temporal and Spatial Variation in the Trophic Roles of Chukchi Sea Fishes	Marsh**	Fish and Invertebrates
11:15 - 11:30 AM	Contrasting Strategies of Lipid Storage in Juvenile Arctic cod (*Boreogadus saida*) and Saffron Cod (*Eleginus gracilis*) Under Variable Thermal Regimes	Copeman	Fish and Invertebrates
11:30 - 1:00 PM	BREAK - LUNCH PROVIDED		
1:00 - 1:15 PM	Limits to Viability of a Critical Arctic Migration Corridor Due to Localized Prey, Changing Sea Ice, and Impending Industrial Development	Lovvorn	Seabirds
1:15 - 1:30 PM	A Year in the Acoustic World of Bowhead Whales in the Northern Bering, Chukchi and Beaufort Seas	Clark	Mammals

* Masters; ** Doctorate

Plenary Sessions: Thursday, January 22 -- Arctic

TIME	TITLE	PRESENTER	SECTION
1:30 - 1:45 PM	Fat Chance – Uptake, Modification, and Storage of Fatty Acids in Bowhead Whales	Horstmann	Mammals
1:45 - 2:00 PM	Regional Diving Behavior of Pacific Arctic Beluga Whales Relative to Water-column Prey	Hauser**	Mammals
2:00 - 2:15 PM	What do Bearded Seals Really Eat? - A Methods Comparison	Bryan	Mammals
2:00 - 3:00 PM	BREAK		
3:00- 3:15 PM	Sea Ice in Barrow Project Jukebox	Brewster	Humans
3:15 - 3:30 PM	Arctic Shield 2014: Arctic Oil Spill Response and Tool Interoperability	Winters-Staszak	Humans
3:30 - 3:45 PM	Establishing Pre-Development Baseline Concentrations of Hydrocarbons and Metals in Sediments and Marine Invertebrates from the Chukchi Sea, Alaska	Durell	Ecosystem Perspectives
3:45 - 4:00 PM	Temporal Variability of Biodiversity in Arctic and Subarctic Marine Benthic Communities	Blanchard	Ecosystem Perspectives
4:00 - 4:15 PM	The Pacific Arctic Marine Arctic Regional Synthesis: Status and Plans	Cooper	Ecosystem Perspectives
4:15 - 4:30 PM	The Synthesis of Arctic Research (SOAR) Program: Status and Plans	Moore	Ecosystem Perspectives
4:30 - 4:45 PM	**Best Student Oral Presentations Winners Announced**		
4:45 - 5:00 PM	**CLOSING REMARKS**		

* Masters; ** Doctorate

FRIDAY - ALL DAY	**AMSS 2015 Workshops – http://amss.nprb.org/program-schedule/workshops/**

Plenary Session Abstracts

Thursday, January 22

Arctic - Climate and Oceanography

Inter-annual Variability in Surface Circulation in the Chukchi and Beaufort Seas: Satellite-tracked Drifter Measurements

Leandra Sousa
North Slope Borough, leandra.sousa@north-slope.org
Thomas Weingartner
University of Alaska Fairbanks (UAF), tjweingartner@alaska.edu
Peter Winsor
UAF, pwinsor@alaska.edu
Seth Danielson
UAF, sldanielson@alaska.edu
Elizabeth Dobbins
UAF, eldobbins@alaska.edu
Cayman Irvine
UAF, cayman.irvine@gmail.com

Surface current and temperature measurements were conducted in 2012, 2013, and 2014 by deploying > 230 satellite-tracked 1-m drogued Microstar (MS) drifters in the Chukchi and Beaufort seas during July, August, and September. In this study, we investigate the influence of wind on the variation of the mean surface flow of the Chukchi and Beaufort seas. In 2012, drifters generally moved eastward over the shelf and then northeastward through Barrow Canyon and then either eastward onto the Beaufort Sea shelf and slope, or northwestward along the Chukchi Sea slope in response to highly variable winds shifting from southwest to northeast and to northwest. In 2013, the majority of drifters remained on the northeast Chukchi Sea shelf and moved westward in response to the prevailing northeasterly winds. In 2013, the majority of drifters remained on the northeast Chukchi Sea and moved westward in response to the prevailing northeasterly winds. In 2014, winds were predominantly from the east/northeast and drifters moved northwestward over Chukchi and Beaufort shelves or northeastward through Barrow Canyon and the Chukchi slope. Surface temperatures also varied markedly among years; such that in 2012 water temperature reached 10 °C while and 2013 and 2014 temperatures over the shelf were < 6 °C. Preliminary analyses suggest that inter-annual variations in drifter trajectories and dispersal characteristics are a result of wind forcing and mesoscale fronts and shelf break currents.

Chukchi Sea Ice Observations by Upward Looking Sonars, 2008-2014

Todd Mudge
ASL Environmental Sciences Inc (ASL), tmudge@aslenv.com
Keath Borg
ASL, kborg@aslenv.com
Dawn Sadowy
ASL, dsadowy@aslenv.com
David Fissel
ASL, dfissel@aslenv.com
Ed Ross
ASL, eross@aslenv.com

A multi-site, multi-year measurement program of Chukchi Sea ice draft using upward looking sonars (ULS) has been funded by Shell (2008-2014), ConocoPhillips (2008-2013), and Statoil (2010-2013). Ice Profiling Sonars provide vertical resolution of better than 0.05 m and a temporal resolution of 1-2 seconds of ice draft. Acoustic Doppler current profilers typically provide one to several minutes of temporal resolution and a precision of up to 1 mm/s for ice velocity. Combined, the systems deliver a nearly continuous record of ice draft at better than a 1 m horizontal resolution.

Seasonal sea ice characteristics at the sites have generally followed a predictable pattern. Ice, as it forms in October and November, is typically quite mobile. By December or January the ice concentrations are high enough and the ice is thick enough that motion becomes limited. March and April tend to be the months with the least amount of ice motion, sometimes with long periods of virtually motionless ice punctuated by a few, short lived, wind-driven ice drift events. The months of May and June see a trending towards greater ice motion. July, August, and September typically sees ice concentrations dropping to zero over most of the ULS sites.

The winter of 2013 did not follow this seasonal trend of sea ice motion and ice thickness. For one ULS site in the Chukchi, monthly median ice motions in January 2013 were twice as high as previous years. Ice draft for the site was lower in 2013 then is previous years, particularly for the month of March. The unexpected ice characteristics seem to be a precursor and symptomatic of the large fracture event in the Chukchi and Beaufort seas that was observed by satellite in February and March of 2013. Using newly acquired ULS data for the 2013-2014 ice season, we will investigate if the sea ice characteristics have gone back to the seasonal trends of 2008-2012 or show a continuation of 2013's elevated ice drift for the winter months.

Arctic - Climate and Oceanography

Lateral Mixing Across Meltwater Fronts of the Chukchi Sea Shelf

KoFan Lu
University of Alaska Fairbanks (UAF), klu3@alaska.edu
Thomas Weingartner
UAF, tjweingartner@alaska.edu
Seth Danielson
UAF, sldanielson@alaska.edu
Peter Winsor
UAF, pwinsor@alaska.edu
Elizabeth Dobbins
UAF, eldobbins@alaska.edu
Kim Martini
NOAA, Pacific Marine Environmental Laboratory, kim.martini@noaa.gov
Hank Statscewich|
UAF, hank.stats@alaska.edu

Hydrographic observations in the northeastern Chukchi Sea in summer and fall frequently detect intra-pycnocline intrusions of warm, moderately salty summer waters derived from the Bering Sea. The intrusions are 10-20 m thick and appear as distinct blobs or plumes. They occur within the shallow (~ 20 m depth) pycnocline that separates cold, dilute, surface meltwater from near-freezing, salty, winter-formed waters found along the bottom. A simple numerical model suggests that the intrusions result from instability of the front that separates meltwater from the Bering waters. Frontal instability generates meanders and eddies, which subsequently propagate laterally and carry warm Bering waters into the pycnocline. The model results suggest that these lateral eddy heat fluxes could play a major role in ablation along the ice edge throughout summer. In fall these same fluxes may be important in delaying the onset of ice formation over some portions of the northeastern Chukchi Sea shelf.

Arctic - Climate and Oceanography

The Arctic Tracer Release Experiment (ARCTREX) - Applications for Mapping Spilled Oil in Arctic Waters

Peter Winsor
University of Alaska Fairbanks (UAF), pwinsor@alaska.edu
Robert Chant
Rutgers University, chant@marine.rutgers.edu
Harper Simmons
UAF, hlsimmons@alaska.edu
Amy Merten
NOAA, Office of Response & Restoration, amy.merten@noaa.gov
Elias Hunter
Rutgers University, hunter@marine.rutgers.edu
Hank Statscewich
UAF, hank.stats@alaska.edu
Elizabeth Dobbins
UAF, eldobbins@alaska.edu
Jacqueline McSweeney
Rutgers University, jmcsween@marine.rutgers.edu
Nicolas Eckhardt
NOAA, Office of Response & Restoration, nicolas.eckhardt@noaa.gov
Jonathan Whitefield
UAF, jwhitefield@alaska.edu

We present preliminary results from the Arctic Tracer Release Experiment (ARCTREX) with application to mapping spilled oil in Arctic waters. Over a 10-day period in September 2014, we performed two separate releases of Rhodamine dye, an inert non-toxic fluorescent tracer, in the mixed layer of the northeastern Chukchi Sea, and mapped the dispersion and evolution of these dye patches over time and space using real-time data from autonomous underwater vehicle (AUV) gliders, towed vehicle surveys, through-flow system, and satellite-tracked drifters. The dye mapping was relayed in real time to the NOAA Arctic Environmental Response Management Application (ERMA) and was displayed on an interactive online geographic information system (GIS) map.

Each dye release was traced over a 4-day period using Rhodamine-specific fluorometers capable of detecting dye down to fractions of parts per billion in concentration. The first dye release was performed in the heavily stratified offshore region close to the Burger lease patch. Dye released here stayed confined to the ~15-m thick mixed layer and dispersed and advected relatively slowly over a 4-day period as the patch stretched and thinned (“strained”) along small gradients in surface salinity. A second dye release was performed close to the main ocean front separating energetic flow from the offshore meltwater regime. Here the dye responded quickly to the dynamical conditions by advecting quickly along the front and within hours subducting along isopycnals, disappearing completely from the surface of the ocean. The subduction was characterized by reduced advection speed and rapid dispersal over a large area. The dye patch formed a thin subsurface layer at 20-30 m depth, in close proximity to the benthos.

Composition, Diversity and Vertical Structure of the Zooplankton Community in the Beaufort Sea

Caitlin Smoot
University of Alaska Fairbanks (UAF), casmoot@alaska.edu
Russell Hopcroft
UAF, rrhopcroft@alaska.edu

We studied the zooplankton communities of the Beaufort Sea as part of a multi-year and interdisciplinary effort to characterize the physics and biology of the Beaufort Sea. Knowledge of the composition and spatial distribution of the zooplankton community is essential given their importance as trophic links, as is establishing foundational data in light of global change and increased oil and gas industry interest in the Arctic region. This work is part of a multi-year dataset (2010-2014) that provides a modern reference point from which future change may be gauged. Zooplankton were sampled along cross-shelf transects from depths of 20 to 1,000 m between Camden Bay and the Mackenzie River during August 2013. This study represents the first depth-stratified examination of these communities. In total 93 taxonomic categories were documented, with the greatest diversity observed in the copepods (46 species). Over 50% of the abundance and biomass was concentrated in the upper 100 m where the community was dominated by a guild of Arctic taxa, including *Calanus* species, *Oithona similis*, and the *Pseudocalanus* species complex. The presence of euryhaline taxa such as *Limnocalanus* and *Eurytemora* reflected the freshened surface water observed in the study region. Pacific expatriates such as *Neocalanus cristatus* and *Eucalanus bungii* were also present in low abundances. Abundance and biomass generally decreased with depth, with the exception of a slight increase in both parameters observed in the transition to Atlantic water (200-300 m). The community exhibited a layered structure that was highly correlated with salinity and depth (Spearman correlation = 0.83).

Phylogeography and Connectivity of Four Sibling Species of *Pseudocalanus* (Copepoda; Calanoida) in the North Pacific and Arctic Oceans

Jennifer Questel
University of Alaska Fairbanks (UAF), jmquestel@alaska.edu
Leocadio Blanco-Bercial
University of Connecticut (UC), leocadio@uconn.edu
Russell Hopcroft
UAF, rrhopcroft@alaska.edu
Ann Bucklin
UC, ann.bucklin@uconn.edu

Pseudocalanus (Copepoda: Calanoida) is one of the most numerically dominant genera in Arctic and sub-Arctic waters. However, *Pseudocalanus* presents taxonomic difficulty in morphological identification down to the species level, resulting in a general lack of detailed species-specific distribution data. To determine population genetic structure of the species, the mitochondrial gene cytochrome oxidase I (mtCOI) was sequenced for two temperate (*P. mimus* and *P. newmani*) and two Arctic (*P. acuspes* and *P. minutus*) species from the Chukchi and Beaufort seas, the Gulf of Alaska, and two fjord systems within Prince William Sound. Genetic data show significant differentiation of the Beaufort Sea population, as well as populations within the fjord systems. Partial genetic isolation (i.e., low gene flow) of the Beaufort Sea population may be a consequence of the Beaufort Gyre's strong frontal zone, which may generate a faunal barrier between the western Arctic Ocean and the North Pacific/Chukchi Sea. We also report the likelihood of alternative models of population connectivity in order to better understand directions of gene flow between sampled populations of *Pseudocalanus* in relation to oceanographic features. Under current warming trends, is it conceivable that faunal barriers for *Pseudocalanus* will shift northward, allowing habitat range expansion and potentially increased population connectivity between Arctic and sub-Arctic populations.

Lower Trophic Level Food Web Structure on the eastern Beaufort Sea Shelf and Slope

Lauren Bell
University of Alaska Fairbanks (UAF), lebell2@alaska.edu
Katrin Iken
UAF, kbiken@alaska.edu
Bodil Bluhm
The Arctic University of Norway, bodil.bluhm@uit.no

Coastal erosion and freshwater discharge along the northern U.S.-Canada coastline deposit large amounts of terrigenous carbon into the eastern Beaufort Sea. This refractory material is reputed to be difficult to assimilate for marine primary consumers, presumably resulting in inefficient energy transfer to higher trophic levels. Our research is the first to describe the relative ecological importance of terrestrially-derived organic matter across the Mackenzie River-influenced Beaufort Sea shelf and slope based on hydrogen stable isotope signatures (δD) of surface water, surface sediment particulate organic matter (POM), and selected benthic consumers. Carbon ($\delta^{13}C$) and nitrogen ($\delta^{15}N$) stable isotope signatures of pelagic and sediment POM and dominant pelagic and benthic consumers were also used to investigate differences in community trophic structure across the region concurrent with variation in terrestrial matter influence. Our δD results confirm a significant decrease in terrestrial organic matter utilization by benthic consumers with bottom depth along the slope, and this depth-related pattern is consistent across the central to eastern Beaufort slope region (136° – 151° W). Food web length, based on the range of $\delta^{15}N$ values of marine consumers, was longer on the Beaufort slope compared to the nearshore shelf and also showed no significant trend across the longitudinal extent of our study area. The results are contrary to our expectation that food webs will be longer when supported by a higher proportion of terrestrially-derived organic matter, which must be reworked through a microbial pathway before being nutritionally available to marine consumers. Instead, our study indicates that shorter food webs are correlated with the shallow depths of the Beaufort shelf, where highest relative utilization of terrestrial matter by benthic consumers occurred. This research thus challenges the current conception of terrestrial matter as a ‘poor’ food source for marine consumers, prompting us to reconsider how forecasted increases in terrestrial organic matter inputs to the Arctic Ocean will impact marine trophic structure.

Growth and Production of the Dominant Alaska Arctic Brittle Stars: *Ophiura sarsii* and *Ophiocten sericeum*

Alexandra Ravelo
University of Alaska Fairbanks (UAF), amravelo@alaska.edu
Brenda Konar
UAF, bhkonar@alaska.edu
Bodil Bluhm
University of Tromso, bodil.bluhm@uit.no
Katrin Iken
UAF, kbiken@alaska.edu

Brittle stars are a key component of Arctic benthic shelf systems due to their high standing stock, dominance in abundance over all other epibenthic organisms, importance in carbon remineralization, and as prey for higher trophic organisms. Despite the pervasiveness of these brittle stars, little is known of their distribution boundaries, variation in abundance and how long it takes for their substantial standing stocks to accumulate, how long these populations persist in time and space, or the factors that may contribute to their geographic distribution. The objective of this study was to analyze the population's distribution, abundance, size structure, growth, and productivity. On the Alaskan Arctic shelves, the circumboreal species *Ophiura sarsii* and *Ophiocten sericeum* are the dominant brittle stars with densities of up to 260 ind. m^{-2} and 20 ind. m^{-2}, respectively. Although present across all Alaska Arctic shelves these specie have a segregated distribution; *O. sarsii* dominates the more productive Chukchi and western Beaufort Sea shelves and *O. sericeum* dominates the more river influenced Beaufort Sea shelf east of 150° W. Overall, *O. sarsii* is a larger species than *O. sericeum*, with a maximum disc diameter of 30.9 mm and 14.9 mm, respectively. Both species showed an exponential relationship between body size and organic mass ($r^2 = 0.93$ for *O. sarsii* and $r^2 = 0.89$ for *O. sericeum*). However, at equal body size, *O. sarsii* had significantly higher organic matter content compared to *O. sericeum*. The first ever age estimates of Arctic brittle stars, based on age bands in ossicles in arms, suggest longevity of ≥ 12 years for *O. sarsii* and 10 years for *O. sericeum*. Preliminary results from age analysis indicate that *O. sarsii* may grow faster and live longer than *O. sericeum*. In the context of a rapid changing Arctic environment, an increase in the systems productivity could favor a faster growing and more productive *O. sarsii*; however a decrease in energy flux to the benthos could favor a smaller more resilient *O. sericeum*, promoting large changes in the distribution and dominance throughout the Alaska Arctic shelves.

Snow Crab (*Chionoecetes opilio*) Ecology in the Alaskan Arctic

Lauren Divine
University of Alaska Fairbanks (UAF), lmdivine@alaska.edu
Katrin Iken
UAF, kbiken@alaska.edu
Bodil Bluhm
University of Tromso, bodil.bluhm@uit.no
Robert Foy
NOAA, Alaska Fisheries Science Center (AFSC), robert.foy@noaa.gov
Bob Lauth
AFSC, robert.lauth@noaa.gov
Brenda Norcross
UAF, bnorcross@alaska.edu
Kerim Aydin
AFSC, kerim.aydin@noaa.gov
Andy Whitehouse
AFSC, andy.whitehouse@noaa.gov

Warming trends and associated sea ice loss have resulted in a contraction of the commercially exploited stock of snow crabs (*Chionoecetes opilio*) in the Bering Sea, raising concerns of dispersal and migration dynamics, as well as connectivity among populations in the Bering, Chukchi, and Beaufort seas. To better predict the impacts of climate change on population characteristics of high-latitude snow crabs, an intense collaborative effort has been made in the Chukchi and Beaufort seas to establish a baseline of information regarding Arctic snow crab ecology. Briefly, we addressed questions regarding distribution and abundance, female fecundity and reproductive potential, and trophic ecology. Snow crabs are much more abundant across the Chukchi shelf (> 300,000 km^{-2} maximum in the southern Chukchi) than the Beaufort Sea shelf (< 10 km^{-2}). Snow crabs in the Beaufort Sea mostly occupy deeper shelf and slope habitats (> 200 to 1000 m); the Chukchi Sea slope was not sampled. Male and immature females are smaller in the Chukchi (up to 90 mm carapace width: CW) than those in the Beaufort Sea (up to 130 mm CW). Mature females have not been collected from the Beaufort Sea, but mature females in the Chukchi Sea are slightly smaller when compared with the long-term dataset for mature females in the eastern Bering Sea. Female fecundity is positively correlated to body size in the Chukchi Sea, and data are still lacking for mature females in the Beaufort Sea. Snow crabs occupy an intermediate trophic position within the benthic food web across the Chukchi and Beaufort Seas, based on $\delta^{13}C$ and $\delta^{15}N$ stable isotopes. Regional diet differences based on stomach content analysis occur and are presumably related to both regional prey availability and crab sizes. Predation on snow crabs seems generally low for high arctic crabs, but cannibalism on younger conspecifics may play a larger role in Chukchi crabs than Beaufort crabs. Together, these data provide a holistic view of high Arctic snow crab ecology on which to base future management decisions, such as through the Arctic Fisheries Management Plan.

SHELFZ Project: Benthic Invertebrates from Nearshore to Offshore in and Around Barrow Canyon in the Northeastern Chukchi Sea

Kimberly Rand
NOAA, Alaska Fisheries Science Center (AFSC), kimberly.rand@noaa.gov
Elizabeth Logerwell
AFSC, libby.logerwell@noaa.gov
Seth Danielson
University of Alaska Fairbanks, sldanielson@alaska.edu
Leandra Sousa
North Slope Borough, leandra.sousa.nsb.dwm@gmail.com

We examined distribution patterns of the epifauna invertebrate community in the northeastern Chukchi Sea as part of the SHELFZ survey in August-September 2013. The nearshore invertebrate community was sampled from the shoreline out to ~20 m water depth with a plumb staff beam trawl and the offshore invertebrate community was sampled with an 83-112 eastern otter trawl. The total catch biomass nearshore was 78% invertebrates and offshore was 98% invertebrates. Of the nearshore invertebrates, crangonid shrimps, jellyfish and sea stars comprised the majority of the biomass. In the offshore, the two species *Gorgonocephalus cf. arcticus* (basket star) and *Psolus peroni* (sea cucumber) were more than 50% of the biomass. The center of highest abundance for *Gorgonocephalus* began at the edge of Barrow Canyon and followed the deeper waters of the canyon. In contrast, *Psolus peroni* was almost nonexistent in Barrow Canyon but was found instead on the perimeter, in the shallow waters in the northwestern part of the study area. In addition to examining the distribution of the invertebrate community by depth, we examined the physical oceanography and habitat features of the study area, of which Barrow Canyon is a significant part. This study is unique in that it begins nearshore and extends offshore encompassing part of Barrow Canyon and the Chukchi sea shelf, both of which may be regulated by different oceanographic processes. Because the majority of the living Arctic community is comprised of invertebrates (epi- and infaunal), understanding what environmental characteristics influence the distribution of epifaunal invertebrates is necessary to predict the impacts of climate change and oil and gas development on Arctic ecosystems.

Arctic - Fishes and Fish Habitats

Ontogenetic, Temporal and Spatial Variation in the Trophic Roles of Chukchi Sea Fishes

Jennifer Marsh
University of Alaska Fairbanks (UAF), jmmarsh@alaska.edu
Franz Mueter
UAF, fmueter@alaska.edu
Katrin Iken
UAF, kbiken@alaska.edu
Seth Danielson
UAF, sldanielson@alaska.edu

With climate warming and longer open-water seasons in the Arctic, there is an increased interest in shipping, oil exploration and the expansion or development of commercial fisheries. Anticipated natural and anthropogenic changes are expected to alter the ecosystem of the Chukchi Sea, including its fish communities. As a component of the Arctic Ecosystem Integrated Survey, we assessed the ontogenetic, spatial and temporal variability of the trophic roles (trophic level and diet source) of key fish species in the Chukchi Sea using C and N stable isotopes. Unlike diet analysis, stable isotope analysis integrates only food items assimilated by consumers and therefore more accurately represents the transfer of energy between trophic levels. During August and September of 2012 and 2013, sixteen common fish species and two baseline invertebrate species were collected from surface, midwater and bottom trawls within the eastern Chukchi Sea. Linear mixed effects models were used to detect possible variation in the relationship between body length and either $\delta^{13}C$ or $\delta^{15}N$ among water masses and years for each fish species. Additionally, we examined the community isotopic niche space, trophic redundancy, and trophic separation in each water mass as measures of resiliency of the food web. We present preliminary results on the ontogenetic, temporal, and spatial variability in the trophic roles of sixteen fish species, including saffron cod (*Eleginus gracilis*), Arctic cod (*Boreogadus saida*), and capelin (*Mallotus villosus*), as well as community-wide measures of isotopic niche space. Examining how spatial gradients in trophic roles are linked to environmental drivers can provide insight into potential community shifts with a changing climate.

Contrasting Strategies of Lipid Storage in Juvenile Arctic Cod (*Boreogadus saida*) and Saffron Cod (*Eleginus gracilis*) Under Variable Thermal regimes.

Louise Copeman
Oregon State University, lcopeman@coas.oregonstate.edu
Benjamin Laurel
NOAA, Alaska Fisheries Science Center (AFSC), Ben.Laurel@noaa.gov
Ron Heintz
AFSC, Ron.Heintz@noaa.gov
Johanna Vollenweider
AFSC, johanna.vollenweider@noaa.gov

Climate models indicate the Arctic will undergo dramatic environmental change as a consequence of global warming. Increasing temperatures will most likely be coupled with increased river runoff which in turn will significantly impact nearshore marine food webs. Both Arctic cod (*Boreogadus saida*) and saffron cod (*Eleginus gracilis*) are abundant and ecologically important in Arctic coastal waters, however, little is known about their growth, feeding ecology, or energy allocation during the juvenile stages. We used both field and laboratory approaches to understand the early energetics of juvenile Arctic and saffron cod in relation to changes in temperature and food availability. Field collections of age-0 and age-1 juvenile gadids showed significant trends in condition metrics both within and between species. Saffron cod showed a significant increase in lipid per wet weight with standard length up until the first over-wintering period. Similar large-scale analyses are underway for Arctic cod, but preliminary analyses suggest Arctic cod have higher levels of total lipids and storage lipids both in muscle and liver tissues than saffron cod. Energetic differences, both within and among these gadids, may stem from regional trophic and thermal conditions. Fatty acid biomarkers indicate Arctic cod have a higher reliance on calanoid copepods than saffron cod and laboratory experiments revealed distinct differences in growth and condition under varying temperatures. These field and laboratory data suggest Arctic cod and saffron cod will likely respond differently to regional warming, such that energetic contribution of these forage fish to higher trophic levels could be substantially altered in the wake of further climate change.

Limits to Viability of a Critical Arctic Migration Corridor Due to Localized Prey, Changing Sea Ice, and Impending Industrial Development

James Lovvorn
Southern Illinois University (SIU), lovvorn@siu.edu
Aariel Rocha
SIU, aariel.rowan@gmail.com
Stephen Jewett
University of Alaska Fairbanks (UAF), scjewett@alaska.edu
Douglas Dasher
UAF, dhdasher@alaska.edu
Steffen Oppel
Royal Society for the Protection of Birds, Steffen.Oppel@rspb.org.uk
Abby Powell
UAF, abby.powell@alaska.edu

In the Arctic, combined effects of climate change and industrialization pose challenges for habitat conservation. Four species of threatened or declining eider ducks that nest in the Arctic migrate through the northeast Chukchi Sea, where anticipated industrial development may require prioritizing areas for regulation. In this nearshore corridor (10–40 m depth), the eiders' access to benthic prey is restricted to variable areas of open water within sea ice. For the most abundant species, the king eider (*Somateria spectabilis*), stable isotopes in blood cells, muscle, and potential prey indicate that these eiders ate mainly bivalves when traversing this corridor. Bivalves there were much smaller than the same taxa in deeper areas of the northern Bering Sea, probably because of ice scour in shallow water; future decrease in seasonal duration of fast ice may increase this effect. Computer simulations suggested that if these eiders forage for > 15 h/day, they can feed profitably at bivalve densities > $200 m^{-2}$ regardless of water depth or availability of ice for resting. Sampling in 2010–2012 showed that large areas of profitable prey densities occurred only in limited locations throughout the migration corridor. Satellite data in April–May over 13 years (2001–2013) indicated that access to major feeding areas through sea ice in different segments of the corridor can vary from 0–100% between months and years. In a warming and increasingly variable climate, unpredictability of access may be enhanced by greater effects of shifting winds on unconsolidated ice. Our results indicate the importance of maintaining a range of potential feeding areas throughout the migration corridor to ensure prey availability in all years. Spatial planning of nearshore industrial development in the Arctic, including commercial shipping, pipeline construction, and the risk of released oil, should consider these effects of high environmental variability on the adequacy of habitats targeted for conservation.

Arctic - Mammals

A Year in the Acoustic World of Bowhead Whales in the Northern Bering, Chukchi, and Beaufort Seas

Christopher Clark
Cornell University, cwc2@cornell.edu
Catherine Berchok
NOAA, Alaska Fisheries Science Center, Catherine.Berchok@noaa.gov
Susanna Blackwell
Greeneridge Sciences, Inc., susanna@greeneridge.com
David Hannay
JASCO Applied Sciences, David.Hannay@jasco.com
Josh Jones
Scripps Institution of Oceanography, j8jones@ucsd.edu
Dimitri Ponirakis
Cornell University, dwp22@cornell.edu
Kathleen Stafford
University of Washington, Stafford@apl.uw.edu

Bowhead whales (*Balaena mysticetus*) in the Bering-Chukchi-Beaufort (BCB) population, experience a highly variable acoustic environment among the regions that they inhabit throughout the year. We analyzed acoustic data from a 14-month period, August 2009 through September 2010, collected with a suite of seafloor recorders distributed at 20 sites throughout a 2,300 km transect. These recorders sampled areas in which bowhead whales occur seasonally and in which there are seasonally natural and anthropogenic sources that produce varying amounts of underwater noise. We analyzed these acoustic data to describe, quantify and compare a) the spatial-temporal occurrence of bowhead whales throughout their range over the 14-month period and b) the spatial-temporal variability in the acoustic environment, as segmented into five contiguous zones and three, 4-month seasons spanning a 12-month period. The results map a) the seasonal acoustic occurrence of bowhead whales in the Bering Sea, Bering Strait and southern Chukchi Sea, northeastern Chukchi Sea, western Beaufort Sea, and eastern Beaufort Sea zones, and b) the spatial and temporal variability of background noise levels encountered by bowhead whales throughout their annual cycles of seasonal migration and residency. GLM analysis showed there was a statistically significant relationship between acoustic occurrence and season, distance offshore and water depth. For the spring 2010 migration, there was a statistically significant inverse relationship between acoustic occurrence and distance offshore. Within a season, K-W analysis revealed there were only significant ambient noise level differences between the Bering Sea and all other zones during the winter season. Within the Bering Sea, Bering Strait, and southern Chukchi Sea, northeastern Chukchi Sea zones there were significant ambient noise level differences between the summer and winter seasons. Singing bowhead whales during the winter in the Bering Sea zone were the greatest single contributor to ambient level. A number of interesting events of unknown origin were evident on recorders > 600 km apart. The timings and distributions of these phenomena suggest that they represent some type of large-scale oceanographic environmental event (e.g., ice movement). Overall, these

Fat Chance – Uptake, Modification, and Storage of Fatty Acids in Bowhead Whales

Lara Horstmann
University of Alaska Fairbanks (UAF), lara.horstmann@alaska.edu
Craig George
North Slope Borough, craig.george@north-slope.org
Alexandra C. M. Oliveira
UAF, aoliveira@alaskaseafood.org

Analysis of fatty acids (FA) in marine mammal blubber is a popular tool to assess feeding ecology and food web linkages. FA interpretation relies on the assumption of predictable deposition of prey FAs in predator tissues without preferential uptake and substantial modification during digestion. Bowhead whales (*Balaena mysticetus*) are endangered baleen whales (Mysticeti) occupying seasonally ice-covered waters of the Bering, Chukchi, and Beaufort seas. Their diet consists predominately of copepods and euphausiids, and digestion (via microbial fermentation) begins in the forestomach. We sampled intestinal tract contents (forestomach, jejunum, colon), liver, and blubber from 13 bowhead whales taken during Alaska Native subsistence harvests (2011-2013). We then extracted and transesterified lipids from all samples and quantified 67 FAs to determine uptake and modification along the intestinal tract, as well as FA distribution and storage in bowhead whale tissues. FA composition and abundance differed significantly among all tissues (ANOSIM, $p < 0.05$), except jejunum and liver (ANOSIM, $p = 0.23$) indicating FAs taken up in the small intestine are delivered to hepatic short-term storage. FAs most dissimilar between forestomach (indicative of prey) and blubber (long-term storage) were the important primary production biomarkers, 16:1*n*7 and 20:5*n*3 (contribution to mean dissimilarity was 14.2% and 12.3%, respectively). Similarly, 16:1*n*7 and 20:5*n*3 contributed most to the difference between forestomach and liver (15.2% and 13.8% contribution to mean dissimilarity, respectively). Unsurprisingly, abundance of most FAs, in particular essential FAs, declined in the colon compared with forestomach. However, some of the most abundant FAs in the colon were the long chain saturated FAs, 20:0 and 22:0, as well as anteiso 15:0, which did not occur in forestomach samples or other tissues of bowheads. This suggests bacterial/microbial modification of FAs along the gastrointestinal tract. The results of this study show differential uptake, considerable modification, and variable storage of fatty acids in tissues of bowhead whales. Commonly used biomarkers of primary productivity in the Arctic were driving the difference between FA intake from prey and long-term storage in blubber. We therefore caution the use of fatty acids as indicators of food web linkages and diet in bowhead whales.

Regional Diving Behavior of Pacific Arctic Beluga Whales Relative to Water-column Prey

Donna Hauser
University of Washington (UW), dhauser@uw.edu
Kristin Laidre
UW, klaidre@uw.edu
Sandra Parker-Stetter
UW, slps@uw.edu
John Horne
UW, jhorne@uw.edu
Robert Suydam
North Slope Borough, Robert.Suydam@north-slope.org
Pierre Richard
Fisheries and Oceans Canada, Pierre.Richard@dfo-mpo.gc.ca

Beluga whales (*Delphinapterus leucas*) make extensive seasonal migrations in the Pacific Arctic, yet there is limited information on population-specific behavior and how diving varies by region. We used satellite tags equipped with time-depth recorders, attached to 30 individuals from two populations from 1997-2012, to assess how beluga whales use the water column by quantifying a suite of diving metrics. In the eastern Beaufort Sea, we also estimated vertically integrated densities of a presumed primary prey item, age 1+ Arctic cod (*Boreogadus saida*), based on an acoustic survey conducted in August 2008. We used generalized linear mixed models (GLMMs) to test how beluga whales dive behaviors in the survey area related to the vertical distribution of Arctic cod. Dive behavior varied among regions and between populations. Maximum and mode dive depths within 6-h periods suggested that Eastern Chukchi Sea (ECS) and Eastern Beaufort Sea (BS) beluga whales were regularly diving to the seafloor in the Chukchi and Bering seas, while more pelagic diving was common in Barrow Canyon, along slope margins of the Beaufort Sea, and in Canada Basin. Maximum dive durations were greater for ECS than BS belugas and often > 20 min. Maximum daily depths recorded for 6 ECS tags also significantly varied regionally, with depths > 900 m recorded in Canada Basin. Arctic cod in the eastern Beaufort Sea were most abundant in the 200-300 m portion of the water column and dive behaviors of ECS belugas located within the area targeted these same depths. Our GLMMs revealed that the number of beluga whale dives to 200-300 m were significantly related to Arctic cod density within 200-300 m and water depth. As cod density within
200-300 m increased, the number of beluga dives to that depth decreased and suggested that belugas need to dive less frequently when Arctic cod are abundant. These results are consistent with the hypothesis that Arctic cod are a primary prey item for Pacific Arctic belugas and that foraging belugas dive to depths that maximize prey availability relative to the energetic cost of diving.

Arctic - Mammals

What Do Bearded Seals Really Eat – A Methods Comparison

Anna Bryan
Alaska Department of Fish & Game (ADFG), anna.bryan@alaska.gov
Lori Quakenbush
ADFG, lori.quakenbush@alaska.gov
Lara Horstmann-Dehn
University of Alaska Fairbanks, lara.horstmann@alaska.edu

Stomach contents, stable isotopes, fatty acids, and more recently, fecal DNA are commonly used to infer the diet of marine mammals. How complimentary or contradictory these methods are, especially when considering individual diet variability, remains poorly understood. Differences in dietary information from stomach contents, stable isotopes, and fatty acids were evaluated for 76 adult bearded seals (*Erignathus barbatus*) harvested in Alaska for subsistence uses. Fishes were investigated using stomach contents and fecal DNA from a subset of 22 seals. As expected, stomach contents and fecal DNA provided information on recently consumed prey, while $d^{13}C$ and $d^{15}N$ of muscle and fatty acid profiles of full-thickness blubber provided information on prey consumed and integrated over a longer time frame. Taxonomic resolution of prey was highest for stomach contents. We identified at least 60 prey taxa in the stomachs; with sculpins (Cottidae) occurring most often at 66% frequency of occurrence (FO), followed by shrimp (64% FO), crab (63% FO), and cod (Gadidae) (55% FO). Proportions of indicator fatty acids from blubber were similar to other fatty acid studies of bearded seals in Alaska and suggest a benthic diet. Specific prey identification using fatty acids was not possible, because fatty acid prey libraries do not exist for the Alaskan Arctic. Some taxonomic resolution was achieved for stable isotopes using a Bayesian stable isotope mixing model (SIAR), but prey had to be combined into isotopically (i.e., not taxonomically) similar prey source groups due to model restrictions. Despite the differences in dietary time frames, the relative occurrence (RO) of prey from stomach contents and the mean proportions of prey source groups from the stable isotope mixing model were similar, except for octopus. Octopus occurred at a higher proportion using estimates from stable isotopes (13%) compared with the RO of stomach contents (3%). Using denaturing gradient gel electrophoresis (DGGE) of 16S gene fragments, only two fishes (shorthorn sculpin (*Myoxocephalus scorpius*) and an unknown snailfish species, Liparidae) could be positively identified. Overall, the methods yielded different, but not contradictory results, and none provided a complete description of diet.

Sea Ice in Barrow Project Jukebox

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

In this NPRB funded project, we have created a Project Jukebox website featuring oral history recordings of local residents talking about their observations of and experiences with sea ice in northern Alaska (www.jukebox.uaf.edu/seaice). It includes recordings made: in 1978 by Ron Metzner and Dr. Lew Shapiro of the UAF Geophysical Institute about sea ice in the Beaufort Sea area and around Barrow; in 2008 and 2009 by Matthew Druckenmiller for his Ph.D. work at the University of Alaska Fairbanks mapping sea ice trails in Barrow; and in 2013 by Karen Brewster and Oliver Dammann with whalers in Barrow discussing recent unusual sea ice conditions. These recordings present traditional knowledge about ice conditions, ice travel, and human adaptation and the changing environment.

By providing access to historical and current oral history recordings about sea ice this website creates a retrospective database of traditional knowledge and long-term observational records. In addition to documenting traditional knowledge, the Sea Ice Project Jukebox also addresses how changes in the sea ice are impacting subsistence and marine resources, and how climate change is affecting the ecosystems and the local people. Using the people's own words, this project demonstrates how the sea ice has changed over the past thirty-four years and how the Inupiat are adapting to these changes.

In this presentation, I will demonstrate the Sea Ice Project Jukebox website, play excerpts of interviews, and highlight some of the associated resources available on the site.

Using the website is the best way to show people the highly interactive and synchronized aspect of Project Jukebox and play excerpts from the oral history recordings. The full effect of Project Jukebox is lost if using screen captures in Microsoft's PowerPoint. Therefore, I will need a reliable internet connection and a way to play audio/video through the room's sound system so everyone can see and hear what is being played.

This presentation represents a final report of the project as required under NPRB grants. We did not give a presentation in 2014, as the project was not yet fully underway by the abstract submission deadline.

Arctic Shield 2014: Arctic Oil Spill Response and Tool Interoperability

Zachary Winters-Staszak
NOAA, Office of Response & Restoration (NOAA-ORR), zachary.winters-staszak@noaa.gov
Amy Merten
NOAA-ORR , amy.merten@noaa.gov
Kurt Hansen
U.S. Coast Guard, Kurt.A.Hansen@uscg.mil
Jill Bodnar
NOAA-ORR, jill.bodnar@noaa.gov
Aaron Racicot
NOAA-ORR, aaron.racicot@noaa.gov

As the Arctic becomes more accessible to industrial activities and tourism, new tools must be identified and tested to prepare for oil spills in the region. Harsh weather and remoteness will limit spill response techniques proven in more temperate environments. Oil and sea ice interaction, movement and freeze-thaw events create additional complexities to survey, track and recover oil. In August of 2014, the National Oceanic and Atmospheric Administration (NOAA) participated in the U.S. Coast Guard Research and Development Center's Arctic Technology Evaluation aboard the U.S. Coast Guard Cutter *Healy* to investigate technologies for potential use in an arctic oil spill response.

During the evaluation, fluorescein dye and oranges were applied as oil simulants. Both media were surveyed and tracked by multiple technologies. Surveying at altitude, NOAA's Unmanned Aerial System, the Puma, recorded high-resolution imagery as an Aerostatic balloon tethered to the *Healy* recorded the dye plume footprint. The Oil Spill Recovery Institute provided GPS-enabled tracking buoys to record ice floe movement and surface ocean currents.

Data from each technology were visualized in an offline instance of NOAA's Environmental Response Management Application (Stand-alone ERMA®), a mapping tool that assists emergency responders, environmental resource managers, and communities in dealing with incidents that may harm the environment. Stand-alone ERMA provides situational awareness where unreliable Internet bandwidth exists. Data from the various technologies were integrated into Stand-alone ERMA in near real-time by scripting unique code to streamline data standardization. Ship-board satellite Internet was utilized to synchronize the data from Stand-alone ERMA with the online ERMA site so results could be viewed by agency leadership back home.

Results from the evaluation provided valuable insight into the need for a comprehensive suite of technologies that can operate in concurrence and in harsh conditions. Due to the remote nature of the Arctic, rapid dissemination of data from the field to decision-makers will rely on novel solutions and require significant investment in planning for hazardous incidents. As such, this presentation will discuss the importance of tool interoperability,

Establishing Pre-Development Baseline Concentrations of Hydrocarbons and Metals in Sediments and Marine Invertebrates From the Chukchi Sea, Alaska

Gregory Durell
Battelle Memorial Institute (BMI), durell@battelle.org
John Trefry
Florida Institute of Technology, jtrefry@fit.edu
John Hardin
BMI, hardinj@battelle.org
Brenda Lasorsa
Pacific Northwest National Laboratory, brenda.lasorsa@pnnl.gov
Waverly Kallestad
Fairweather LLC, waverly.kallestad@fairweather.com

Oil and gas exploration is being planned for the Chukchi Sea, including the Burger Prospect where exploratory drilling occurred in 1989 and 1990. In 2008, a multi-disciplinary program was initiated to establish baseline environmental conditions and thereby enable detection of any potential future impacts from offshore activities. The program includes studies of physical, chemical and biological oceanography. This presentation focuses on the distribution of metals and hydrocarbons in sediments and marine invertebrates.

Oceanographic surveys were conducted in 2008, 2012, and 2013 to collect sediment and invertebrates. During 2013, samples were collected at 41 stations in the Burger Prospect, including reference locations. Somewhat fewer stations were sampled in 2008 and 2012. Samples were analyzed for polycyclic aromatic hydrocarbons (PAH), saturated hydrocarbons, petroleum biomarkers and a series of major and trace metals required by the NPDES permit. The chemical concentrations in sediment and organisms are discussed. Natural and anthropogenic processes are considered to help explain the sources, concentrations and distribution of the chemicals and their ecological significance.

Sediment hydrocarbon and metal concentrations were somewhat variable, reflecting different sediment characteristics (e.g., grain size, TOC content), but were low and at background levels throughout most of the study area. Subtle petrogenic hydrocarbon signatures were observed in the regional sediments, as have been reported previously (e.g., COMIDA), but concentrations were within the range found in other similar Arctic environments. Total PAH concentrations, for instance, were generally in the 200 to 400 µg/kg range. Sediment trace metal concentrations were demonstrated to be present at natural background levels when normalized to Al, a major constituent of the sediment. Sediment core data showed a uniform historical record. Concentrations of Ba and PAH were above background at a historic drilling site. PAHs and metals in invertebrates were within the background range for the adjacent Beaufort Sea and the rest of the Chukchi Sea; the lipid content and clam species influenced the accumulation of PAH. This

baseline information greatly enhances our understanding of the Chukchi Sea and helps establish reference values for detecting potential future chemical changes (e.g., from O&G production and climate change) and for carrying out impact assessments.

Temporal Variability of Biodiversity in Arctic and Subarctic Marine Benthic Communities

Arny Blanchard
University of Alaska Fairbanks, alblanchard@alaska.edu

An emerging question in understanding arctic biodiversity is the influence of climatic variations on observed patterns of marine biota. Northward water circulation along Alaska's coastline results in transport of larvae to high latitude seas resulting in high similarity of benthic faunal assemblages from southeast Alaska to the Arctic. Expectations of faunal changes with climatic warming are that species introductions may increase. Yet, pathways through which regional climate variations might influence locally-measured biodiversity are not clear. Temporal variations in density and richness of benthic macrofauna collected with a van Veen grab from a sub-arctic glacial fjord in Port Valdez, Alaska, were compared to regional climate indices to evaluate sources for observed patterns from 1989 to 2012. Density and species richness of subtidal communities demonstrated significant positive correlations with the Pacific Decadal Oscillation (PDO), an index of regional climate change in the North Pacific. Likewise, a short-term correlation was observed between macrofaunal density and richness in the northeastern Chukchi Sea and the Arctic Oscillation (AO: an index of sea-level atmospheric pressure). Intertidal community richness (determined via nondestructive, quadrat sampling) in Port Valdez demonstrated a weaker correlation with the PDO but a high correlation with the North Pacific Gyre Oscillation (NPGO: significantly correlated with seawater salinity and nutrient concentrations) from 1988 to1992. Positive PDO values are associated with increased water circulation along coastal Alaska presumably leading to greater benthic density and richness via increased transport of larvae. Increased nutrient levels suggested by positive NPGO values might lead to enhanced development of intertidal regions in Port Valdez. Observed biodiversity patterns are mediated by regional-scale factors and biodiversity estimates from short-term studies will be incomplete with potentially less than 50% of biodiversity captured irrespective of the spatial extent of sampling. Thus, regional climate variations may in part, drive inferences concerning biodiversity in short-term studies regardless of scale and sampling intensity.

The Pacific Arctic Marine Regional Synthesis: Status and Plans

Lee Cooper
University of Maryland Center for Environmental Science (UM), cooper@umces.edu
Jacqueline Grebmeier
UM, jgrebmei@umces.edu
Bodil Bluhm
University of Tromso, bodil.bluhm@uit.no
Carin Ashjian
Woods Hole Oceanographic Institution, cashjian@whoi.edu
Ken Dunton
University of Texas Marine Science Institute, ken.dunton@utexas.edu
John Trefry
Florida Institute of Technology, jtrefry@fit.edu
Jim Moore
National Center for Atmospheric Research (NCAR), jmoore@ucar.edu
Robert Campbell
University of Rhode Island, rcampbell@gso.uri.edu
Gay Sheffield
University of Alaska Fairbanks (UAF), gay.sheffield@alaska.edu
Steve Okkonen
UAF, okkonen@alaska.net
Sveta Yamin-Pasternak
UAF, syamin@alaska.edu
Eddy Carmack
Department of Fisheries and Oceans Canada, Eddy.Carmack@dfo-mpo.gc.ca
Robert Ulanowicz
UM, ulan@umces.edu

The Pacific Arctic Marine Regional Synthesis (PacMARS), supported by Shell Oil and ConocoPhillips, and managed by the NPRB, was initiated to facilitate new synergies in our understanding of the marine ecosystem of the northern Bering, Chukchi and Beaufort seas. The objectives of the PacMARS research team and collaborators were to: 1) identify and synthesize existing data sets that are critical for evaluating the current state of knowledge of this marine ecosystem, including human dimensions, and 2) define the high-priority, overarching scientific themes and research needs for the next decade or more of marine ecosystem studies in the Pacific Arctic Region. The PacMARS program has been conducted in collaboration with the Synthesis of Arctic Research (SOAR). The coordinated goal for both activities is to contribute effectively to an improved understanding of the Pacific Arctic marine ecosystem in an era of rapid change.

During the project we compiled multiple data sets and/or identified internet-based linkages to data that have now been assembled for public use with other products at the Earth Observing Laboratory of the National Center for Atmospheric Research (http://pacmars.eol.ucar.edu). Organization of this data inventory and related products facilitated our second objective of identifying science needs for potential integrated, multi-agency research and modeling efforts in the northern Bering/Chukchi/Beaufort region.

Major findings, research gaps, and topics of relevance to local communities has now been identified. We outline a prospectus for interdisciplinary research that would evolve around four core topics: 1) advective fluxes involving heat and freshwater, as well as nutrients and biology, 2) sea ice production and melt, 3) biological and physical phenology of key system processes, and (4) nearshore processes. Two broad-scale questions involving advection and phenology can be woven into these four core study themes: 1) How does advection in the Pacific Arctic drive regional gradients between the Bering Strait, southern and northern Chukchi Sea, with connections to the Beaufort Sea including both offshore and coastal systems? 2) How do sea ice conditions drive the phenology of the biological system and what influences those sea ice conditions?

Synthesis of Arctic Research (SOAR) – Physics to Marine Mammals in the Pacific Arctic

Lisa Sheffield Guy
University of Washington, lisa.guy@noaa.gov
Sue Moore
NOAA, Office of Science & Technology, 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 2001 with funding from 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, with particular emphasis on the Chukchi Sea oil and gas lease sale areas. The first phase of the synthesis will produce a special issue of *Progress in Oceanography* comprised of 15 papers addressing 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 (4 papers); 2) Response of mid-level trophic species to the 'New State' of the Pacific Arctic: Benthic and pelagic invertebrates and forage fishes (3 papers); and 3) Response of upper-trophic species to the 'New State' of the Pacific Arctic: Marine mammal and seabird distribution, relative abundance, and phenology (8 papers). Two of these papers have been published online and with open access. The special issue represents the combined effort of more than 100 authors from over 30 institutions. The second phase of SOAR will build upon this synthesis to explore questions generated by Phase I and continue to provide a strong platform to support collaborations among scientists, resource managers and Alaskan Arctic residents.

Poster Presentations

Poster Presentations

Day	Wave	LME	Section	Title	Authors
Mon	1	Gulf of Alaska	Climate and Oceanography	High-resolution modeling of coastal freshwater discharge and glacier mass balance in the Gulf of Alaska watershed	speaker: Jordan Beamer, David Hill, Anthony Arendt, and Glen Liston
Mon	1	Gulf of Alaska	Climate and Oceanography	Recent trends in the oceanography of Prince William Sound.	speaker: Robert Campbell
Mon	1	Gulf of Alaska	Climate and Oceanography	Conclusions from a IV year research study: Ocean acidification in Prince William Sound, Alaska	speaker: Alta Dean
Mon	1	Gulf of Alaska	Climate and Oceanography	Observations of waves off Yakutat's Cannon Beach	speaker: Jeremy Kasper and Timothy Tschetter
Mon	1	Gulf of Alaska	Climate and Oceanography	The long game: Oceanographic variability and limits to climate change detection in Glacier Bay, Alaska	speaker: Lewis Sharman
Mon	1	Gulf of Alaska	Climate and Oceanography	Evaluating particle abundances and size distributions with chlorophyll a concentrations in the northern coastal Gulf of Alaska	speaker: Jessica Turner and Andrew McDonnell
Mon	1	Gulf of Alaska	Ecosystem Perspectives	Subsidy pathways from glacial melt water to Gulf of Alaska's coastal marine food webs	speaker: Mayumi Arimitsu, John Piatt, Keith Hobson, Eran Hood, Jason Fellman, Franz Mueter, and Anne Beaudreau
Mon	1	Gulf of Alaska	Ecosystem Perspectives	Conceptual models are flexible tools for research planning, prioritization, and communication	speaker: Tuula Hollmen and Suresh Sethi
Mon	1	Gulf of Alaska	Ecosystem Perspectives	Testing the use of unmanned aircraft systems for intertidal surveys – proof of concept	speaker: Brenda Konar, Katrin Iken, Marty Rogers, and Samuel Vanderwaal
Mon	1	Gulf of Alaska	Ecosystem Perspectives	Static habitat attributes influence biological variability in intertidal communities in the central Gulf of Alaska	speaker: Brenda Konar, Katrin Iken, Heather Coletti, Thomas Dean, and Daniel Monson
Mon	1	Gulf of Alaska	Ecosystem Perspectives	Volunteer photos document 26th year of intertidal biota variability in Western Prince William Sound	speaker: Alan Mearns
Mon	1	Gulf of Alaska	Ecosystem Perspectives	Inter-annual and spatial variation in Pacific blue mussels (*Mytilus trossulus*) in the Gulf of Alaska, 2006-2013	speaker: Daniel Monson, Thomas Dean, Mandy Lindeberg, James Bodkin, Heather Coletti, Daniel Esler, Kimberly Kloecker, Benjamin Weitzman, and Brenda Ballachey
Mon	1	Gulf of Alaska	Ecosystem Perspectives	Effects of glacial discharge on recruitment and succession in subtidal kelp beds	speaker: Sarah Traiger and Brenda Konar
Mon	1	Gulf of Alaska	Fishes and Fish Habitats	Ihcthyophonus vs proteins: Should we be eating these fish?	speaker: Alisa Aist
Mon	1	Gulf of Alaska	Fishes and Fish Habitats	Seasonal movements of Pacific herring tagged with acoustic transmitters in Prince William Sound, Alaska	speaker: Mary Anne Bishop and John Eiler
Mon	1	Gulf of Alaska	Fishes and Fish Habitats	Intensive concurrent acoustic and trawl surveys of overwintering juvenile herring (*Clupea pallassii*) in two potential nursery bays in Prince William Sound	speaker: Michele Buckhorn, Megan McKinzie, Mary Anne Bishop, and Richard Thorne
Mon	1	Gulf of Alaska	Fishes and Fish Habitats	Seasonal habitat use and productivity of commercially important rockfish in the Gulf of Alaska	speaker: Christina Conrath, Brian Knoth, and Christopher Rooper
Mon	1	Gulf of Alaska	Fishes and Fish Habitats	Mercury and selenium health benefit values of Alaska's Pacific halibut: Ecological and human health implications	speaker: Christoff Furin and Robert Gerlach
Mon	1	Gulf of Alaska	Fishes and Fish Habitats	Quantifying *Ichthyophonus hoferi* prevalence and intensity in Pacific halibut (*Hippoglossus stenolepis*) in Cook Inlet, Alaska	speaker: Caitlin Grenier, Bradley Harris, Paul Hershberger, and Leslie Cornick
Mon	1	Gulf of Alaska	Fishes and Fish Habitats	The effectiveness of biodegradable plastic panels for crab pots in Alaskan waters	speaker: Kevin Heffern and Jacek Maselko
Mon	1	Gulf of Alaska	Fishes and Fish Habitats	A bioenergetics model for Pacific halibut reveals the potential for bottom-up controls on growth and size-at-age	speaker: Kirstin Holsman, Kerim Aydin, Gordon Kruse, Bruce Leaman, Steve Martell, Jane Sullivan, Bruce Miller, and Stephani Zador
Mon	1	Gulf of Alaska	Fishes and Fish Habitats	Bomb dating and validation of the age determination methodology for big (*Beringraja binoculata*) and longnose (*Raja rhina*) skates	speaker: Jackie King, Thomas Helser, Chris Gburski, Dave Ebert, Greg Cailliet, and Craig Castelle
Mon	1	Gulf of Alaska	Fishes and Fish Habitats	Phylogeography of threespine stickleback (*Gasterosteus aculeatus*) from the North Pacific Basin	speaker: Emily Lescak, Ryan Lucas, Jeffrey Colgren, Frank von Hippel, and J. Andres Lopez
Mon	1	Gulf of Alaska	Fishes and Fish Habitats	Upper thermal tolerances for red and blue king crabs	speaker: William Long and Benjamin Daly
Mon	1	Gulf of Alaska	Fishes and Fish Habitats	Variation in Pacific halibut size-at-age and the harvest policy implications	speaker: Steven Martell, Jane Sullivan, Kirsten Holmsman, Gordon Kruse, Bruce Leaman, and Kerim Aydin
Mon	1	Gulf of Alaska	Fishes and Fish Habitats	Humpback whales as indicators of herring movements in Prince William Sound	speaker: John Moran, Janice Straley, and Mayumi Arimitsu
Mon	1	Gulf of Alaska	Fishes and Fish Habitats	Salmon blitz: Engaging citizen scientists in documenting salmon habitat in the Copper River watershed	speaker: Kate Morse and Rich Brenner

Mon	1	Gulf of Alaska	Fishes and Fish Habitats	Activity costs for swimming Pacific herring (*Clupea pallasii*)	speaker: Bonita Nelson, Ron Heintz, and Andrew Eller
Mon	1	Gulf of Alaska	Fishes and Fish Habitats	The use of ecosystem metrics for pre-season forecasts of pink salmon harvest in Southeast Alaska: What have we learned?	speaker: Joseph Orsi, Emily Fergusson, and Alex Wertheimer
Mon	1	Gulf of Alaska	Fishes and Fish Habitats	Juvenile herring index from aerial surveys reflects recruitment to spawning stock in Prince William Sound, Alaska	speaker: W. Scott Pegau, Mayumi Arimitsu, and Mike Collns
Mon	1	Gulf of Alaska	Fishes and Fish Habitats	Age, growth, and sexual maturity of the deepsea skate, *Bathyraja abyssicola* (Gilbert, 1896)	speaker: Cameron Provost, Bradley Harris, David Ebert, Kenneth Goldman, and Cindy Tribuzio
Mon	1	Gulf of Alaska	Fishes and Fish Habitats	Seasonal patterns in nutrient utilization and storage by the California sea cucumber (*Parastichopus californicus*) from Southeastern Alaska	Sarah M. Hardy, Alexandra C. M. Oliveira, and speaker: Charlotte Regula-Whitefield
Mon	1	Gulf of	Fishes and Fish	Length changes in Auke Creek salmon	speaker: Joshua Russell, John Joyce, Scott Vulstek, Ryan
Mon	1	Gulf of Alaska	Fishes and Fish Habitats	Influences of size, condition, and diet on winter survival of juvenile Pacific herring in Prince William Sound	speaker: Fletcher Sewall, Ron Heintz, and Johanna Vollenweider
Mon	1	Gulf of Alaska	Fishes and Fish Habitats	Temperature and salinity effects on the larvae that create zombie crabs	speaker: Leah Sloan and Sarah Hardy
Mon	1	Gulf of Alaska	Fishes and Fish Habitats	Mechanisms influencing growth and size-at-age of Pacific halibut	speaker: Jane Sullivan, Gordon Kruse, and Steven Martell
Mon	1	Gulf of Alaska	Fishes and Fish Habitats	Expanded hydroacoustic surveys of adult herring in Prince William Sound, 2013-2014	speaker: Richard Thorne and Michele Buckhorn
Mon	1	Gulf of Alaska	Fishes and Fish Habitats	What to do when spiny dogfish lie about their age?	speaker: Cindy Tribuzio, Beth Matta, Chris Gburski, Walter Bubley, Gordon Kruse, William Bechtol, and Cal Blood
Mon	1	Gulf of	Fishes and Fish	Mapping Tanner crab habitat in the Kodiak Area of the Gulf	speaker: Carrie Worton, David Barnard, Gregg
Mon	1	Gulf of Alaska	GOAEIRP	Dissolved iron over the Gulf of Alaska shelf during spring and fall 2013	speaker: Ana Aguilar-Islas, Marie Segure, Robert Rember, and Dean Stockwell
Mon	1	Gulf of Alaska	GOAEIRP	Gulf of Alaska Integrated Ecosystem Research Program: Ichthyoplankton assemblages in the eastern and western Gulf of Alaska during spring and summer of 2011 and 2013	speaker: Deborah Blood, Lisa De Forest, Ann Matarese, and Miriam Doyle
Mon	1	Gulf of Alaska	GOAEIRP	A multivariate method for the characterization of IBM larval life histories in the Gulf of Alaska	speaker: Albert Hermann, Sarah Hinckley, and Ken Coyle
Mon	1	Gulf of Alaska	GOAEIRP	Forage fish distributions in the Central and Eastern Gulf of Alaska	speaker: David McGowan and John Horne
Mon	1	Gulf of Alaska	GOAEIRP	The role of bathymetry in the cross-shelf transport of nutrients and ichthyoplankton in the Northern Gulf of Alaska	speaker: Calvin Mordy, Phyllis Stabeno, Nancy Kachel, David Kachel, Carol Ladd, Mark Zimmermann, and Miriam Doyle
Mon	1	Gulf of Alaska	GOAEIRP	Distribution, diet, and energetic condition of age-0 walleye pollock (*Gadus chalcogrammus*) and Pacific cod (*Gadus macrocephalus*) inhabiting the Gulf of Alaska	speaker: Jamal Moss, Marilyn Zaleski, and Ron Heintz
Mon	1	Gulf of Alaska	GOAEIRP	Seasonal oceanography of inshore waters in the Gulf of Alaska	speaker: Olav Ormseth and Kim Rand
Mon	1	Gulf of Alaska	GOAEIRP	Effect of spawning timing and location on transport of walleye pollock in the Gulf of Alaska: An individual-based model study	speaker: Carolina Parada, Miriam Doyle, and Sarah Hinckley
Mon	1	Gulf of Alaska	GOAEIRP	Habitat suitability models for groundfish in the Gulf of Alaska	speaker: Jodi Pirtle, Kalei Shotwell, Mark Zimmermann, Jane Reid, and Nadine Golden
Mon	1	Gulf of Alaska	GOAEIRP	Surviving the biophysical gauntlet: Juvenile Pacific Ocean perch in the Gulf of Alaska 2010-2013	speaker: Wyatt Rhea-Fournier
Mon	1	Gulf of Alaska	GOAEIRP	Growth, consumption, and energy allocation strategies of age 0+ and 1+ rockfish (*Sebastes* spp.) reared at three different temperatures	speaker: Ashwin Sreenivasan and Ron Heintz
Mon	1	Gulf of Alaska	GOAEIRP	Can temperature-dependent egg development affect connectivity between spawning areas and nursery grounds for arrowtooth flounder (*Atheresthes stomias*) in the Gulf of Alaska?	speaker: William Stockhausen, Deborah Blood, and Kenneth Coyle
Mon	1	Gulf of Alaska	GOAEIRP	The heat is on: Comparing growth potential 'hot spots' of young of the year walleye pollock and Pacific cod in the Gulf of Alaska	speaker: Marilyn Zaleski, Ron Heintz, and Jamal Moss
Mon	1	Gulf of Alaska	GOAEIRP	Energetic differences in young of the year walleye pollock across the Gulf of Alaska	speaker: Marilyn Zaleski, Ron Heintz, and Jamal Moss
Mon	1	Gulf of Alaska	Seabirds	Refining remote observation: Techniques of monitoring Black-legged Kittiwakes (*Rissa tridactyla*) in Resurrection Bay in the Northern Gulf of Alaska	speaker: Sarah Tanedo and Tuula Hollmén
Mon	2	Bering Sea	Ecosystem Perspectives	Trophic interactions between jellyfish and fish: Investigating the ecosystem impacts of jellyfish variability in the Bering Sea	Mary Beth Decker, speaker: Kristin Cieciel, Richard Brodeur, and James Ruzicka

Mon	2	Bering Sea	Ecosystem Perspectives	Multi-species harvest control rules for fishery management	speaker: Kirstin Holsman, Leif Sandal, Cecilie Hansen, Ásta Guðmundsdóttir, Jan Arge Jacobsen, Lars Ravn-Jonsen , Mike Sigler, and Mette Skern-Mauritzen , Jason Link, and Kerim Aydin
Mon	2	Bering Sea	Ecosystem Perspectives	Biobanking In Alaska: Two projects of the Marine Environmental Specimen Bank	speaker: Rebecca Pugh, Amanda Moors, Stacy Vander Pol, and Paul Becker
Mon	2	Bering Sea	Humans	Real-world education: Using NOAA data for high school curricula in Alaska	speaker: Lisa Hiruki-Raring, Pam Goddard, and Rebecca Reuter
Mon	2	Bering Sea	Humans	Quantifying spatial differences in the distributions of observed and unobserved fishing	speaker: JordanWatson, AlanHaynie
Mon	2	Gulf of Alaska	Humans	Evaluation of the Abraxis Saxitoxin Enzyme-Linked Immunosorbent Assay (ELISA) for testing subsistence Alaska shellfish	Brian Himelbloom, speaker: Julie Matweyou, Tia Leber, and Ray RaLonde
Mon	2	Gulf of Alaska	Humans	Graying of the fleet: Alaska's next generation of commercial fishermen	speaker: Danielle Ringer, Jesse Coleman, Courtney Carothers, Paula Cullenberg, and Rachel Donkersloot
Mon	2	Gulf of Alaska	Humans	NEPA, ESA, and MMPA: Conservation of marine species through Federal permitting	speaker: Suzann Speckman, Donna Robertson Aderhold, and Bonnie Easley-Appleyard
Mon	2	Gulf of Alaska	Humans	Paralytic Shellfish Poisoning: Novel biosensor and potentiostat for detecting Saxitoxins	Thomas Stewart, Theresa Forshey, Ryan Boehm, speaker: Wayne Litaker, and Pat Tester
Mon	2	Gulf of Alaska	Lower Trophic Levels	Dietary lipids improve the nutrition and condition of red king crab larvae (*Paralithodes camtschaticus*)	speaker: Asia Beder, Ginny Eckert, and Louise Copeman
Mon	2	Gulf of Alaska	Lower Trophic Levels	Monitoring phytoplankton in Kachemak Bay, Alaska	speaker: Dominic Hondolero and Kristine Holderied
Mon	2	Gulf of Alaska	Lower Trophic Levels	Determinants of seaweed biogeography along the North Pacific rim, with emphasis on the northern Gulf of Alaska	speaker: Sandra Lindstrom
Mon	2	Gulf of Alaska	Lower Trophic Levels	Surveying euphausiid abundance to understand the central Gulf of Alaska ecosystem	Kirsten Simonsen, speaker: Patrick Ressler, Christopher Rooper, Stephani Zador, and Martin Dorn
Mon	2	Gulf of Alaska	Lower Trophic Levels	Spatial and temporal variability of the suspended particulate Fe load over the Gulf of Alaska shelf	speaker: Megan Roberts, Marie Seguret, and Ana Aguilar-Islas
Mon	2	Gulf of Alaska	Lower Trophic Levels	Pinto Abalone: Overview of the Endangered Species Act listing evaluation	speaker: Sadie Wright
Mon	2	Bering Sea	Mammals	Age specific birth rates at Steller sea lion rookeries in the Russian Far East	speaker: Alexey Altukhov, Russel Andrews, Thomas Gelatt, and Vladimir Burkanov
Mon	2	Bering Sea	Mammals	Survival rates of Steller sea lions during periods of differing population trends in the Kuril Islands	speaker: Alexey Altukhov, Russel Andrews, Thomas Gelatt, and Vladimir Burkanov
Mon	2	Bering Sea	Mammals	Busted! First detection of steroid hormones in Pacific walrus bones	speaker: Patrick Charapata, Lara Horstmann-Dehn, and Nicole Misarti
Mon	2	Bering Sea	Mammals	Blast from the past: Pacific walrus foraging ecology across prehistoric, historic, and modern timeframes	speaker: Casey Clark, Lara Horstmann-Dehn, and Nicole Misarti
Mon	2	Bering Sea	Mammals	Prevalence of *Coxiella burnetii* and Brucella spp. in tissues from subsistence harvested northern fur seals (*Callorhinus ursinus*) of St. Paul Island, Alaska	speaker: Colleen Duncan, Bobette Dickerson, Kristy Pabilonia, Amy Miller, and Tom Gelatt
Mon	2	Bering Sea	Mammals	Genetic variation and immune response in Beluga whales	speaker: Tatiana Ferrer, Heidi Pagan, Sarah Rodgers, Ashley Taylor, Robert Suydam, Lori Quakenbush, Greg O'Corry-Crowe, and Jorge Monroy
Mon	2	Bering Sea	Mammals	Evaluation of the population dynamics of Steller sea lion (*Eumetopias jubatus*) on the reproductive rookery by using non-monotonic growth curves: Comparison of two logistic models	Oksana Savenko and speaker: Vladimir Burkanov
Mon	2	Bering Sea	Mammals	Evaluating RNA-Seq as a tool for assessing health status of Steller sea lions (*Eumetopias jubatus*) in an area of population decline	speaker: John Harley, Lorrie Rea, Brian Fadely, Tom Gelatt, Terrance Kavanagh, James MacDonald, and Todd O'Hara
Mon	2	Bering Sea	Mammals	Digenean parasites of the northern fur seals (*Callorhinus ursinus*): Prevalence and biodiversity on different rookeries of St. Paul Island, Alaska	speaker: Tetiana Kuzmina, Terry Spraker, Olena Kudlai, and Eugene Lyons
Mon	2	Bering Sea	Mammals	Gastrointestinal parasite community in northern fur seals (*Callorhinus ursinus*): Relation of seal age and parasite burden	speaker: Tetiana Kuzmina, Terry Spraker, and Eugene Lyons
Mon	2	Bering Sea	Mammals	Diving behaviors and habitat use of adult female Steller sea lions (*Eumetopias jubatus*)	speaker: Michelle Lander, Brian Fadely, Thomas Gelatt, Jeremy Sterling, Susanne McDermott, Martin Haulena, Lorrie Rea, and Johanna Vollenweider, KimberleeBeckmen, MichaelRehberg
Mon	2	Bering Sea	Mammals	At-risk marine mammal populations: Using the NIST marine environmental specimen bank to answer questions	speaker: Amanda Moors, Rebecca Pugh, Carrie Goertz, and Paul Becker
Mon	2	Bering Sea	Mammals	Quantitative assessment of species identification in aerial transect surveys for ice-associated seals	Brett McClintock, speaker: Erin Moreland, Josh London, Shawn Dahle, Gavin Brady, Erin Richmond, Kym Yano, and Peter Boveng

Mon	2	Bering Sea	Mammals	Preliminary results from hunter-assisted walrus sampling near Saint Lawrence Island, Alaska 2012–2014	speaker: Lori Quakenbush, Jonathan Snyder, Anna Bryan, Harold Kiyuklook, Sheena Anningayou, and Mark Nelson
Mon	2	Bering Sea	Mammals	Determining the number of exhales necessary for the application of minimally-invasive blow sampling to molecular analyses in wild belugas (*Delphinapterus leucas*)	speaker: Justin Richard, Krystle Schultz, and Becky Sartini
Mon	2	Bering Sea	Mammals	Northernmost Stejneger's Beaked Whale (Mesoplodon stejnegeri) Stranding, Saint Lawrence Island, Alaska	speaker: Gay Sheffield, Raphaela Stimmelmayr, Kathy Burek, Chris Koonooka, Teri Rowles, and Taqulik Hepa
Mon	2	Bering Sea	Mammals	Causes of on-land mortality in northern fur seals (*Callorhinus ursinus*): long-term observation on St. Paul Island, Alaska (1986–2014)	speaker: Terry Spraker, Tetiana Kuzmina, Eugene Lyons, and Tom Gelatte
Mon	2	Bering Sea	Mammals	Multi-year, pulse-coded VHF transmitters to monitor foraging trip duration of northern fur seals on St. Paul Island, Alaska	speaker: J. Ward Testa, Rolf R. Ream, and Thomas S. Gelatt
Mon	2	Bering Sea	Mammals	Freshwater harbor seals of Iliamna Lake, Alaska: Recent population updates	speaker: Dave Withrow, Jennifer Burns, Peter Boveng, Jay VerHoef, and Greg O'Corry-Crowe
Mon	2	Bering Sea	Mammals	Stable isotopes predict foraging habitat of northern fur seals (*Callorhinus ursinus*) in Alaska	speaker: Tonya Zeppelin, Johnson Devin, Carey Kuhn, Sara Iverson, and Rolf Ream
Mon	2	Gulf of Alaska	Mammals	Factors affecting haulout behavior of harbor seals in tidewater glacier inlets	speaker: Gail Blundell, Grey Pendleton, and Justin Smith
Mon	2	Gulf of Alaska	Mammals	Acoustic monitoring for belugas (*Delphinapterus leucas*) and harbor porpoises (*Phocoena phocoena*) off two river mouths in Yakutat Bay, Alaska	speaker: Manuel Castellote, Kathleen Stafford, and William Lucey
Mon	2	Gulf of Alaska	Mammals	Technique development for monitoring physiology in large whales	Shannon Atkinson, speaker: Kelly Cates, and Jan Straley
Mon	2	Gulf of Alaska	Mammals	*Coxiella burnetii* exposure in northern sea otters (*Enhydra lutris kenyoni*)	Verena Gill, Kristin Worman, Kathy Burek, Kristy Pabilonia, Sam Johnson, Kelly Fitzpatrick, Gil Kersh, and speaker: Colleen Duncan
Mon	2	Gulf of Alaska	Mammals	Calculating acoustic environment metrics for Glacier Bay marine mammals	speaker: Christine Gabriele, Dimitri Ponirakis, Christopher Clark, Jamie Womble, and Phoebe Vanselow
Mon	2	Gulf of Alaska	Mammals	Comparisons of whole blood and fur concentrations of total mercury among three pinniped species: Validation of cellulose filter paper methodology	speaker: Amanda Grimes, Stephanie Hughes, J. Margaret Castellini, Frances Gulland, Lorrie Rea, and Todd O'Hara
Mon	2	Gulf of Alaska	Mammals	Estimating age dependent mortality rates and age structure for Beluga whales in Cook Inlet	speaker: Roderick Hobbs, Daniel Vos, and Kim Shelden
Mon	2	Gulf of Alaska	Mammals	Combining opportunistic re-encounter data with known fate mortality data in vital rate telemetry: Linking implanted satellite transmitters to stationary receivers.	speaker: Markus Horning and Roger Hill
Mon	2	Gulf of Alaska	Mammals	Estimating lactation parameters in harbor seals using aerial photography	speaker: John Jansen, Gavin Brady, Jay Ver Hoef, and Peter Boveng
Mon	2	Gulf of Alaska	Mammals	Live capture and disentanglement of Steller sea lions in Alaska	speaker: Lauri Jemison, Kate Savage, Justin Jenniges, Mike Rehberg, Marty Haulena, Kimberlee Beckmen, Kim Raum-Suryan, Greg Snedgen, Dennis McAllister, Neil Barten, Betsy Van Burgh, and Chad Rice
Mon	2	Gulf of Alaska	Mammals	Factors that influence free-ranging harbor seal heart rates during resting periods	speaker: Shawna Karpovich, John Skinner, Jeff Mondragon, and Gail Blundell
Mon	2	Gulf of Alaska	Mammals	Life-history strategies, population trends, and the relative lack of elasticity in Steller sea lion natality rates	speaker: John Maniscalco, Alan Springer, and Pamela Parker
Mon	2	Gulf of Alaska	Mammals	Life history and population dynamics of Southern Alaska resident killer whales (*Orcinus orca*)	Eva Saulitis, J. Ward Testa, Graeme Ellis, and speaker: Craig Matkin
Mon	2	Gulf of Alaska	Mammals	Effects of marine vessel management on the underwater acoustic environment of Glacier Bay National Park, Alaska	speaker: Megan F. McKenna, Christine Gabriele, and Blair Kipple
Mon	2	Gulf of Alaska	Mammals	The interaction of intraspecific competition and habitat on individual diet specialization: a near range-wide examination of sea otters	speaker: Seth Newsome, Tim Tinker, Verena Gill, Zachary Hoyt, Angela Doroff, Linda Nichol, and James Bodkin
Mon	2	Gulf of Alaska	Mammals	Analysis of MHC class II promoter regions in beluga whales and related species	speaker: Heidi Pagan, Tatiana Ferrer, and Gregory O'Corry-Crowe
Mon	2	Gulf of Alaska	Mammals	Examining resident killer whale (*Orcinus orca*) subpopulation structure and social connectivity in the Aleutian Islands, Alaska using stereotyped acoustic calls	speaker: Athena Palmer, Paul Wade, Manuel Castellote, and Leslie Cornick
Mon	2	Gulf of Alaska	Mammals	Haul-out patterns and the effects of vessel disturbance on harbor seals in an Alaskan glacial fjord	speaker: Grey Pendleton, Lauri Jemison, Elizabeth Mathews, Karen Blejwas, and Kevin Hood
Mon	2	Gulf of Alaska	Mammals	Changes in blood profiles of Steller sea lions due to age, exercise regime, and nutritional status	speaker: David Rosen, Carling Gerlinsky, and Andrew Trites

Mon	2	Gulf of Alaska	Mammals	The efficacy of an early detection pregnancy hormone in determining Steller sea lion (*Eumetopias jubatus*) pregnancy rates at multiple haulouts in Resurrection Bay, AK	speaker: Renae Sattler, Lori Polasek, and John Maniscalco
Mon	2	Gulf of Alaska	Mammals	Spatio-temporal changes in beluga whale, *Delphinapterus leucas* , distribution: Results from aerial surveys (1977-2012), opportunistic sightings (1975-2012), and satellite tagging (1999-2003) in Cook Inlet, Alaska	speaker: Kim Shelden, Kimberly Goetz, David Rugh, Donald Calkins, Barbara Mahoney, and Rod Hobbs
Mon	2	Gulf of Alaska	Mammals	The geology of sea lions? Size, mass and occurrance of gastroliths in juvenile Steller sea lions (*Eumetopias jubatus*)	speaker: Courtney Shuert and Jo-Ann Mellish
Mon	2	Gulf of Alaska	Mammals	Changes in harbor seal heart rate with vessel encounters in glacial fjords of southeast Alaska: An alternative approach for assigning biological significance to disturbance	speaker: John Skinner, Shawna Karpovich, and Gail Blundell
Mon	2	Gulf of Alaska	Mammals	Individual identification and sighting histories of dead Cook Inlet beluga whales (*Delphinapterus leucas*) obtained from a left-side photo-id catalog	speaker: Amber Stephens and Tamara McGuire
Mon	2	Gulf of Alaska	Mammals	Evaluating methods for monitoring humpback whales in the Juneau area	speaker: Suzanne Teerlink and Larissa Horstmann-Dehn
Mon	2	Gulf of Alaska	Mammals	Distinguishing sources of foraging pits using pit dimensions and shell litter in nearshore soft substrates	speaker: Sarah Traiger, Brenda Konar, Angela Doroff, and Lauren McCaslin
Mon	2	Gulf of Alaska	Mammals	Implications of recolonization and food limitation for sea otters in soft-bottom habitats of Glacier Bay, AK	speaker: Benjamin Weitzman, George Esslinger, James Bodkin, Kim Kloecker, Daniel Monson, Tim Tinker, and James Estes
Mon	2	Gulf of Alaska	Mammals	The use of passive acoustic monitoring to study cetacean distribution and estimate abundance in the Gulf of Alaska	speaker: Tina Yack, Shannon Coates, Thomas Norris, and Brenda Rone
Mon	2	Bering Sea	Seabirds	The effects of rapid environmental change on high Arctic coastal marine communities	Kurt Burnham, speaker: Veronica Padula, and Douglas Causey
Tues	1	Bering Sea	Climate and Oceanography	Seasonal circulations on the Southeast Bering Sea shelf	speaker: Wei Cheng, Carol Ladd and Phyllis Stabeno
Tues	1	Bering Sea	Climate and Oceanography	Simulation of seasonal phytoplankton variations in the Bering-Chukchi Sea with a 3-D physical-biological model	speaker: Haoguo Hu and Jia Wang
Tues	1	Bering Sea	Climate and Oceanography	Toward the accurate estimation of a passive species biological mortality	speaker: Gleb Panteleev and Jacob Stroh
Tues	1	Bering Sea	Fishes and Fish Habitats	The ups and downs of capelin (*Mallotus villosus*) and Pacific herring (*Clupea pallasii*) in the eastern Bering Sea	speaker: Alex Andrews, Wess Strasburger, Ed Farley, Jim Murphy, and Ken Coyle
Tues	1	Bering Sea	Fishes and Fish Habitats	Examining the effects of offshore mining activities on habitat features important for Norton Sound red king crab	speaker: Mabel Baldwin-Schaeffer and Brad Harris
Tues	1	Bering Sea	Fishes and Fish Habitats	Intra-guild predation among early benthic phase red and blue king crabs: Evidence for a habitat-mediated competitive advantage	speaker: Benjamin Daly and W. Christopher Long
Tues	1	Bering Sea	Fishes and Fish Habitats	Genetic analysis of blackspotted rockfish (*Sebastes melanostictus*) in the Bering Sea and Aleutian Islands	speaker: Alex Godinez, Anthony Gharrett, Megan McPhee, and Paul Spencer
Tues	1	Bering Sea	Fishes and Fish Habitats	Bioeffects assessment in Kvichak and Nushagak bays, Alaska: Characterization of soft bottom benthic habitats, animal body burdens and contaminant baseline	speaker: Ian Hartwell, Dennis Apeti, Tony Pait, Todd Radenbaugh, and Ron Britton
Tues	1	Bering Sea	Fishes and Fish Habitats	Estuarine ecology of juvenile salmon on the Yukon River Delta	speaker: Kathrine Howard, Katharine Miller, James Murphy, and Ragnar Alstrom
Tues	1	Bering Sea	Fishes and Fish Habitats	Blue king crab, habitat, and the ecosystem: Data rescued from the 1980s	W. Christopher Long, David Armstrong, Janet Armstrong, Alexandra Doty, speaker: Jake Kvistad, and P. Sean McDonald
Tues	1	Bering Sea	Fishes and Fish Habitats	Informing rebuilding efforts: Understanding the effects of red king crab, temperature and fish predation on survival and habitat selection by age-0 Pribilof Islands blue king crab	speaker: Courtney Lyons and Ginny Eckert
Tues	1	Bering Sea	Fishes and Fish Habitats	Early marine ecology of juvenile Chinook salmon (*Oncorhynchus tshawytscha*) on the Yukon Delta, Alaska	speaker: Katharine Miller
Tues	1	Bering Sea	Fishes and Fish Habitats	Comparison of carbon (δ13C) and nitrogen (δ15N) stable isotope ratios of Atka mackerel (*Pleurogrammus monopterygius*) and Pacific cod (*Gadus macrocephalus*) in the central and western Aleutian Islands	speaker: Katherine Opp, Todd O'Hara, J. Margaret Castellini, Andrew Cyr, Susanne Mcdermott, Todd Loomis, and Lorrie Rea
Tues	1	Bering Sea	Fishes and Fish Habitats	An age-length structured population dynamics model for fish and invertebrate stocks	speaker: Andre Punt and Caitlin Allen
Tues	1	Bering Sea	Fishes and Fish Habitats	Observations of seasonal movement of a single tag release group of Pacific cod in the eastern Bering Sea	speaker: Kimberly Rand, Peter Munro, Sandra Neidetcher, and Daniel Nichol

Tues	1	Bering Sea	Fishes and Fish Habitats	Oceanic dispersal and behavior of Chinook salmon in the Bering Sea	speaker: Andrew Seitz, Mark Evans, Trey Walker, and Jim Murphy
Tues	1	Bering Sea	Fishes and Fish Habitats	Feasibility of direct age determination in commercially important crustaceans in Alaska	Raouf Kilada, Joel Webb, speaker: Laura Stichert, Quinn Smith, and Kevin McNeel
Tues	1	Bering Sea	Fishes and Fish Habitats	Temporal fluctuations in Pacific salmon diets in the Bering Sea	speaker: Wesley Strasburger
Tues	1	Arctic	Humans	Guidelines for collecting high priority ephemeral data for oil spills in the Arctic in support of Natural Resource Damage Assessment	speaker: Sarah Allan, Adriana Bejarano, and Jacqueline Michel
Tues	1	Arctic	Humans	A new bird in the Alaskan Arctic: Lessons learned during coordination of manned and unmanned aerial operations in 2013 and 2014	speaker: Megan Ferguson, Janet Clarke, Andrew Harcombe, Willow Hetrick, and Sheyna Wisdom
Tues	1	Arctic	Humans	Creating common understanding - multi-partner pilot to communicate coastal storm hazards	Aimee Fish, Louise Fode, Nicole Kinsman, and speaker: Amy Holman
Tues	1	Arctic	Humans	Community Integrated Coastal Incident Preparedness Project	Peter Neitlich and speaker: Tahzay Jones
Tues	1	Arctic	Humans	Correlation of Arctic marine debris to human occupation distributions in Northwest Alaska	speaker: Tahzay Jones and Peter Neitlich
Tues	1	Arctic	Humans	Yellow-billed Loon Youth Videography Initiative	Melanie Flamme, Stacia Backensto, and speaker: Dev Dharm Khalsa
Tues	1	Arctic	Humans	Climate change: A human rights issue needing attention	speaker: Leif Monnett
Tues	1	Arctic	Humans	Estimating an oil spill response gap for the Aleutian Islands and U.S. Arctic Ocean	speaker: Tim Robertson, Bretwood Higman, Sierra Fletcher, and Andrew Mattox
Tues	1	Arctic	Humans	Teachers: Communicators of climate change	speaker: Janet Warburton, Sarah Bartholow, and Angela Larson
Tues	1	Bering Sea	Humans	Catch sampling and estimation in the Federal groundfish	Jason Gasper, speaker: Jennier Cahalan, and Jennifer
Tues	1	Bering Sea	Lower Trophic Levels	Place-based marine education: Reinforcing student understanding through a local framework and contextualized data	speaker: Alexandra Doty, P. Sean McDonald, Janet Armstrong, David Armstrong, and Christopher Long
Tues	1	Bering Sea	Lower Trophic Levels	Communities associated with crustose coralline algae reef habitat in the western Aleutian Islands	speaker: Alexandra Ravelo, Benjamin Weitzman, Douglas Rasher, and Robert Steneck
Tues	1	Arctic	Mammals	Marine mammal occurrence in the Distributed Biological Observatory (DBO) from ship-based visual and passive acoustic surveys	speaker: Catherine Berchok, Jessica Crance, Brenda Rone, and Sue Moore
Tues	1	Arctic	Mammals	Gray whale occurrence in the Beaufort Sea	speaker: Amelia Brower, Janet Clarke, and Megan Ferguson
Tues	1	Arctic	Mammals	A comparison of marine mammal sightings from different	speaker: Jenipher Cate, Megan Blees, Samantha Simpson,
Tues	1	Arctic	Mammals	Harbor porpoise sightings from shipboard surveys in the Chukchi Sea during Summer and Fall, 2008-2014	speaker: Cynthia Christman and Lisanne Aerts
Tues	1	Arctic	Mammals	Inter-annual variability in the fall movements of bowhead whales in the Chukchi Sea	speaker: John Citta, Lori Quakenbush, Stephen Okkonen, John "Craig" George, Robert Small, Mads Peter Heide-Jorgensen, Lois Harwood, and Harry Brower
Tues	1	Arctic	Mammals	Large Cetacean occurrence in the South-Central Chukchi Sea, Summer and Fall 2014	speaker: Janet Clarke, Amelia Brower, Megan Ferguson, Christy Sims, Vicki Beaver, Jennifer Gatzke, and Bob Lynch
Tues	1	Arctic	Mammals	Results from hunter-assisted walrus studies in Alaska, 2014	speaker: Justin Crawford, Lori Quakenbush, Clarence Irrigoo, Edwin Noongwook, and Joel Garlich-Miller
Tues	1	Arctic	Mammals	2014 aerial surveys of marine mammals in the Colville River Delta (North Slope, AK) using stabilized aerial infrared imagery	speaker: Bonnie Easley-Appleyard, Kristen Ampela, and Dan Wilkinson
Tues	1	Arctic	Mammals	Beluga whale (*Delphinapterus leucas*) vocalizations from the Eastern Beaufort Sea population	speaker: Ellen Garland, Catherine Berchok, and Manuel Castellote
Tues	1	Arctic	Mammals	Use of UAS for photographic re-identification of bowhead whales, *Balaena mysticetus*	speaker: William Koski, Gayan Gamage, Andrew Davis, Tony Mathews, Bernard LeBlanc, and Steven Ferguson
Tues	1	Arctic	Mammals	Identifying marine mammal fall migration core areas in the U.S. Beaufort Sea	speaker: Christopher Krenz, Melanie Smith, Nathan Walker, Kristie Livingston, Raychelle Daniel, and Bruce Robson
Tues	1	Arctic	Mammals	A circumpolar assessment of Arctic marine mammals and sea ice loss, with conservation recommendations for the 21st century	speaker: Kristin Laidre, Harry Stern, Kit Kovacs, Lloyd Lowry, Sue Moore, Eric Regehr, Steven Ferguson, Øystein Wiig, Peter Boveng, Robyn Angliss, Erik Born, Dennis Litovka, Lori Quakenbush, Christian Lydersen, Dag Vongraven, and Fernando Ugarte
Tues	1	Arctic	Mammals	Reproductive responses in female Pacific walrus to changes in Arctic climate	Shannon Atkinson and speaker: Jenell Larsen
Tues	1	Arctic	Mammals	Late summer distribution of bowhead whales in the Canadian Beaufort Sea: Environmental correlates and predicting future habitat use	speaker: Deanna Leonard, Lara Horstmann, and Lois Harwood
Tues	1	Arctic	Mammals	Analysis of knock sequences produced by walruses in the northeastern Chukchi Sea	speaker: Xavier Mouy and David Hannay

Tues	1	Arctic	Mammals	Hunter-assisted study on ringed and bearded seal movements, habitat use, and traditional knowledge	speaker: Mark Nelson, Lori Quakenbush, John Goodwin, Merlin Henry, Alex Whiting, Kathy Frost, and Justin Crawford
Tues	1	Arctic	Mammals	Physiological constraints to diving: Defining the capacity of belugas to alter foraging behaviors in response to habitat degradation	speaker: Shawn Noren
Tues	1	Arctic	Mammals	Genetic investigation of multi-decadal shifts in beluga whale behavior in a changing Arctic	speaker: Greg O'Corry-Crowe, Robert Suydam, Lori Quakenbush, Barbara Mahoney, Lois Harwood, Willie Goodwin, Kathy Frost, and Eric Archer
Tues	1	Arctic	Mammals	Hindcasts of potential bowhead whale habitat: A comparison of two species distribution models for spatio-temporally dynamic estimates of potential habitat quality	speaker: Dan Pendleton, Elizabeth Holmes, and Jinlun Zhang
Tues	1	Arctic	Mammals	Pacific walrus monitoring	speaker: Lori Polasek
Tues	1	Arctic	Mammals	Spring 2014: Ice associated pups ashore - a comparison	speaker: Gay Sheffield, Brandon Ahmasuk, and Raphaela
Tues	1	Arctic	Mammals	Real-time marine mammal and noise monitoring from ocean gliders	speaker: Kate Stafford, Peter Winsor, and Mark Baumgartner
Tues	1	Arctic	Mammals	First documentation of gas bubbles in ringed seals (*Phoca hispida*) entangled and drowned in gill nets: 2 case reports	speaker: Raphaela Stimmelmayr and Anne Riddle
Tues	1	Arctic	Mammals	Bile collection technique in subsistence harvested beluga whales (*Delphinapterus leucas*)	speaker: Raphaela Stimmelmayr, Gina Ytalo, Leslie Pierce, Robert Suydam, and Taqulik Hepa
Tues	1	Arctic	Mammals	Influence of sea ice on walrus activity in the Chukchi Sea	speaker: Rebecca Taylor, Chadwick Jay, Anthony Fischbach, and Mark Udevitz
Tues	1	Arctic	Mammals	Bowhead whale earplug exposes lifetime chemical profiles	speaker: Stephen Trumble
Tues	1	Arctic	Seabirds	Genetic characterization of novel Adenoviruses Isolated from Long-Tailed Ducks (*Clangula hyemalis*)	speaker: Katrina Counihan, J. C. Franson, and Tuula Hollmen
Tues	1	Arctic	Seabirds	Habitat associations of the seabird community in the Northeastern Chukchi Sea	speaker: Adrian Gall, Tawna Morgan and Robert Day
Tues	1	Arctic	Seabirds	Assessing hydrocarbon sensitivity and establishing current CYP1A Baselines in select marine birds and waterfowl of the Beaufort and Chukchi seas	speaker: Ann Riddle, Tuula Hollmen, Robert Suydam and Raphaela Stimmelmayr
Tues	1	Bering Sea	Seabirds	The Pribilof Island Seabird Youth Network	Carley Bourdukofsky, Chauncey Bourdukofsky, Miles Bourdukofsky, Nathan Bourdukofsky, Aiden Bristol, Leslie Jones, Heather Kozloff, Anna Warner, Henry Kushin, Brittney Lestenkof, Courtney Lestenkof, Diamond Lestenkof, Ethan Lestenkof-Mandregan, Ezra Melovidov, Ian Melovidov, Sonia Merculief, Sean Roever, Doug Causey, Lauren Divine, Trevor Haynes, Karin Holser, Pamela Lestenkof, speaker: Kendra Bush-St. Louis, Veronica Padula, Ram Papish, Marc Romano, Tonia Kushin, Chris Merculief, and Ann Harding
Tues	1	Bering Sea	Seabirds	Geolocators reveal the migratory patterns and wintering	speaker: Katherine Robbins, Carley Schacter, and Ian
Tues	1	Bering Sea	Seabirds	Testing a new tape-based external transmitter attachment technique for sea ducks using captive Long-tailed Ducks during winter	speaker: Sadie Ulman, Tuula Hollmén, January Frost, Manfred Enstipp, Russel Andrews, Charles Frost, and Pamela Tuomi
Tues	2	Arctic	Climate and Oceanography	Using autonomous marine vehicles in the Arctic	speaker: Chris Carter
Tues	2	Arctic	Climate and	Up- and down- welling in the Beaufort Sea	speaker: Jeremy Kasper and Sookmi Moon
Tues	2	Arctic	Climate and	Summertime exchange of water between an Arctic lagoon	speaker: Chunyan Li and Kevin Boswell
Tues	2	Arctic	Climate and Oceanography	Internal wave generation and propagation in Chukchi Sea	speaker: Kim Martini, Phyllis Stabeno, Carol Ladd, and Thomas Weingartner
Tues	2	Arctic	Climate and Oceanography	Particle size distributions over the Alaskan Beaufort Shelf and Slope: Insights into the sources, transport, and vertical fluxes of particulate matter	speaker: Telayna Gordon, Jessica Turner, and Andrew McDonnell
Tues	2	Arctic	Climate and Oceanography	Using in situ optical instrumentation to investigate particle and plankton dynamics in Alaska's coastal waters	speaker: Andrew McDonnell, Russell Hopcroft, Dean Stockwell, Jessica Turner, and Telayna Gordon
Tues	2	Arctic	Climate and Oceanography	Circulation in the Chukchi Sea during the summer 2012 derived through the 4Dvar data assimilation of velocity observations from HFR and moorings	speaker: Gleb Panteleev, Jacob Stroh, Tom Weingartner, and Max Yaremchuk
Tues	2	Arctic	Climate and Oceanography	Adjoint-free variational data assimilation into a regional models	speaker: Gleb Panteleev and Max Yaremchuk
Tues	2	Arctic	Climate and Oceanography	Optimization of the high-frequency radar sites in the Bering Strait region	speaker: Gleb Panteleev, Max Yaremchuk, Jacob Stroh, Pamela Posey, and David Hebert
Tues	2	Arctic	Climate and Oceanography	Variability of the circulation in the Pacific Sector of the Arctic Ocean	speaker: Gleb Panteleev and Max Yaremchuk

Tues	2	Arctic	Climate and Oceanography	Dissolved and particulate trace element variability, distribution and transport in the Chukchi Sea and Southern Canada Basin	speaker: Robert Rember, Ana Aguilar-Islas, and Marie Seguret
Tues	2	Arctic	Climate and Oceanography	Ensemble-based assimilation of hydrographical and surface data into a regional model of the Chukchi Sea	speaker: J. N. Stroh, G. Panteleev, T. Weingartner, and D. Nechaev
Tues	2	Arctic	Climate and Oceanography	Sea-surface temperature and salinity product comparison against external in situ data in the Arctic Ocean	speaker: J. N. Stroh, G. Panteleev, S. Kirillov, M. Mikhotin, and N. Shakhova
Tues	2	Arctic	Climate and Oceanography	Crowdsourcing large-scale environmental data recovery for the North Pacific – Arctic region from 1850 to the satellite era	speaker: Kevin Wood
Tues	2	Arctic	Ecosystem Perspectives	North Slope Beach Survey Monitoring Program	speaker: Ionjon Brower, Lynette Hepa, Shaylyn Storms, Robert Sarren, Joe Skin, Isaac Levitt, Cyd Hanns, Dave Ramey, Craig George, Raphaela Stimmelmayr, and Taqulik Hepa
Tues	2	Arctic	Ecosystem	How do you monitor an ecosystem? CSESP studies in 2014	speaker: Robert Day, Thomas Weingartner, Lisanne
Tues	2	Arctic	Ecosystem Perspectives	Preliminary findings of an oil-in-ice mesocosm experiment	speaker: Kyle Dilliplaine, Marc Oggier, Hajo Eicken, Bodil Bluhm, Rolf Gradinger, and Eric Collins
Tues	2	Arctic	Ecosystem Perspectives	Year two: Ecological implications of background PAH and biomarker analyses of nearshore fish and sediments of the Central Beaufort Sea, Alaska	speaker: John Hardin, Greg Durell, Sean Burril, Matt Nemeth, Steve Shaner, and Chris Warren
Tues	2	Arctic	Ecosystem Perspectives	ShoreZone imaging and mapping in Alaska	speaker: Cindy Hartmann Moore, Steve Lewis, John Harper, Mandy Lindeberg, Mary Morris, Susan Saupe, and Amalie Cauvillion
Tues	2	Arctic	Ecosystem Perspectives	AMBON – a US Arctic Marine Biodiversity Observing Network	speaker: Katrin Iken, Bodil Bluhm, R. Eric Collins, Lee Cooper, Seth Danielson, Jacquline Grebmeier, Russ Hopcroft, Kathy Kuletz, Franz Mueter, Sue Moore, Kate Stafford, and Rob Bochenek
Tues	2	Arctic	Ecosystem Perspectives	Assessment of marine oil spill risk and environmental vulnerability for the State of Alaska	speaker: Jason Lehto, Danielle Reich, Richard Balouskus, Dagmar Schmidt Etkin, Jacqueline Michel, Margaret McBrien, and Jennifer Steger
Tues	2	Arctic	Ecosystem Perspectives	Benthic community assessment at three locations within the Chukchi Sea	speaker: Meg Pinza, Jay Word, Lucinda Word, Jack Word, and Waverly Kallestad
Tues	2	Arctic	Ecosystem Perspectives	Food for Thought: Regional response to Avian Cholera in the Bering Strait region of Alaska	speaker: Gay Sheffield, Vera Metcalf, Brandon Ahmasuk, and Raphaela Stimmelmayr
Tues	2	Arctic	Ecosystem Perspectives	Synthesis of Arctic Research (SOAR) – Physics to marine mammals in the Pacific Arctic	speaker: Lisa Sheffield Guy, Sue Moore, and Phyllis Stabeno
Tues	2	Arctic	Ecosystem Perspectives	Summer zoogeography of the northern Bering and Chukchi seas	speaker: Mike Sigler, Franz Mueter, Bodil Bluhm, Morgan Busby, Ned Cokelet, Seth Danielson, Alex De Robertis, Lisa Eisner, Ed Farley, Katrin Iken, Kathy Kuletz, Bob Lauth, Libby Logerwell, Alexei Pinchuk, and Chris Wilson
Tues	2	Arctic	Ecosystem Perspectives	A synthesis of important areas in the U.S. Beaufort Sea	speaker: Raychelle Daniel, Christopher Krenz, Melanie Smith, Nathan Walker, Kristie Livingston, Bruce Robson, Eleanor Huffines, Andrew Hartsig, and Henry Huntington
Tues	2	Arctic	Ecosystem Perspectives	A synthesis of important areas in the U.S. Chukchi Sea	speaker: Melanie Smith, Christopher Krenz, Nathan Walker, Raychelle Daniel, Bruce Robson, Eleanor Huffines, Andrew Hartsig, and Henry Huntington
Tues	2	Arctic	Ecosystem Perspectives	Data management strategy for the Distributed Biological Observatory (DBO)	speaker: Don Stott, Janet Scannell, James Moore, and Steve Williams
Tues	2	Arctic	Fishes and Fish Habitats	Diets of four Lycodes species (*L. adolfi* , *L. polaris* , *L. sagittarius* , and *L. seminudus*) in the Beaufort Sea	speaker: Sarah Apsens and Brenda Norcross
Tues	2	Arctic	Fishes and Fish Habitats	Temporal and spatial variability of nearshore fish communities in three Arctic nearshore habitat types in Barrow, AK	speaker: Mark Barton, Kevin Boswell, Ron Heintz, John Moran, Johanna Vollenweider, and Ann Robertson
Tues	2	Arctic	Fishes and Fish Habitats	Environmental DNA assessment of marine life in the Beaufort Sea of Alaska	speaker: Todd Sformo, John Bickham, Adam Crawford, Elizabeth Montano, Donald Stoeckel, Gregory Durell, and John Hardin
Tues	2	Arctic	Fishes and Fish Habitats	Dispersal patterns and summer ocean distribution of adult Dolly Varden in the Beaufort Sea using satellite telemetry	Andrew Seitz, Brendan Scanlon, speaker: Michael Courtney, and Randy Brown
Tues	2	Arctic	Fishes and Fish Habitats	Fatty acid profiles of Alaskan Arctic forage fishes: Investigating regional and temporal diet variation	speaker: Julia Dissen, Sarah M. Hardy, A. C. M. Oliveira, and Lara Horstmann-Dehn
Tues	2	Arctic	Fishes and Fish Habitats	An analysis of hatch timing of Arctic cod *Boreogadus saida* from the Eastern Beaufort Sea	speaker: Alyssa Frothingham and Brenda Norcross
Tues	2	Arctic	Fishes and Fish Habitats	Variation between active acoustic and net-based sampling gears in an Arctic lagoon in Barrow, AK	speaker: Samuel George
Tues	2	Arctic	Fishes and Fish Habitats	SHELFZ project: Pelagic fish and macrozooplankton in the eastern Chukchi Sea	speaker: John Horne, Sandra Parker-Stetter, Hannah Linder, and Jennifer Nomura

Tues	2	Arctic	Fishes and Fish Habitats	The first comprehensive assessment of the community structure and habitat associations of demersal marine fishes in the Canadian Beaufort Sea	speaker: Andrew Majewski, Sheila Atchison, Jane Eert, Shannon MacPhee, James Reist, and Robert Young
Tues	2	Arctic	Fishes and Fish Habitats	Demersal communities on the shelf of the U.S. Beaufort Sea	speaker: Brenda Norcross and Brenda Holladay
Tues	2	Arctic	Fishes and Fish Habitats	Energetic value of prey species utilized by Black Guillemots (*Cepphus grylle*) on Cooper Island, an Arctic barrier island	speaker: Ann Robertson, George Divoky, Kevin Boswell, Ron Heintz, Johanna Vollenweider, John Moran, and Mark Barton
Tues	2	Arctic	Fishes and Fish Habitats	Energetic content of Alaskan Arctic forage species	speaker: J. J. Vollenweider, Ron Heintz, John Moran, and Ann Robertson
Tues	2	Arctic	Fishes and Fish Habitats	Diet compositions and trophic guild structure of the demersal fish community of the eastern Chukchi Sea	speaker: Andy Whitehouse and Troy Buckley
Tues	2	Arctic	Fishes and Fish Habitats	Latitudinal and size-based variation in the diet of Arctic cod in the eastern Chukchi Sea	speaker: Andy Whitehouse, Troy Buckley, Caroline Robinson, and Kimberly Sawyer
Tues	2	Arctic	Lower Trophic Levels	Thin plankton layers in the Marginal Ice Zone	speaker: James Churnside and Richard Marchbanks
Tues	2	Arctic	Lower Trophic	Diversity and distribution of marine mollusks along the	speaker: Nora Foster, Bodil Bluhm, and Katrin Iken
Tues	2	Arctic	Lower Trophic Levels	Inter-annual variability of the planktonic communities in the Northeastern Chukchi Sea: 2008-2014	speaker: Russell Hopcroft, Jennifer Questel, and Cheryl Clarke-Hopcroft
Tues	2	Arctic	Lower Trophic Levels	Inshore to offshore environmental characteristics and benthic macrofauna along the CSESP Distributed Biological Observatory (DBO) line in the Northeastern Chukchi Sea	speaker: Ann Knowlton and ArnyBlanchard
Tues	2	Arctic	Lower Trophic Levels	Phytoplankton assemblage structure in the Chukchi Sea: Insight from flow cytometry	speaker: Samuel Laney and Heidi Sosik
Tues	2	Arctic	Lower Trophic Levels	Shell length variations of the bivalve *Ennucula tenuis* in the northeastern Chukchi Sea, 2008–2013	speaker: Erin May and Arny Blanchard
Tues	2	Arctic	Lower Trophic Levels	Utilizing sediment profile imaging for physical seafloor surveys in the Chukchi Sea	speaker: John Nakayama, Jasper Boas, Waverly Kallestad, and Barbara Bohn
Tues	2	Arctic	Lower Trophic Levels	SHELFZ project: Arctic shelf zooplankton populations in the vicinity of Barrow underwater canyon - preliminary results	speaker: Alexei Pinchuk, Leandra Sousa, and Seth Danielson
Tues	2	Arctic	Lower Trophic Levels	Interannual variation of epibenthic communities in the Chukchi Sea, Alaska	speaker: Kimberly K.Powell and Brenda H.Konar
Tues	2	Arctic	Lower Trophic Levels	SHELFZ project: Benthic invertebrates from nearshore to offshore in and around Barrow Canyon in the northeastern Chukchi Sea	speaker: Kimberly Rand, Elizabeth Logerwell, Seth Danielson, and Leandra Sousa
Tues	2	Arctic	Lower Trophic Levels	Temporal variation of benthic macrofauna of the northeastern Chukchi Sea, 2008-2013	speaker: Tama Rucker and Arny Blanchard
Tues	2	Arctic	Lower Trophic Levels	Contribution of sea ice algae to various benthic feeding types on the Chukchi Sea shelf	speaker: Tanja Schollmeier, Katrin Iken, Matthew J. Wooller, Alexandra C. M. Oliveira
Tues	2	Arctic	Lower Trophic Levels	Food web structure in the southern Chukchi Sea	speaker: Carlos Serratos, Katrin Iken, and Bodil Bluhm
Tues	2	Arctic	Lower Trophic Levels	Diversity and community structure of benthic meiofauna in the Chukchi and Beaufort seas: A high-throughput sequencing approach	speaker: Alexis Walker, Sarah Hardy, and Holly Bik
Tues	2	Arctic	Lower Trophic Levels	Is splitting up hard to do? Comparing zooplankton sample processing methods by estimating larval crab abundance	speaker: Jared Weems and Alexei Pinchuk

SYMPOSIUM ABSTRACTS

Summertime Exchange of Water Between an Arctic Lagoon and Beaufort Sea

Chunyan Li
Louisiana State University, lcx.lsu@gmail.com
Kevin Boswell
Florida International University, kevin.boswell@fiu.edu

Exchange of water through a tidal pass of the Elson Lagoon was determined using a bottom-mounted acoustic Doppler current profiler (ADCP), deployed at the Plover Point, in the summer of 2013 and summer of 2014. Another multi-frequency ADCP was also used with a small boat crossing the inlet repeatedly mapping the vertical structures of the horizontal velocity. The study is aimed at the subtidal net exchange under various conditions especially under severe weather when strong wind persists for a few days as an arctic atmospheric low pressure system passes by the area. As the western most tidal inlet of the Elson Lagoon connecting to the Beaufort Sea at the edge of the Chukchi Sea, the exchange responds to the wind significantly. Net water transport occurs across the narrow inlet, overwhelming tidal effect. A model of a coastal lagoon with multiple inlets is used for the interpretation of the characteristics of the exchange. With a strong easterly, the net flow is outward at the Plover Point. With a strong westerly, the net flow is inward. All these changes are associated with water level changes inside the lagoon, measured by a pressure sensor. During the last deployment, the ADCP was dragged by the strong wind to an offshore location. This provides about 5 days of data on the shallow water outside of the lagoon. The data provide the net flow at this nearshore shallow water in respond to the strong arctic summer time atmospheric event.

The Arctic Tracer Release Experiment (ARCTREX) - Applications for Mapping Spilled Oil in Arctic Waters

Peter Winsor
University of Alaska Fairbanks (UAF), pwinsor@alaska.edu
Robert Chant
Rutgers University, chant@marine.rutgers.edu
Harper Simmons
UAF, hlsimmons@alaska.edu
Amy Merten
NOAA, Office of Response & Restoration, amy.merten@noaa.gov
Elias Hunter
Rutgers University, hunter@marine.rutgers.edu
Hank Statscewich
UAF, hank.stats@alaska.edu
Elizabeth Dobbins
UAF, eldobbins@alaska.edu
Jacqueline McSweeney
Rutgers University, jmcsween@marine.rutgers.edu
Nicolas Eckhardt
NOAA, Office of Response & Restoration, nicolas.eckhardt@noaa.gov
Jonathan Whitefield
UAF, jwhitefield@alaska.edu

We present preliminary results from the Arctic Tracer Release Experiment (ARCTREX) with application to mapping spilled oil in Arctic waters. Over a 10-day period in September 2014, we performed two separate releases of Rhodamine dye, an inert non-toxic fluorescent tracer, in the mixed layer of the northeastern Chukchi Sea, and mapped the dispersion and evolution of these dye patches over time and space using real-time data from autonomous underwater vehicle (AUV) gliders, towed vehicle surveys, through-flow system, and satellite-tracked drifters. The dye mapping was relayed in real time to the NOAA Arctic Environmental Response Management Application (ERMA) and was displayed on an interactive online geographic information system (GIS) map.

Each dye release was traced over a 4-day period using Rhodamine-specific fluorometers capable of detecting dye down to fractions of parts per billion in concentration. The first dye release was performed in the heavily stratified offshore region close to the Burger lease patch. Dye released here stayed confined to the ~15-m thick mixed layer and dispersed and advected relatively slowly over a 4-day period as the patch stretched and thinned ("strained") along small gradients in surface salinity. A second dye release was performed close to the main ocean front separating energetic flow from the offshore meltwater regime. Here the dye responded quickly to the dynamical conditions by advecting quickly along the front and within hours subducting along isopycnals, disappearing completely from the surface of the ocean. The subduction was characterized by reduced advection speed and rapid dispersal over a large area. The dye patch formed a thin subsurface layer at 20-30 m depth, in close proximity to the benthos.

Our preliminary results show clearly how dynamically complex the Chukchi Sea is and that dispersed oil can undergo a number of different behaviors depending on ocean circulation, stratification and atmospheric forcing conditions.

Lateral Mixing Across Meltwater Fronts of the Chukchi Sea Shelf

KoFan Lu
University of Alaska Fairbanks (UAF), klu3@alaska.edu
Thomas Weingartner
UAF, tjweingartner@alaska.edu
Seth Danielson
UAF, sldanielson@alaska.edu
Peter Winsor
UAF, pwinsor@alaska.edu
Elizabeth Dobbins
UAF, eldobbins@alaska.edu
Kim Martini
NOAA, Pacific Marine Environmental Laboratory, kim.martini@noaa.gov
Hank Statscewich|
UAF, hank.stats@alaska.edu

Hydrographic observations in the northeastern Chukchi Sea in summer and fall frequently detect intra-pycnocline intrusions of warm, moderately salty summer waters derived from the Bering Sea. The intrusions are 10-20 m thick and appear as distinct blobs or plumes. They occur within the shallow (~ 20 m depth) pycnocline that separates cold, dilute, surface meltwater from near-freezing, salty, winter-formed waters found along the bottom. A simple numerical model suggests that the intrusions result from instability of the front that separates meltwater from the Bering waters. Frontal instability generates meanders and eddies, which subsequently propagate laterally and carry warm Bering waters into the pycnocline. The model results suggest that these lateral eddy heat fluxes could play a major role in ablation along the ice edge throughout summer. In fall these same fluxes may be important in delaying the onset of ice formation over some portions of the northeastern Chukchi Sea shelf.

Optimization of the High-frequency Radar Sites in the Bering Strait Region

Gleb Panteleev
University of Alaska Fairbanks, International Arctic Research Center (UAF-IARC), gleb@iarc.uaf.edu
Max Yaremchuk
U.S. Naval Research Laboratory (NRL), yarmx@mail.ru
Jacob Stroh
UAF-IARC, jnstroh@alaska.edu
Pamela Posey
UAF-IARC, pamela.posey@nrlssc.navy.mil
David Hebert
NRL, david.hebert@nrlssc.navy.mil

Monitoring surface currents by coastal high-frequency radars (HFRs) is a cost-effective observational technique with good prospects for further development. An important issue in improving the efficiency of HFR systems is optimization of radar positions on the coastline. Besides being constrained by environmental and logistic factors, such optimization has to account for prior knowledge of local circulation and the target quantities (such as transports through certain key sections) with respect to which the radar positions are to be optimized.

In the proposed methodology, prior information of the regional circulation is specified by the solution of the 4d variational assimilation problem, where the available climatological data in the Bering Strait (BS) region are synthesized with dynamical constraints of a numerical model. The optimal HFR placement problem is solved by maximizing the reduction of *a posteriori* error in the mass, heat and salt (MHS) transports through the target sections in the region. It is shown that the MHS transports into the Arctic and their redistribution within the Chukchi Sea are best monitored by placing HFRs at Cape Prince of Wales and on the Little Diomede Island. Another equally efficient configuration involves placement of the second radar at Sinuk (Western Alaska) in place of Diomede. Computations show that 1) optimization of the HFR deployment yields a two-fold reduction of the transport errors; 2) error reduction provided by two HFRs is an order of magnitude better than the one obtained from three moorings permanently maintained in the region for the last five years. This result shows a significant advantage of BS monitoring by HFRs compared to more traditional technique of it in situ moored observations. The obtained results are validated by an extensive set of observing system simulation experiment.

Adjoint-Free Variational Data Assimilation into Regional Models

Gleb Panteleev
University of Alaska Fairbanks, International Arctic Research Center, gleb@iarc.uaf.edu
Max Yaremchuk
National Science Foundation, yarmx@mail.ru

A variational data assimilation algorithm is developed for the ocean wave prediction model 7 (WAM). The algorithm employs the adjoint-free technique and tested in a series of data 8 assimilation experiments with synthetic observations in the South Chukchi Sea region from 9 various platforms. The types of considered observations are directional spectra measured by stationary buoys, SWH observations by coastal high-frequency radars (HFRs) and satellite measurements of sea surface roughness. Numerical experiments demonstrate computational feasibility and robustness of the adjoint-free variational algorithm with the regional configuration of WAM. The largest improvement of the model forecast skill is provided by assimilating HFR data (the most numerous among the considered types). Assimilating observations of the wave spectrum from a moored platform provides only moderate improvement of the skill which disappears after 3 hours of running WAM in the forecast mode, whereas skill improvement provided by HFRs is shown to persist up to 9 hours. Space-borne observations, being the least numerous, do not have a significant impact on the forecast skill, but appear to have a noticeable effect when assimilated in combination with other types of data. In particular, when spectral data from a single mooring are used, the satellite data are found to be the most beneficial as a supplemental data type, suggesting the importance of spatial coverage of the domain by observations. Preliminary results of the application Adjoint-Free 4Dvar to NCOM and MIT GCM will be also discussed.

Arctic - Climate and Oceanography

Variability of the Circulation in the Pacific Sector of the Arctic Ocean

Gleb Panteleev
University of Alaska Fairbanks, International Arctic Research Center, gleb@iarc.uaf.edu
Max Yaremchuk
National Science Foundation, yarmx@mail.ru

The climatological mean summer-fall circulations in the Pacific sector of Arctic Ocean were reconstructed by 4Dvar assimilation of observations available for the periods of (i) 1900-2006, (ii) cyclonic (1989-1997) and (iii) anticyclonic (1997-2006) states and (iv) for the period of the International Polar Year (2007-2009). Comparison of these climatological states with the 2008 July-October circulation reveals significant variations caused by drastic changes in model forcing — namely, wind forcing and sea ice conditions. The 2008 state was additionally validated with respect to independent velocity observations, which were not assimilated. The distribution of the sea surface height anomalies reveals reasonable correlation with gridded AVISO satellite altimetry anomaly, suggesting that the satellite along-track altimetry could be a valuable source of data for operational hindcast/forecast of the local circulation after its accurate re-tracking and validation

Sea-surface Temperature and Salinity Product Comparison Against External *in situ* Data in the Arctic Ocean

Jacob Stroh
University of Alaska Fairbanks (UAF), jnstroh@alaska.edu
Gleb Panteleev
UAF, gleb.pantel@gmail.com
Sergei Kirillov
University of Manitoba, Sergei.Kirillov@umanitoba.ca
M. Makhotin
National Tomsk Research Polytechnic University, Russia, m-makhotin@mail.ru
Natalia Shakhova
UAF, nshakhov@iarc.uaf.edu

Sea-surface temperature and salinity (SST/S) in the Arctic Ocean (AO) from global satellite analyses and models, which incorporate remotely-observed SST/S, may be inaccurate in the AO due to lack of direct measurements for calibrating satellite observation and presence of sea ice. For this reason, we are motivated to validate global SST satellite analyses and SST/S models by comparing product SST/S in the AO against oceanographic records during 2006–2013. The bulk of this pan-Arctic dataset was garnered as part of a NOAA-funded International Polar Year database, and contains over 30,000 hydrographical profiles. All SST satellite analyses considered favorably agree with high-latitude CTD *in situ* data. Also, the US Navy Coupled Ocean Data Assimilation (NCODA) system using the Hybrid Ocean Coordinate Model (HYCOM) more accurately reflects the SST/S data than does the NASA Estimation of the Circulation and Climate of the Ocean version 2 (ECCO2) model. We also consider a region-specific comparison of these products against other data in the Chukchi and Bering seas. Such results are useful for understanding the uncertainties involved in using satellite-derived data products for high-latitude research.

Crowdsourcing Large-scale Environmental Data Recovery for the North Pacific – Arctic Region from 1850 to the Satellite Era

Kevin Wood
University of Washington, kevin.r.wood@noaa.gov

The Arctic is increasingly affected by a rapidly changing climate, but our ability to document, understand, and communicate about the past and future of the northern regions is hampered by limited environmental data. The additional data we need exists, however, thanks to the efforts of past generations of mariners, explorers, and scientists, but they are trapped in hundreds of thousands of pages of handwritten ship logbooks, field books, and weather journals.

Historical weather and environmental data -- amounting to millions of individual observations -- is now being made available for new research. For example, a sophisticated new generation of computationally-intensive retrospective analysis (reanalysis) systems being developed today depend on these data to yield the most detailed reconstruction of the Earth's atmosphere of the past two centuries yet produced. Recovered first-hand observations of sea ice will also give us a far more complete picture of what the Arctic ice pack was like before it began to disappear. As the available data resource is extended farther back in history it will be possible for the first time to objectively investigate a range of lower-frequency climate phenomena that have occurred in Arctic and to assess their impact on the regional environment. Confidence in future climate projections will also be enhanced as currently opaque physical relationships are better understood.

Dissolved and Particulate Trace Element Variability, Distribution and Transport in the Chukchi Sea and Southern Canada Basin

Robert Rember
University of Alaska Fairbanks (UAF), rdrember@alaska.edu
Ana Aguilar-Islas
UAF, amaguilarislas@alaska.edu
Marie Seguret
UAF, mseguret@alaska.edu

The dearth in our knowledge of the source, distribution, variability and transport of trace elements in the Chukchi Sea and Canada Basin has hampered our understanding of their implications for local and global biogeochemical cycles. Here we present dissolved and particulate Mn, Fe, Cu, Ni, Pb, and Zn data from the Chukchi Sea shelf and the southern Canada Basin collected in 2010 and 2013. A total of 25 stations were occupied during the two sampling periods. The data suggest that there is significant sedimentary input of select dissolved and particulate metals to the halocline of the Canada Basin. Water column data were collected onboard the R/V *Mirai* during the late summer and fall (September-October) and range in location from the Bering Strait to almost 80 degrees North in the Canada Basin. In 2013, one station was occupied repeatedly during a period of 10 days over the outer shelf providing the first time-series of concentrations of dissolved and particulate metals in the region. Results from the time-series show that within a narrow and somewhat variable benthic boundary layer (5-10 m) concentrations of some metals were highly elevated suggesting a sedimentary source. At the tail end of the occupation of that station, a significant mixing event occurred which dramatically changed the concentration and distribution of metals within the water column. Trace metal variability and transport from the shelf to the interior of the Canada Basin will be discussed in context with shelf mechanisms contributing to this export, and to potential future changes in the Arctic Ocean.

Chukchi Sea Ice Observations by Upward Looking Sonars, 2008-2014

Todd Mudge
ASL Environmental Sciences Inc (ASL), tmudge@aslenv.com
Keath Borg
ASL, kborg@aslenv.com
Dawn Sadowy
ASL, dsadowy@aslenv.com
David Fissel
ASL, dfissel@aslenv.com
Ed Ross
ASL, eross@aslenv.com

A multi-site, multi-year measurement program of Chukchi Sea ice draft using upward looking sonars (ULS) has been funded by Shell (2008-2014), ConocoPhillips (2008-2013), and Statoil (2010-2013). Ice Profiling Sonars provide vertical resolution of better than 0.05 m and a temporal resolution of 1-2 seconds of ice draft. Acoustic Doppler current profilers typically provide one to several minutes of temporal resolution and a precision of up to 1 mm/s for ice velocity. Combined, the systems deliver a nearly continuous record of ice draft at better than a 1 m horizontal resolution.

Seasonal sea ice characteristics at the sites have generally followed a predictable pattern. Ice, as it forms in October and November, is typically quite mobile. By December or January the ice concentrations are high enough and the ice is thick enough that motion becomes limited. March and April tend to be the months with the least amount of ice motion, sometimes with long periods of virtually motionless ice punctuated by a few, short lived, wind-driven ice drift events. The months of May and June see a trending towards greater ice motion. July, August, and September typically sees ice concentrations dropping to zero over most of the ULS sites.

The winter of 2013 did not follow this seasonal trend of sea ice motion and ice thickness. For one ULS site in the Chukchi, monthly median ice motions in January 2013 were twice as high as previous years. Ice draft for the site was lower in 2013 then is previous years, particularly for the month of March. The unexpected ice characteristics seem to be a precursor and symptomatic of the large fracture event in the Chukchi and Beaufort seas that was observed by satellite in February and March of 2013. Using newly acquired ULS data for the 2013-2014 ice season, we will investigate if the sea ice characteristics have gone back to the seasonal trends of 2008-2012 or show a continuation of 2013's elevated ice drift for the winter months.

Arctic - Climate and Oceanography

Particle Size Distributions Over the Alaskan Beaufort Shelf and Slope: Insights Into the Sources, Transport, and Vertical Fluxes of Particulate Matter

Telayna Gordon
University of Alaska Fairbanks (UAF), tgordon10@alaska.edu
Jessica Turner
UAF, jessie.turner@alaska.edu
Andrew McDonnell
UAF, amcdonnell@alaska.edu

In August 2014, the University of Alaska Fairbanks Transboundary Cruise of the ice-free eastern Alaskan Beaufort Sea sampled 53 stations from 6 transects aboard the R/V *Norseman II*. Two optical instruments, the Underwater Vision Profiler (UVP), and the Laser In Situ Scattering and Transmissometry (LISST-deep) were deployed opportunistically from the Conductivity-Temperature-Depth (CTD) rosette in order to determine the abundances of particles over a wide size range (2.5 µm and several cm). This data was used to obtain detailed maps, transects, and vertical profiles of particle abundance and size distribution across the study area. In addition, images of the largest particles allowed for the identification of particle and plankton types present in the water column at various sites over the shelf and slope of the Alaskan Beaufort Sea. We utilize this data to investigate the sources, transport, and vertical flux of particulate matter in this poorly understood and rapidly changing Arctic sea. This work represents an important step towards improving our understanding of the regional cycles of carbon, nutrients, and lithogenic material as well as the ecological dynamics of the Beaufort Sea.

Arctic - Climate and Oceanography

Internal Wave Generation and Propagation in Chukchi Sea

Kim Martini
NOAA, Pacific Marine Environmental Laboratory (NOAA-PMEL), kim.martini@noaa.gov
Phyllis Stabeno
NOAA-PMEL, Phyllis.Stabeno@noaa.gov
Carol Ladd
NOAA-PMEL, carol.ladd@noaa.gov
Thomas Weingartner
University of Alaska Fairbanks, tjweingartner@alaska.edu

Globally, internal waves are important drivers of turbulence and mixing, but in the Chukchi Sea their generation is suppressed by the presence of sea ice. This leads to a seasonal cycle of internal wave activity and mixing that peaks during the ice-free summer. Two years of moored data show that internal wave generation and propagation is sensitive to local ice concentrations and stratification. Recent increases in the length of the ice-free season suggests patchy and intermittent internal wave induced turbulence will increase. Increased mixing could change the vertical distribution of heat and nutrients, potentially impacting the seasonal ice pack and local ecosystems. A new technique for tracking internal waves is also introduced, which utilizes existing networks of shore-based high-frequency radar arrays that measure surface currents.

Ensemble-based Assimilation of Hydrographical and Surface Data into a Regional Model of the Chukchi Sea

Jacob Stroh
University of Alaska Fairbanks (UAF), jnstroh@alaska.edu
Gleb Panteleev
UAF, gleb.pantel@gmail.com
Thomas Weingartner
UAF, tjweingartner@alaska.edu
Dmitri Nechaev
University of Southern Mississippi, dmitri.nechaev@usm.edu

The hydrographical state of the Chukchi Sea is monitored and measured by several methods, including a high-frequency radar (HFR) array along the Alaska coast, sensors moored along the shelf floor, and conductivity-temperature-depth (CTD) profiles obtained during cruises. We present an effort to model the east Chukchi Sea shelf region during ice-free seasons using the Regional Ocean Modeling System (ROMS). Using an ensemble-approach based on the Maximum-Likelihood Ensemble Filter (MLEF), the 2012 and 2013 ice-free season measurements of velocity, temperature, and salinity (garnered from the aforementioned sources) are incorporated into the model. This data assimilation is efficient and acts in a highly-parallelizable scheme, making it practical for operational usage. We compare the original model solution with that of the data-optimized model.

Toward a Better Hindcast/Forecast of Waves in the Arctic Ocean

Oceana Francis
University of Hawaii, oceanaf@hawaii.edu
Jacob Stroh
University of Alaska Fairbanks (UAF), jnstroh@alaska.edu
Gleb Panteleev
UAF, gleb@iarc.uaf.edu
Max Yaremchuk
U.S. Naval Research Laboratory, max.yaremchuk@nrlssc.navy.mil
Peter Bieniek
UAF, pbieniek@alaska.edu

The Arctic Ocean has been strongly affected by climate changes observed during the last decades and has experienced a pronounced diminishing of ice cover. The ice retreat triggered a number of physical mechanisms, including a 30–40% increase of surface waves since 1993, acceleration of coastal erosion, and enhanced vertical mixing in the surface layer. As observed in 2012, increased storm activity has led to further diminishing of ice, intensification of ocean-atmospheric interactions, and giant waves (16-foot waves were observed for the first time in the Beaufort/Chukchi Sea). Thus, surface waves play significantly role in the variability of the hydrochemical and biological Arctic Ocean state and strongly affect human activity in the Arctic. This is essentially important for the coastal Alaska regions with high rates of retreating shoreline observed during the last 20 years which has forced relocation of Alaskan Native villages and other infrastructure. Therefore, the important factors that strongly affect wave hindcasts and forecasts is the quality of the utilized wind product. We will present results of the validation of several available wind products for the Western part of the Arctic Ocean and discuss effects of atmospherically dynamic downscaling with the goal of improving sea surface wind.

Arctic - Climate and Oceanography

Up- and Down-welling in the Beaufort Sea

Jeremy Kasper
University of Alaska Fairbanks (UAF), jlkasper@alaska.edu
Sookmi Moon
UAF, smoon5@alaska.edu

Observations, satellite data and modeling are used to study shelfbreak upwelling in the presence of sea ice in the Alaskan Beaufort Sea. Satellite estimates of sea ice drift and concentration are used to calculate the ice ocean stress for a nine ten year period (2002-2011) for the Beaufort and eastern Chukchi seas. The magnitude of the ice ocean stress is greatest over the Beaufort Sea shelf break. Modeling and observations from this same period show that this stress distribution promotes the upwelling of nutrient rich shelf break waters onto the shelf and offshore, the downwelling of shelf derived waters into the cold halocline. Idealized models based on observed salinity, temperature, and ice ocean stress distributions are used to understand how the strength of this up- and down-welling circulation pattern varies with the location of the fast ice edge and the width of the transition zone between the immobile, fast ice and the rapidly moving ice over the shelf break. Model results suggest that in a changing climate with less immobile fast ice, the rate of nutrient replenishment on the shallow Beaufort Sea shelf by upwelling will increase. At the same time, down-welling of shelf water into the halocline offshore of the shelf break will likely increase.

Arctic - Climate and Oceanography

Inter-annual Variability in Surface Circulation in the Chukchi and Beaufort Seas: Satellite-tracked Drifter Measurements

Leandra Sousa
North Slope Borough, leandra.sousa@north-slope.org
Thomas Weingartner
University of Alaska Fairbanks (UAF), tjweingartner@alaska.edu
Peter Winsor
UAF, pwinsor@alaska.edu
Seth Danielson
UAF, sldanielson@alaska.edu
Elizabeth Dobbins
UAF, eldobbins@alaska.edu
Cayman Irvine
UAF, cayman.irvine@gmail.com

Surface current and temperature measurements were conducted in 2012, 2013, and 2014 by deploying > 230 satellite-tracked 1-m drogued Microstar (MS) drifters in the Chukchi and Beaufort seas during July, August, and September. In this study, we investigate the influence of wind on the variation of the mean surface flow of the Chukchi and Beaufort seas. In 2012, drifters generally moved eastward over the shelf and then northeastward through Barrow Canyon and then either eastward onto the Beaufort Sea shelf and slope, or northwestward along the Chukchi Sea slope in response to highly variable winds shifting from southwest to northeast and to northwest. In 2013, the majority of drifters remained on the northeast Chukchi Sea shelf and moved westward in response to the prevailing northeasterly winds. In 2013, the majority of drifters remained on the northeast Chukchi Sea and moved westward in response to the prevailing northeasterly winds. In 2014, winds were predominantly from the east/northeast and drifters moved northwestward over Chukchi and Beaufort shelves or northeastward through Barrow Canyon and the Chukchi slope. Surface temperatures also varied markedly among years; such that in 2012 water temperature reached 10 °C while and 2013 and 2014 temperatures over the shelf were < 6 °C. Preliminary analyses suggest that inter-annual variations in drifter trajectories and dispersal characteristics are a result of wind forcing and mesoscale fronts and shelf break currents.

Using Autonomous Marine Vehicles in the Arctic

Chris Carter
Schlumberger, ccarter7@slb.com

This paper will study the ability to acquire information in Arctic marine environments using the Wave Glider autonomous marine vehicle (AMV). AMVs offer a viable alternative to conventional offshore data collection methods and are designed with the aim of increasing offshore safety and reducing risk while delivering a quality service. The glider is designed as a pilotable and mobile marine vehicle that delivers data across a far wider area than conventional methods. The AMV comes equipped with sensors, cameras with satellite communications and have the ability to accurately collect and deliver real-time information in hard to reach areas of potential interest.

This study will examine the utilization of AMVs with integrated meteorological and oceanographic (METOC) sensors in the Chukchi Sea; the success of this mission proved this is a viable platform for effectively obtaining previously hard to reach data. The ability to utilize this method for further exploration efforts in the Arctic, in conjunction or independent of conventional methods, provides great potential for more extensive exploration in areas that are considered difficult or not possible to reach. Conventional sensor platforms such as buoys, ships, aircraft, and satellites require extensive lead time for planning, procurement, and construction. Satellite-mounted sensors and storm-chaser aircraft evaluate the air column and ocean surface but are limited in their on-scene endurance, real-time sampling data rates and capability to measure conditions at or beneath the sea-air interface. Oceanographic ships can range over great distances while taking a variety of measurements, but vessel and crew are not meant to withstand extreme conditions and also must return to port for replenishment after a limited time. Ocean-observation buoys can also be outfitted with sensors but are anchored in place, so they measure conditions within only a relatively fixed location.

This paper will delve into operating the Wave Glider AMV in the Arctic, mission duration and the types of METOC data that were collected. When we take into account the safety factors and the valuable data acquired during this mission, it equates to reduction in safety and environmental incidents while simultaneously reducing the uncertainty surrounding operating in these remote regions.

Circulation in the Chukchi Sea During the Summer 2012 Derived through the 4Dvar Data Assimilation of Velocity Observations from High Frequency Radars and Moorings

Gleb Panteleev
University of Alaska Fairbanks, International Arctic Research Center (UAF-IARC), gleb@iarc.uaf.edu
Jacob Stroh
UAF-IARC, jnstroh@alaska.edu
Tom Weingartner
UAF, tjweingartner@alaska.edu
Max Yaremchuk
U.S. Naval Research Laboratory (NRL), yarmx@mail.ru

We present the results of a circulation reconstruction in the Chukchi Sea for July-October 2012 through the assimilation of data from various sources. Assimilated data include velocity observations from High Frequency Radars and moorings, and temperature/salinity measurements from sea surface temperature (SST) and conductivity-temperature-depth (CTD) observations. The volume, heat, and salt transports through the Bering Strait and into the Arctic Ocean are discussed. We also provide an analysis of the informational content for each of the different observation types. For the purposes of obtaining accurate hindcast/forecast of the circulation in the Chukchi Sea, we discuss the need for operational velocity observations in the Bering Strait.

Using *in situ* Optical Instrumentation to Investigate Particle and Plankton Dynamics in Alaska's Coastal Waters

Andrew McDonnell
University of Alaska Fairbanks (UAF), amcdonnell@alaska.edu
Russell Hopcroft
UAF, rrhopcroft@alaska.edu
Dean Stockwell
UAF, dastockwell@alaska.edu
Jessica Turner
UAF, jessie.turner@alaska.edu
Telayna Gordon
UAF, tgordon10@alaska.edu

We combined multiple *in situ* optical sensors to provide *in situ* observations of particles and plankton in Alaska's coastal waters. Suspended sediments as well as living and detrital particulate organic material are critical components of ocean physics, chemistry, biology, and geology. By merging an *in situ* camera system with a laser scattering instrument, we determined the size distributions of particles across a wide size range from 2.5 µm to several cm. These size distributions are conducted at much higher spatial and temporal resolutions than can be achieved with traditional techniques such as bottle collections or net tows. Furthermore, the integration of these instruments into conventional shipboard conductivity, temperature, depth (CTD) rosettes enables these measurements to be made opportunistically as part of most oceanographic cruises without the need for additional dedicated wire time or numerous berths for scientific personnel. Here we discuss the optical instrumentation and methodology of merging measurements of particle size over a wide size range. We also highlight recent applications of this *in situ* optical technology over the continental shelves and slopes of the Arctic and Gulf of Alaska. This new data is used to evaluate hypotheses regarding the efficiency of the oceans' biological carbon pump as well as the role of lateral transport of particulate matter between the shelves and the deep ocean basins.

Global Ocean Acidification Observing Network: Implications for the Arctic

Libby Jewett
NOAA Office of Oceanic & Atmospheric Research Headquarters, libby.jewett@noaa.gov
Jeremy Mathis
NOAA Pacific Marine Environmental Laboratory, Jeremy.Mathis@noaa.gov

The Global Ocean Acidification Observing Network (www.GOA-ON.org) was recently established and is comprised, at its core, of scientists making measurements relevant to ocean acidification (OA) throughout the world's oceans. The intent is to have a global to local approach. The GOA-ON will provide data important for understanding how ocean acidification is unfolding from a macro, full earth scale but should also provide actionable information for coastal communities. How coasts and regions are affected is and will be variable. Observations in the Arctic are expanding but fuller coverage is necessary to understand better how melting sea ice (freshening), increased ocean-atmosphere contact (reduced sea ice) and warming temperatures will affect the biogeochemistry and particularly the carbonate chemistry of the Arctic Ocean. In addition, the second goal of the GOA-ON is to measure marine ecosystem response to OA. Given the relative paucity of biological data available for the Arctic, it is difficult to predict how OA will change the marine ecosystem. However, it is imperative that we determine what biological parameters might be monitored over time to track and even predict the change. This presentation will explore how the GOA-ON is currently being implemented in the Arctic and suggestions for expansion.

Thin Plankton Layers in the Marginal Ice Zone

James Churnside
NOAA Earth System Research Laboratory (ESRL), james.h.churnside@noaa.gov
Richard Marchbanks
ESRL, richard.marchbanks@noaa.gov

Thin plankton layers have been observed near the pycnocline in a variety of coastal and open-ocean environments. When present, they may affect patterns of primary productivity, plankton community structure, trophic transfer, survival of zooplankton and fish larvae, and development of harmful algal blooms. Several criteria for a layer to be considered as thin have been used; in this work, we defined a thin layer as a region of enhanced LIDAR return whose vertical extent was less than three meters between the depths at which the return was half of the peak value above and below the peak. This definition has been shown to be consistent with other definitions based on *in situ* measurements. In July of 2014, we flew a profiling LIDAR over the Marginal Ice Zone and into open waters of the Chukchi and Beaufort seas. The objective was to detect thin layers that might be associated with the stratification caused by melting ice. The LIDAR does not penetrate through the ice, but can obtain profiles of optical backscattering through regions of open water between floes. In all, we obtained just over 3 million LIDAR profiles over a distance of just over 6000 km. The fraction of the surface covered by ice ranged between 0 and 1, with an average value of 0.15. Thin layers were detected by LIDAR within the marginal ice zone, as well as in open water just outside of the ice. These layers were commonly found between 5 and 10 m in depth and were a few km in length.

Arctic - Lower Trophic Levels

Diversity and Community Structure of Benthic Meiofauna in the Chukchi and Beaufort Seas: A High-throughput Sequencing Approach

Alexis Walker
University of Alaska Fairbanks (UAF), amwalker8@alaska.edu
Sarah Hardy
UAF, smhardy@alaska.edu
Holly Bik
University of Birmingham, holly.bik@gmail.com

Rapid change is occurring in the Arctic marine environment concurrently with increased human activity in the form of petroleum resource development, yet our knowledge of the structure and function of Arctic marine communities, particularly the meiobenthos, is still rudimentary. Sediment communities are ideally suited to tracking long-term change because they tend to dampen short-term seasonal or interannual "noise" in many environmental characteristics (e.g., primary production, hydrographic features). Additionally, benthic infauna are widely used as indicators of disturbance impacts because they are relatively non-motile, reproduce rapidly, and respond very quickly to change. Due to their small size (63-500 um), traditional morphological taxonomy is difficult and time-consuming. Therefore we set out to characterize diversity and community structure of benthic meiofaunal invertebrates using a high-throughput DNA sequencing approach in conjunction with morphological methods. Sediment samples were collected in the Chukchi and Beaufort seas annually, between 2012 and 2014, and subsequently frozen at -80 °C for sequencing. Our molecular meiofaunal samples were processed using ribosomal 18S marker gene surveys of environmental DNA. Sequence read data for meiofauna was analyzed using the bioinformatics pipeline QIIME and the SILVA reference database. Sequence-derived community structure data were examined with environmental variables: temperature, salinity, depth, latitude, chlorophyll-a, grain size, lipid, and stable isotope data, to look for potential drivers structuring meiofaunal communities within and between the Chukchi and Beaufort seas. We found that using a modern sequencing approach provides higher resolution in assessments of benthic meiofauna taxonomy and diversity, resulting in a greater comprehension of the benthic metazoan community. With uncertainties regarding climate change, reduction in sea ice, and impending oil exploration and drilling a greater understanding of benthic communities will contribute to better monitoring systems of ecosystem health.

Lower Trophic Level Food Web Structure on the eastern Beaufort Sea Shelf and Slope

Lauren Bell
University of Alaska Fairbanks (UAF), lebell2@alaska.edu
Katrin Iken
UAF, kbiken@alaska.edu
Bodil Bluhm
The Arctic University of Norway, bodil.bluhm@uit.no

Coastal erosion and freshwater discharge along the northern U.S.-Canada coastline deposit large amounts of terrigenous carbon into the eastern Beaufort Sea. This refractory material is reputed to be difficult to assimilate for marine primary consumers, presumably resulting in inefficient energy transfer to higher trophic levels. Our research is the first to describe the relative ecological importance of terrestrially-derived organic matter across the Mackenzie River-influenced Beaufort Sea shelf and slope based on hydrogen stable isotope signatures (δD) of surface water, surface sediment particulate organic matter (POM), and selected benthic consumers. Carbon ($\delta^{13}C$) and nitrogen ($\delta^{15}N$) stable isotope signatures of pelagic and sediment POM and dominant pelagic and benthic consumers were also used to investigate differences in community trophic structure across the region concurrent with variation in terrestrial matter influence. Our δD results confirm a significant decrease in terrestrial organic matter utilization by benthic consumers with bottom depth along the slope, and this depth-related pattern is consistent across the central to eastern Beaufort slope region (136° – 151° W). Food web length, based on the range of $\delta^{15}N$ values of marine consumers, was longer on the Beaufort slope compared to the nearshore shelf and also showed no significant trend across the longitudinal extent of our study area. The results are contrary to our expectation that food webs will be longer when supported by a higher proportion of terrestrially-derived organic matter, which must be reworked through a microbial pathway before being nutritionally available to marine consumers. Instead, our study indicates that shorter food webs are correlated with the shallow depths of the Beaufort shelf, where highest relative utilization of terrestrial matter by benthic consumers occurred. This research thus challenges the current conception of terrestrial matter as a 'poor' food source for marine consumers, prompting us to reconsider how forecasted increases in terrestrial organic matter inputs to the Arctic Ocean will impact marine trophic structure.

Utilizing Sediment Profile Imaging for Physical Seafloor Surveys in the Chukchi Sea

John Nakayama
NewFields, jnakayama@newfields.com
Jasper Boas
NewFields, jboas@newfields.com
Waverly Kallestad
Fairweather Science, waverly.kallestad@fairweather.com
Barbara Bohn
Olgoonik, bbohn@olgoonik.com

In 2013, the Shell Exploration and Production Company funded baseline Sediment Profile Imaging (SPI) and plan view photography surveys in the Chukchi Sea in advance of proposed exploratory drilling operations. SPI collects images of the surface sediments in profile and plan view collects images of the sediment surface. SPI and plan view surveys were conducted at three proposed drilling sites in the Burger and Crackerjack prospects to document baseline physical properties of surface sediments (grain size major mode, boundary roughness, depth of oxygenation) as well as several biological properties including infaunal successional stage, surface burrow structures, and presence and identification of epifauna. These surveys were conducted as part of a multi-disciplinary survey of proposed drill sites that included benthic community structure, sediment chemistry, and benthic/epibenthic bioaccumulation monitoring. Baseline SPI and plan view photography survey results were compared between the drilling sites to determine potential smaller-scale variability in physical and biological sediment properties. The results were also evaluated within the context of the larger-scale benthic ecology studies conducted under the Chukchi Sea Environmental Studies Program (CSESP), a multi-year, multi-discipline marine science research program in the northeastern Chukchi Sea.

Growth and Production of the Dominant Alaska Arctic Brittle Stars: *Ophiura sarsii* and *Ophiocten sericeum*

Alexandra Ravelo
University of Alaska Fairbanks (UAF), amravelo@alaska.edu
Brenda Konar
UAF, bhkonar@alaska.edu
Bodil Bluhm
University of Tromso, bodil.bluhm@uit.no
Katrin Iken
UAF, kbiken@alaska.edu

Brittle stars are a key component of Arctic benthic shelf systems due to their high standing stock, dominance in abundance over all other epibenthic organisms, importance in carbon remineralization, and as prey for higher trophic organisms. Despite the pervasiveness of these brittle stars, little is known of their distribution boundaries, variation in abundance and how long it takes for their substantial standing stocks to accumulate, how long these populations persist in time and space, or the factors that may contribute to their geographic distribution. The objective of this study was to analyze the population's distribution, abundance, size structure, growth, and productivity. On the Alaskan Arctic shelves, the circumboreal species *Ophiura sarsii* and *Ophiocten sericeum* are the dominant brittle stars with densities of up to 260 ind. m^{-2} and 20 ind. m^{-2}, respectively. Although present across all Alaska Arctic shelves these specie have a segregated distribution; *O. sarsii* dominates the more productive Chukchi and western Beaufort Sea shelves and *O. sericeum* dominates the more river influenced Beaufort Sea shelf east of 150° W. Overall, *O. sarsii* is a larger species than *O. sericeum*, with a maximum disc diameter of 30.9 mm and 14.9 mm, respectively. Both species showed an exponential relationship between body size and organic mass ($r^2 = 0.93$ for *O. sarsii* and $r^2 = 0.89$ for *O. sericeum*). However, at equal body size, *O. sarsii* had significantly higher organic matter content compared to *O. sericeum*. The first ever age estimates of Arctic brittle stars, based on age bands in ossicles in arms, suggest longevity of $\geq$ 12 years for *O. sarsii* and 10 years for *O. sericeum*. Preliminary results from age analysis indicate that *O. sarsii* may grow faster and live longer than *O. sericeum*. In the context of a rapid changing Arctic environment, an increase in the systems productivity could favor a faster growing and more productive *O. sarsii*; however a decrease in energy flux to the benthos could favor a smaller more resilient *O. sericeum*, promoting large changes in the distribution and dominance throughout the Alaska Arctic shelves.

Composition, Diversity and Vertical Structure of the Zooplankton Community in the Beaufort Sea

Caitlin Smoot
University of Alaska Fairbanks (UAF), casmoot@alaska.edu
Russell Hopcroft
UAF, rrhopcroft@alaska.edu

We studied the zooplankton communities of the Beaufort Sea as part of a multi-year and interdisciplinary effort to characterize the physics and biology of the Beaufort Sea. Knowledge of the composition and spatial distribution of the zooplankton community is essential given their importance as trophic links, as is establishing foundational data in light of global change and increased oil and gas industry interest in the Arctic region. This work is part of a multi-year dataset (2010-2014) that provides a modern reference point from which future change may be gauged. Zooplankton were sampled along cross-shelf transects from depths of 20 to 1,000 m between Camden Bay and the Mackenzie River during August 2013. This study represents the first depth-stratified examination of these communities. In total 93 taxonomic categories were documented, with the greatest diversity observed in the copepods (46 species). Over 50% of the abundance and biomass was concentrated in the upper 100 m where the community was dominated by a guild of Arctic taxa, including *Calanus* species, *Oithona similis*, and the *Pseudocalanus* species complex. The presence of euryhaline taxa such as *Limnocalanus* and *Eurytemora* reflected the freshened surface water observed in the study region. Pacific expatriates such as *Neocalanus cristatus* and *Eucalanus bungii* were also present in low abundances. Abundance and biomass generally decreased with depth, with the exception of a slight increase in both parameters observed in the transition to Atlantic water (200-300 m). The community exhibited a layered structure that was highly correlated with salinity and depth (Spearman correlation = 0.83).

Phylogeography and Connectivity of Four Sibling Species of *Pseudocalanus* (Copepoda; Calanoida) in the North Pacific and Arctic Oceans

Jennifer Questel
University of Alaska Fairbanks (UAF), jmquestel@alaska.edu
Leocadio Blanco-Bercial
University of Connecticut (UC), leocadio@uconn.edu
Russell Hopcroft
UAF, rrhopcroft@alaska.edu
Ann Bucklin
UC, ann.bucklin@uconn.edu

Pseudocalanus (Copepoda: Calanoida) is one of the most numerically dominant genera in Arctic and sub-Arctic waters. However, *Pseudocalanus* presents taxonomic difficulty in morphological identification down to the species level, resulting in a general lack of detailed species-specific distribution data. To determine population genetic structure of the species, the mitochondrial gene cytochrome oxidase I (mtCOI) was sequenced for two temperate (*P. mimus* and *P. newmani*) and two Arctic (*P. acuspes* and *P. minutus*) species from the Chukchi and Beaufort seas, the Gulf of Alaska, and two fjord systems within Prince William Sound. Genetic data show significant differentiation of the Beaufort Sea population, as well as populations within the fjord systems. Partial genetic isolation (i.e., low gene flow) of the Beaufort Sea population may be a consequence of the Beaufort Gyre's strong frontal zone, which may generate a faunal barrier between the western Arctic Ocean and the North Pacific/Chukchi Sea. We also report the likelihood of alternative models of population connectivity in order to better understand directions of gene flow between sampled populations of *Pseudocalanus* in relation to oceanographic features. Under current warming trends, is it conceivable that faunal barriers for *Pseudocalanus* will shift northward, allowing habitat range expansion and potentially increased population connectivity between Arctic and sub-Arctic populations.

Contribution of Sea Ice Algae to Various Benthic Feeding Types on the Chukchi Sea Shelf

Tanja Schollmeier
University of Alaska Fairbanks (UAF), tschollmeier@alaska.edu
Katrin Iken
UAF, kbiken@alaska.edu
Matthew J. Wooller
UAF, mjwooller@alaska.edu
Alexandra C. M. Oliveira
UAF, acoliveira@alaska.edu

Arctic waters have two main sources of particulate organic matter (POM) from primary production, sympagic (iPOM - sea ice) and pelagic (pPOM - 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 towards pPOM. An open question is how benthic consumers of the early ice algal food pulse on the Chukchi shelf might be affected by this food source shift. We used compound specific stable isotope analysis of individual fatty acids (FAs) to determine the proportional contribution of sympagic FAs to different benthic feeding groups (omnivores, suspension feeders, surface deposit-feeders and subsurface deposit-feeders). The FAs we focused on were the diatom biomarkers 16:1(*n*-7) and 20:5(*n*-3), which have different carbon isotope signatures depending on whether they originated from pPOM or iPOM. The carbon isotope signatures of FAs from these two sources are conserved in consumer tissues and can be used to identify carbon sourcing in consumers. Stations were grouped by length of ice coverage where stations with long ice cover simulate conditions of high ice algal production and short ice cover simulates conditions of ice loss (more phytoplankton production) as it is expected with increased climate warming. Although large variations were found among individuals within a feeding group and within ice cover groups, FAs in omnivores had higher FA $\delta^{13}C$ values in regions with longer ice coverage. In contrast, FAs in suspension feeders and surface deposit-feeders had lower $\delta^{13}C$ values with longer ice coverage. In subsurface deposit-feeders, the two FAs showed opposite trends with higher $\delta^{13}C$ values for 16:1(*n*-7) but a decrease in 20:5(*n*-3) $\delta^{13}C$ with longer ice coverage. These results imply that omnivores rely more on an ice algal-driven pathway than suspension and surface deposit-feeders, while results are ambiguous for subsurface-deposit feeders. This strong link between omnivores and ice algae may come from direct consumption or from preying on intermediary consumers that consume ice algae. Regardless, our results indicate that specific trophic links exist in the benthic system that will be affected if ice algal supply decreases.

Is Splitting Up Hard to Do? Comparing Zooplankton Sample Processing Methods by Estimating Larval Crab Abundance

Jared Weems
University of Alaska Fairbanks (UAF), jdweems@alaska.edu
Alexei Pinchuk
UAF, aipinchuk@alaska.edu

Planktonic crab larvae occur throughout the water column during the Arctic summer and are common constituents of the zooplankton community. They generally occur in low numbers in comparison to other zooplankton groups such as copepods. Enumerating low density species can be problematic using common laboratory processing methods such as sample splitting. However, a more complete sample workup is a laborious process which can be time consuming and costly. Therefore, a comparison between processing methodologies must first be conducted for cost-benefit analysis. This study compares larval crab abundance estimates from identical, 505µm mesh Bongo net zooplankton samples processed using 1) sequential splitting with taxonomic identification to family level, and 2) sorting through the entire sample and identification to species and stage-specific levels. We examine observed differences in larval crab abundances obtained with both techniques and test density dependent relationships across sample split levels (½, ¼, etc.) to determine sub-sampling efficiency. These results should allow us to select a better methodology to enumerate larval crab in existing Arctic Eis Program zooplankton samples from the northeastern Bering Sea and Chukchi Sea.

Diversity and Distribution of Marine Mollusks Along the Chukchi and Beaufort Sea Shelf and Slope

Nora Foster
NRF Taxonomic Services, swamprat@mosquitonet.com
Bodil Bluhm
University of Alaska Fairbanks (UAF), babluhm@alaska.edu
Katrin Iken
UAF, kbiken@alaska.edu

Surveys of the shelf fauna of the Chukchi Sea, and of the Beaufort Sea shelf and slope have resulted in new information on the diversity and biogeography of the marine benthic fauna of the Pacific Arctic. The composition of benthic fauna changes both along an east-west gradient and by depth along the Chukchi shelf and Beaufort shelf and slope. Over 300 voucher specimens representing 91 molluscan species were identified for these studies. Molluscs inhabiting the Chukchi and Beaufort seas shelves are part of a Pacific boreal fauna. The mollusks inhabiting the Beaufort Sea slope show an increasing Atlantic influence with increasing depth and from east to west. Apparent new range information for 11 of the 91 species, better known from the north Atlantic fauna, is noted. The fauna, particularly large gastropods, is in need of further study and revision. Several genera, including *Aartensina*, *Turrisipho*, *Iphinopsis*, and *Siphonodentalium* are recorded for the first time in the Beaufort Sea.

Phytoplankton Assemblage Structure in the Chukchi Sea: Insight From Flow Cytometry

Samuel Laney
Woods Hole Oceanographic Institution (WHOI), slaney@whoi.edu
Heidi Sosik
WHOI, hsosik@whoi.edu

Imaging and standard flow cytometry were used to assess phytoplankton assemblage composition in the Chukchi Sea on cruises in 2010, 2011, 2013, and 2014. Such detailed information on assemblage composition, spanning multiple seasons, provides an unprecedented view into the spatiotemporal structure of phytoplankton communities in this Arctic Ocean shelf ecosystem. An approach will be presented for synthesizing information about large size classes (from imaging flow cytometry) with information about smaller size classes (from standard flow cytometry). This approach provides considerable insight into how the physics and chemistry of the Chukchi Sea control the distribution and timing of phytoplankton biomass, with ramifications to primary production.

SHELFZ Project: Arctic Shelf Zooplankton Populations in the Vicinity of Barrow Underwater Canyon - Preliminary Results

Alexei Pinchuk
University of Alaska Fairbanks (UAF), aipinchuk@alaska.edu
Leandra Sousa
North Slope Borough, leandra.sousa.nsb.dwm@gmail.com
Seth Danielson
UAF, sldanielson@alaska.edu

Underwater canyons cutting through continental shelves often generate unique hydrography and may facilitate exchange between shelf and abyssal biotas contributing to increased local oceanic productivity. Zooplankton composition and distribution in the vicinity of Barrow canyon was investigated in summer 2013 as a part of SHELFZ, a multidisciplinary project in which nearshore (< 20 m isobath) and offshore (> 20 m isobath) data were concurrently collected for fish, zooplankton, fisheries acoustics, and water mass properties along Alaska's Chukchi Sea coast. While majority of zooplankton comprised wide-spread shelf species such as *Calanus glacialis*, substantial amounts of large-bodied Arctic deepwater *Calanus hyperboreus* along with less common *Pareuchaeta glacialis*, *Metridia longa* and *Themisto abyssorum* were recorded nearshore, indicating penetration of cold and saline winter water into the study area. Pacific influence was indicated by low numbers of *Eucalanus bungii* and *Neocalanus* spp. euphausiids and the formation of dense aggregations of large hyperiids *Themisto libellula* at some stations. The presence of lipid-reach Arctic species was likely beneficial to a variety of planktivorous predators from fish to whales observed in the study area.

Arctic - Lower Trophic Levels

Food Web Structure in the Southern Chukchi Sea

Carlos Serratos
University of Alaska Fairbanks (UAF), serratos.carlos@gmail.com
Katrin Iken
UAF, kbiken@alaska.edu
Bodil Bluhm
University of Tromso, Department of Arctic and Marine Biology, bodil.bluhm@uit.no

The goal of this study is to explore spatial and temporal patterns in food web structure in the southern Chukchi Sea, a region that may be prone to ecosystem-wide changes due to climate alterations. Benthic invertebrate samples were collected from eight repeat stations during the Russian-American Long-term Census of the Arctic (RUSALCA) cruises in 2004, 2009, and 2012. Stable carbon and nitrogen isotope analysis was used to assess trophic patterns. Stations were grouped by three prominent water masses to identify spatial patterns in food web structure under different nutrient and productivity regimes. Organisms in the nutrient-rich Bering Shelf-Anadyr water (BSAW) had significantly higher $\delta^{13}C$ values when compared with their conspecifics in the freshwater influenced and less nutrient-rich Alaskan Coastal water (ACW) in 2012 and on the Russian coast (RC) in 2009. The higher $\delta^{13}C$ of benthic organisms in the BSAW suggests a mostly marine-derived carbon source. By comparison, the lighter $\delta^{13}C$ values of organisms under the ACW and RC can be indicative of more terrestrial carbon input. BSAW benthos in 2012 also had lower $\delta^{15}N$ values than their counterparts in the ACW, suggesting less reworking of the food sources before consumption in BSAW than in ACW Temporal differences were only detected for organisms in the RC, which were significantly lighter in $\delta^{13}C$ in 2009 and 2012 than in 2004. These differences coincided with changes in physical conditions in the RC water, specifically in the lower salinity (more fresh water) in 2009 and 2012 that may have carried carbon sources of terrestrial origin. Our findings document that (1) known differences in the nutrient and productivity regimes of water masses in the study region are reflected in the respective benthic food webs, and that (2) food web structure remained relatively stable across the survey years in ACW and BSAW, while we infer some between-year variation in hydrographic conditions near the Russian coast.

SHELFZ Project: Benthic Invertebrates from Nearshore to Offshore in and Around Barrow Canyon in the Northeastern Chukchi Sea

Kimberly Rand
NOAA, Alaska Fisheries Science Center (AFSC), kimberly.rand@noaa.gov
Elizabeth Logerwell
AFSC, libby.logerwell@noaa.gov
Seth Danielson
University of Alaska Fairbanks, sldanielson@alaska.edu
Leandra Sousa
North Slope Borough, leandra.sousa.nsb.dwm@gmail.com

We examined distribution patterns of the epifauna invertebrate community in the northeastern Chukchi Sea as part of the SHELFZ survey in August-September 2013. The nearshore invertebrate community was sampled from the shoreline out to ~20 m water depth with a plumb staff beam trawl and the offshore invertebrate community was sampled with an 83-112 eastern otter trawl. The total catch biomass nearshore was 78% invertebrates and offshore was 98% invertebrates. Of the nearshore invertebrates, crangonid shrimps, jellyfish and sea stars comprised the majority of the biomass. In the offshore, the two species *Gorgonocephalus cf. arcticus* (basket star) and *Psolus peroni* (sea cucumber) were more than 50% of the biomass. The center of highest abundance for *Gorgonocephalus* began at the edge of Barrow Canyon and followed the deeper waters of the canyon. In contrast, *Psolus peroni* was almost nonexistent in Barrow Canyon but was found instead on the perimeter, in the shallow waters in the northwestern part of the study area. In addition to examining the distribution of the invertebrate community by depth, we examined the physical oceanography and habitat features of the study area, of which Barrow Canyon is a significant part. This study is unique in that it begins nearshore and extends offshore encompassing part of Barrow Canyon and the Chukchi sea shelf, both of which may be regulated by different oceanographic processes. Because the majority of the living Arctic community is comprised of invertebrates (epi- and infaunal), understanding what environmental characteristics influence the distribution of epifaunal invertebrates is necessary to predict the impacts of climate change and oil and gas development on Arctic ecosystems.

Interannual Variation of Epibenthic Communities in the Chukchi Sea, Alaska

Kimberly K. Powell
University of Alaska Fairbanks (UAF), kkpowell2@alaska.edu
Brenda H. Konar
UAF, bhkonar@alaska.edu

Epibenthic communities contain a wide range of organisms and serve an important role in marine ecosystems. They are involved in carbon remineralization, benthic production, and are important prey items for higher trophic levels. Due to climate variability, non-anthropogenic environmental drivers, and in some areas oil and gas exploration, epibenthic communities may be experiencing significant changes in species composition, abundance, and biomass. While epibenthic communities may be responding to long-term shifts in the environment, differentiating long-term trends from inter-annual variability can be problematic. This study examined inter-annual variability in epibenthic communities and their potential environmental drivers in the Chukchi Sea. A plumb staff beam trawl was used to sample epibenthic biomass, abundance, and species composition of dominant invertebrate taxa at 76 stations around the Chukchi Sea during the ice free seasons of 2009, 2010, 2012, and 2013. Epibenthic communities declined in biomass and abundance over the course of the study (2009 to 2013) an order of magnitude over what was found in the inter-annual variability (2009 to 2010 and 2012 to 2013). The largest variability was found in the east near Barrow Canyon. Echinoderms and crustaceans were the organisms that not only contributed most to community composition, but also contributed most to variability in community composition. Environmental factors such as bottom water temperature, salinity, dissolved oxygen and pH, sediment grain size, sediment organic matter and sediment, and chlorophyll content were found to vary along with the epibenthic community composition. While these data provide a benchmark on inter-annual variability, more monitoring is essential to determine long-term trends.

Inshore to Offshore Environmental Characteristics and Benthic Macrofauna Along the CSESP Distributed Biological Observatory (DBO) Line in the Northeastern Chukchi Sea

Ann Knowlton
University of Alaska Fairbanks (UAF), alknowlton@alaska.edu
Arny Blanchard
UAF, alblanchard@alaska.edu

Benthic macrofaunal community characteristics covaried with strong inshore to offshore gradients across the Chukchi Sea Environmental Studies Program (CSESP) distributed biological observatory (DBO) line in 2013. Due to the length of this DBO line, large transitions in both physical and biological characteristics were seen. The shallower inshore benthic environment had coarser sediments, and was primarily under relatively warm Alaskan Coastal Water (ACW). Benthic communities had relatively low biomass and density and were dominated by intertidal and disturbance-tolerant species. Moving offshore, depth increased, sediments became finer, and bottom-water temperature decreased under Bering Sea Water (BSW). Benthic biomass and density peaked in these muddier habitats and then declined farther away from shore. The invertebrate communities transitioned to deposit-feeding polychaetes and suspension-feeding bivalves. At the farthest offshore stations benthic biomass and density again peaked, though to a lesser extent. This small peak likely reflects a change in water circulation patterns that allows for greater transport of organic carbon to the seafloor. Terrestrial carbon input is evident in the inshore stations as seen by the lower $\delta^{13}C$ sediment values compared to offshore stations.

Two intertidal isopods, *Tecticeps alascensis* and *T.* cf. *renoculis*, occurred at the most inshore station at 15 m water depth and ~3 nmi offshore. These species demonstrate the ability of benthic organisms to acclimate to broad environmental and temperature ranges, as well as highlight the northward transport of North Pacific species into the Arctic Ocean. Other species with similar distributions include the mussel *Mytlius trossulus*, the barnacle *Semibalanus balanoides*, and the sea star *Ctenodiscus crispatus*.

Temporal Variation of Benthic Macrofauna of the Northeastern Chukchi Sea, 2008-2013

Tama Rucker
University of Alaska Fairbanks (UAF), trucker@alaska.edu
Arny Blanchard
UAF, alblanchard@alaska.edu

Macrobenthic community biomass, density, and richness significantly increased over 6 years in the Chukchi Sea Environmental Studies Program (CSESP) study area in the northeastern Chukchi Sea, 2008-2013. Macrofauna were sampled for community ecology analyses using a 0.1 m^{-2} van Veen grab in the Burger and Klondike study areas (9 monitoring stations each) from 2008–2013 and the Statoil study area (9 monitoring stations) from 2010–2013. Temporal variations of biomass and density were great, with up to a 229% increase in biomass, 487% increase in density, and 157% increase in richness from minimum to maximum values. Species composition was largely similar among stations and years, and multivariate analysis suggested greater spatial patterns in community structure and weak temporal effects. In the North Pacific, the Pacific Decadal Oscillation is associated with long-term variations in benthic density and richness, and a similar association may exist between benthic communities in the Chukchi Sea and the Arctic Oscillation (AO). Increased recruitment of juvenile bivalves (*Ennucula tenuis*), as indicated by declining median lengths from 2008 to 2013, is also associated with benthic community variations as well as with the AO. The temporal variations suggest high ecosystem variability, although benthic community characteristics overall appear to be within historical ranges.

Inter-annual Variability of the Planktonic Communities in the Northeastern Chukchi Sea: 2008-2014

Russell Hopcroft
University of Alaska Fairbanks (UAF), rrhopcroft@alaska.edu
Jennifer Questel
UAF, jmquestel@alaska.edu
Cheryl Clarke-Hopcroft
UAF, cclarkehopcroft@alaska.edu

Since 2008, interdisciplinary studies have established baselines in the oil & gas exploration areas in the northeastern Chukchi Sea. Here we consider the annual patterns of major zooplankton species over these 7 years. Although the suite of species remains the same from year-to-year, all species show considerable interannual variability, leading to large variability in community composition as well as overall abundances and biomass. Warm years tend to be dominated by smaller-bodied Pacific/Bering species that result in low community biomass, while the coldest years are dominated by larger-bodied Arctic species. The role of advection from the Bering Sea and more local arctic sources are considered and discussed. It is suggested that, within the northeastern Chukchi Sea, warmer years may result in lower planktonic productivity and thus less energy available to the benthos and higher vertebrate trophic levels.

Arctic - Lower Trophic Levels

Shell Length Variations of the Bivalve *Ennucula tenuis* in the Northeastern Chukchi Sea, 2008–2013

Erin May
University of Alaska Fairbanks (UAF), Enmay@alaska.edu
Arny Blanchard
UAF, alblanchard@alaska.edu

Population dynamics of the bivalve *Ennucula tenuis* were investigated during the Chukchi Sea Environmental Studies Program (CSESP) in the northeastern Chukchi Sea, 2008–2013. Macrofauna were sampled for community ecology analyses using a 0.1 m^{-2} van Veen grab with up to 26 stations in both of the Burger and Klondike study areas in 2008–2013 and up to 24 stations from the Statoil study area in 2010–2013. In addition to taxonomic analyses, shell lengths of *E. tenuis* were measured in the laboratory to further evaluate temporal variations in benthic communities. Spatially, the samples collected from the Burger study area had significantly greater median shell lengths than those from the Klondike and Statoil study areas in all years. Temporally, median shell lengths declined from 2008 to 2013 and length-frequency histograms suggested increased proportions of small (juvenile) *E. tenuis*, rather than increased mortality of adults, particularly in 2011 to 2013. The biomass:density ratio for *E. tenuis* also declined over the study period further indicting increased numbers of smaller animals. Median shell lengths were strongly correlated with the prior year's winter-time Arctic Oscillation (AO; r = 0.72). Additionally, macrobenthic biomass, density, and richness all increased over the study period, also with links to the AO. The high community variability in macrofauna and population level variability for *E. tenuis* in the study area suggest high ecosystem variability.

An Analysis of Hatch Timing of Arctic Cod *Boreogadus saida* from the Eastern Beaufort Sea

Alyssa Frothingham
University of Alaska Fairbanks (UAF), afrothingham@alaska.edu
Brenda Norcross
UAF, bnorcross@alaska.edu

Arctic cod (*Boreogadus saida*), an abundant fish with a circumpolar distribution, is vital to the Arctic ecosystem. Arctic cod plays a key ecological role in the Arctic ecosystem by transferring energy between trophic levels, from plankton to marine mammals and sea birds. Due to the importance of Arctic cod in the Arctic food web, establishing hatch dates of Arctic cod can provide an idea how the species will adapt to the effects of climate change and an increase in human activities such as oil and gas exploration and shipping routes in the Arctic. Arctic cod is a short-lived, abundant, and reproductive species, but across the species distribution, egg hatching events are variable. Salinity and temperature greatly influence the timing of hatch dates and consequently the survival rates of juvenile Arctic cod. Daily otolith increments (rings) were counted from the hatch mark to the edge of larval Arctic cod otoliths collected in 2013 from the eastern U.S. Beaufort Sea. To best enumerate daily rings for age estimation, otoliths were transversely sectioned and photographed under transmitted light. Hatch dates were determined by subtracting the age of the Arctic cod in days from date of capture. Results from this project will be compared with hatch dates of Arctic cod from other Arctic areas.

Diets of Four *Lycodes* Species (*L. adolfi, L. polaris, L. sagittarius, and L. seminudus*) in the Beaufort Sea

Sarah Apsens
University of Alaska Fairbanks (UAF), sjapsens@alaska.edu
Brenda Norcross
UAF, bnorcross@alaska.edu

Eelpout (genus *Lycodes*) is a family (Zoarcidae) of demersal fish found in the Beaufort Sea and across the Arctic basin. Despite prevalence in the region, very little is known about diet and general ecology of members of this family. During the 2012 and 2013 U.S. Transboundary cruises, four species of genus *Lycodes* were collected: Adolf's eelpout (*L. adolfi*), Canadian eelpout (*L. polaris*), Archer Eelpout (*L. sagittarius*) and longear eelpout (*L. seminudus*). Canadian eelpout was found primarily on the continental shelf (< 200 m), while the other three species were found in deeper waters (200 m to 1,000 m). For this study, the stomach contents of these four Zoarcids were characterized using stomach content analysis. Analysis of fish diet through stomach content analysis is a useful tool as it provides valuable insight into the habitat and ecological niche of the group of fish being examined. In addition, comparing diets among fish species of the same genus can give further clues as to prey selectivity and resource partitioning among predator species. Fish stomachs were removed, and prey items were identified to the lowest taxonomic level possible though they were grouped into broader categories for statistical analysis. Percent prey number (%N), prey weight (%W), prey occurrence (%O) and percent index of relative importance (%IRI) were used to characterize diets and identify important prey groups. Preliminary results using %IRI showed that differences in diet composition occur among the four species. Diets of Adolf's eelpouts were dominated by benthic amphipods, while polychaetes were a major prey group for Canadian, Archer and longear eelpouts. Characterizing the diets of these four species of Zoarcids is a first step in creating a more complete view of demersal fish ecology in the Beaufort Sea.

Age Structure and Growth Comparisons Among Four Species of Eelpouts from the Beaufort Sea

Kelly Walker
University of Alaska Fairbanks (UAF), klwalker2@alaska.edu
Brenda Norcross
UAF, bnorcross@alaska.edu

Arctic ecosystem research has recently moved into the spotlight due to climate change and increased oil and gas exploration. Developing baseline knowledge of the organisms present in this ecosystem is an important aspect of current research. During the open-water seasons of 2011 through 2014, fish were collected from the Beaufort Sea using bottom trawl gear. *Lycodes seminudus (*longear eelpout), *L. sagittarius* (Archer eelpout), *L. adolfi* (Adolf's eelpout) and *L. polaris* (Canadian eelpout) were the four most abundant zoarcids collected during these field seasons. These species were captured at different depth ranges across sampling areas during each year. *L. seminudus* and *L. sagittarius* were captured at depths from 350 m to 1,000 m. *L. adolfi* were captured from 500 m to 1,000 m. *L. polaris* was only captured at depths from 20 m to 200 m. Very little has been published describing the age and growth of these demersal fishes. Otoliths were used to estimate ages of individual fish from each species. Length-at-age plots were used to describe the age structure of these four species. The species that were found deeper than 200 m (*L. seminudus, L. sagittarius, L. adolfi*) had a larger age range than the species found shallower than 200 m (*L. polaris*). *L. seminudus* had the largest age range of 1 to 24 years. *L. sagittarius* had the second largest age range of 2 to 21 years. *L. adolfi* had an age range of zero to 12 years. *L. polaris* had the smallest age range of zero to 11 years. Preliminary analysis of growth indicated that *L. seminudus*, *L. sagittarius,* and *L. adolfi* displayed slower growth than *L. polaris*.

Contrasting Strategies of Lipid Storage in Juvenile Arctic Cod (*Boreogadus saida*) and Saffron Cod (*Eleginus gracilis*) Under Variable Thermal regimes.

Louise Copeman
Oregon State University, lcopeman@coas.oregonstate.edu
Benjamin Laurel
NOAA, Alaska Fisheries Science Center (AFSC), Ben.Laurel@noaa.gov
Ron Heintz
AFSC, Ron.Heintz@noaa.gov
Johanna Vollenweider
AFSC, johanna.vollenweider@noaa.gov

Climate models indicate the Arctic will undergo dramatic environmental change as a consequence of global warming. Increasing temperatures will most likely be coupled with increased river runoff which in turn will significantly impact nearshore marine food webs. Both Arctic cod (*Boreogadus saida*) and saffron cod (*Eleginus gracilis*) are abundant and ecologically important in Arctic coastal waters, however, little is known about their growth, feeding ecology, or energy allocation during the juvenile stages. We used both field and laboratory approaches to understand the early energetics of juvenile Arctic and saffron cod in relation to changes in temperature and food availability. Field collections of age-0 and age-1 juvenile gadids showed significant trends in condition metrics both within and between species. Saffron cod showed a significant increase in lipid per wet weight with standard length up until the first over-wintering period. Similar large-scale analyses are underway for Arctic cod, but preliminary analyses suggest Arctic cod have higher levels of total lipids and storage lipids both in muscle and liver tissues than saffron cod. Energetic differences, both within and among these gadids, may stem from regional trophic and thermal conditions. Fatty acid biomarkers indicate Arctic cod have a higher reliance on calanoid copepods than saffron cod and laboratory experiments revealed distinct differences in growth and condition under varying temperatures. These field and laboratory data suggest Arctic cod and saffron cod will likely respond differently to regional warming, such that energetic contribution of these forage fish to higher trophic levels could be substantially altered in the wake of further climate change.

SHELFZ Project: Environmental Drivers of Benthic Fish Distribution in and Around Barrow Canyon in the Northeastern Chukchi Sea

Elizabeth Logerwell
NOAA Alaska Fisheries Science Center (AFSC), libby.logerwell@noaa.gov
Kimberly Rand
AFSC, kimberly.rand@noaa.gov
Seth Danielson
University of Alaska Fairbanks, sldanielson@alaska.edu

Barrow underwater canyon is a dominant feature of the SHELFZ study area. It is oriented parallel to the shore and drops to depths around 150 m, around 20-40 km from shore. Water depths rise to around 60 m offshore of the canyon in the study area. The benthic fish community in and around Barrow Canyon was surveyed with an 83-112 eastern otter trawl at water depths greater than 20 m. Maps of the distribution of benthic fish indicate that Barrow Canyon influences where fish are most abundant. For example, Arctic cod (*Boreogadus saida*), eelpouts (Zoarcidae), and snailfish (Liparidae) were more abundant in the deeper waters inside Barrow Canyon. In contrast, sculpin were more abundant all around the outside of the canyon, in shallower waters both inshore and offshore of the canyon edge. Other species, were found only inshore or only offshore of the canyon. To further examine the role of the environment in and around Barrow Canyon, we analyzed the distribution and abundance of benthic fish in relation to several drivers. We examined physical oceanographic drivers such as temperature, salinity, water column stratification, and mixed layer depth. We also examined factors such as latitude, distance from shore, and bottom type. Understanding the oceanographic and habitat features important for Arctic benthic fish can help predict and manage for the potential impacts on Arctic ecosystems of climate change and human activities such as shipping and oil and gas development.

Fatty acid Profiles of Alaskan Arctic Forage Fishes: Investigating Regional and Temporal Diet Variation

Julia Dissen
University of Alaska Fairbanks (UAF), jndissen@alaska.edu
Sarah M. Hardy
UAF, smhardy@alaska.edu
A.C.M. Oliveira
UAF, acoliveira@alaska.edu
Lara Horstmann-Dehn
UAF, lara.horstmann@alaska.edu

Forage fishes are important prey items of marine mammals, sea birds, and predatory fishes. This project aims to characterize the fatty acid (FA) profiles of three abundant species of Arctic forage fishes, Arctic cod (*Boreogadus saida*), Canadian eelpout (*Lycodes polaris*), and longear eelpout (*Lycodes seminudus*) across multiple years (2010-2013) and geographic locations (Beaufort and Chukchi seas). FAs in consumer tissues can be used to represent the prey assemblages present in an ecosystem, because many dietary FAs ingested are conserved and incorporated into consumer tissues in predictable patterns. By characterizing FA profiles of these three study species, we can better understand how Arctic fish diet varies across time and space. Lipids were extracted from whole-body homogenates using a modified Folch extraction and esterified to produce fatty acid methyl esters (FAME). FAMEs were analyzed quantitatively and qualitatively in relation to commercial FA standards with gas chromatography. Using multivariate analysis, FA profiles were found to differ among species, regions, and years, with decreasing significance respectively; thus signifying diet variation between Arctic cod and eelpout species as the strongest determination of FA profile, followed by intraspecific variation in diet over space and time. FA profiles also varied with fish length suggesting different diets among age classes and indicating the importance of considering fish size in FA interpretation. The data from this study show that FA profiles are useful in detecting intra- or inter-specific differences in forage fish diets across regions and years. Moreover, understanding the degree of within-species variability is essential to the accurate interpretation of FA data used to characterize diets of top predators. The intraspecific variation observed in this project suggests that FA studies in the Arctic must be specific to region and year to avoid biasing results.

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

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

Dolly Varden is highly valued as a subsistence fish on the North Slope of Alaska and local residents harvest thousands of these fish each year. In contrast to the information that is available about North Slope Dolly Varden (*Salvelinus malma*) during their freshwater phase, biologists have little direct information about their summer ocean ecology and distribution. Therefore, we used Pop-up Satellite Archival Transmitting tags to study the oceanic habits, distribution and migration patterns of Dolly Varden that spend summers in the Beaufort Sea. In June and July 2014, we deployed 13 Microwave Telemetry X-tags on large (62–71 cm) Dolly Varden from the Ivishak River (n = 9) the marine waters near Kaktovik (n = 4). While at-liberty, the tags collected temperature, depth and ambient light data for daily geoposition estimates, after which they released from the fish and transmitted the collected data and an end location to satellites. Of the tagged fish, five never left the Ivishak River and likely moved upstream to spawn, one was located in the Kongakut River, two were located in the Hulahula River, two sent brief transmissions, but no location was obtained, and three were missing. Based on our results, it’s likely that some fish (prespawners) forego an oceanic feeding migration, or spend very little time in saltwater during the summer, similar to stocks in northwestern Alaska. Lessons learned from the 2014 field season will be applied to next year’s tag deployments to increase the information obtained about the oceanic ecology of Dolly Varden in the Beaufort Sea.

Ontogenetic, Temporal and Spatial Variation in the Trophic Roles of Chukchi Sea Fishes

Jennifer Marsh
University of Alaska Fairbanks (UAF), jmmarsh@alaska.edu
Franz Mueter
UAF, fmueter@alaska.edu
Katrin Iken
UAF, kbiken@alaska.edu
Seth Danielson
UAF, sldanielson@alaska.edu

With climate warming and longer open-water seasons in the Arctic, there is an increased interest in shipping, oil exploration and the expansion or development of commercial fisheries. Anticipated natural and anthropogenic changes are expected to alter the ecosystem of the Chukchi Sea, including its fish communities. As a component of the Arctic Ecosystem Integrated Survey, we assessed the ontogenetic, spatial and temporal variability of the trophic roles (trophic level and diet source) of key fish species in the Chukchi Sea using C and N stable isotopes. Unlike diet analysis, stable isotope analysis integrates only food items assimilated by consumers and therefore more accurately represents the transfer of energy between trophic levels. During August and September of 2012 and 2013, sixteen common fish species and two baseline invertebrate species were collected from surface, midwater and bottom trawls within the eastern Chukchi Sea. Linear mixed effects models were used to detect possible variation in the relationship between body length and either $\delta^{13}C$ or $\delta^{15}N$ among water masses and years for each fish species. Additionally, we examined the community isotopic niche space, trophic redundancy, and trophic separation in each water mass as measures of resiliency of the food web. We present preliminary results on the ontogenetic, temporal, and spatial variability in the trophic roles of sixteen fish species, including saffron cod (*Eleginus gracilis*), Arctic cod (*Boreogadus saida*), and capelin (*Mallotus villosus*), as well as community-wide measures of isotopic niche space. Examining how spatial gradients in trophic roles are linked to environmental drivers can provide insight into potential community shifts with a changing climate.

Environmental DNA Assessment of Marine Life in the Beaufort Sea of Alaska

Todd Sformo
North Slope Borough, Todd.Sformo@north-slope.org
John Bickham
Battelle Memorial Institute (BMI), bickhamj@battelle.org
Adam Crawford
BMI, CrawfordJA@battelle.org
Elizabeth Montano
BMI, montanoe@battelle.org
Donald Stoeckel
BMI, STOECKELD@battelle.org
Gregory Durell
BMI, durellg@battelle.org
John Hardin
BMI, Hardinj@battelle.org

Environmental DNA (eDNA) was used for marine species identification in an arctic lagoon (Elson Lagoon) along Alaska's Beaufort Seacoast under varying seasonal conditions. In this study, molecular analyses that targeted the cytochrome c oxidase subunit I gene (COI) were used for species identification in eDNA samples. Specifically, a qPCR-based assay detected pink salmon, a SNP (single nucleotide polymorphism) assay detected multiple species of coregonids, and COI-sequence-based phylogeny analysis identified broader taxonomic diversity in eDNA isolated from water samples collected throughout spring and summer months. The molecular methods identified species consistent with arctic aquatic environments, including important subsistence fish (whitefish, ciscos, and salmon), as well as other fish, clams, multiple worm species, algae, waterfowl, and marine mammals (cetaceans and pinnipeds). Both timing and presence of fish detected by molecular methods matched catch records from local subsistence fishermen (gill net) and from scientific sampling (fyke net) from these arctic water bodies. The results demonstrate how eDNA can be used for ecological and biodiversity monitoring in difficult to access and understudied environments such as remote freshwater, estuarine, and marine ecosystems in Alaska and other arctic regions.

Arctic - Fishes and Fish Habitats

The First Comprehensive Assessment of the Community Structure and Habitat Associations of Demersal Marine Fishes in the Canadian Beaufort Sea

Andrew Majewski,
Fisheries and Oceans Canada (DFO), andrew.majewski@dfo-mpo.gc.ca
Sheila Atchison
DFO, sheila.atchison@dfo-mpo.gc.ca
Jane Eert
DFO, jane.eert@dfo-mpo.gc.ca
Shannon MacPhee
DFO, shannon.macphee@dfo-mpo.gc.ca
James Reist
DFO, jim.reist@dfo-mpo.gc.ca
Robert Young
DFO, robert.young@dfo-mpo.gc.ca

Marine fishes play a critical role in energy transfer from lower (e.g., zooplankton, epibenthic invertebrates) and upper (e.g., seals, beluga) trophic levels in Arctic marine ecosystems. However, the distributions, habitat requirements and community structure of many Beaufort Sea marine fishes are not known, precluding effective regulatory management of hydrocarbon development in the region. Fisheries and Oceans Canada, Arctic Aquatic Research Division, led the first-ever comprehensive baseline investigation of offshore marine fishes and habitats in the Canadian Beaufort Sea during 2012 and 2013 as part of the Beaufort Regional Environmental Assessment (BREA). Benthic trawling was conducted at 90 stations spanning 20-1,500 m depths across the southern Canadian Beaufort Sea and Amundsen Gulf to establish baselines for fish diversity and relative abundances. Concurrent sampling of oceanographic parameters and sediment composition was also conducted at each fishing location. Fish community structure was assessed amongst all stations using hierarchical clustering methods and non-parametric multi-dimensional scaling (nMDS) to determine the presence of discrete species assemblages. Habitat parameters including depth, near-bottom salinity and temperature, and sediment grain size were assessed as explanatory variables for fish community structure using a non-parametric statistical approach. Herein, results are discussed in the context of regional-scale watermass structure, circulatory patterns and sediment composition. New information on the community structure and habitat associations of Beaufort Sea marine fishes informs regulatory processes associated with oil and gas exploration and development. Accrued knowledge and baselines will also aid in mitigation and conservation efforts by enhancing our ability to monitor and predict the effects of hydrocarbon development and climate change on this pivotal ecosystem component. Increased knowledge of key fish species and their habitat associations also provide a basis for oceans management and fisheries protection activities.

Latitudinal and Size-based Variation in the Diet of Arctic Cod in the Eastern Chukchi Sea

Andy Whitehouse
University of Washington (UW), gaw@uw.edu
Troy Buckley
NOAA Alaska Fisheries Science Center, troy.buckley@noaa.gov
Caroline Robinson
UW, caroline.robinson@noaa.gov
Kimberly Sawyer
UW, kimberly.sawyer@noaa.gov

Arctic cod (*Boreogadus saida*) is a nodal species in Arctic marine food webs. It preys on a variety of zooplankton and benthic-oriented prey, and is itself an important prey item for many birds, marine mammals, and fishes. We present here the diet composition of Arctic cod collected throughout the eastern Chukchi Sea during the summer of 2012. Arctic cod were collected from the continental shelf waters of the eastern Chukchi Sea during a bottom-trawl survey conducted as part of the Arctic Ecosystem Integrated Survey (Arctic Eis). A total of 714 Arctic cod were collected from 57 different hauls, covering a latitudinal range from 65.75 to 73°N. Predator specimens ranged in size from 5.7 to 19.3 cm fork length (mean 11.2 cm). Qualitative analysis of diet composition indicated Arctic cod diet varied with predator size (FL) and location in the eastern Chukchi Sea. Fish were a more important prey item in the southern Chukchi Sea, while in the northern Chukchi Sea copepods were of greater importance. The proportion of euphausiids in the diet decreased with increasing latitude across the entire study region. In the northern Chukchi Sea, the proportion of benthic-oriented prey in the diet, such as gammarid amphipods, increased with predator size, while the importance of copepods decreased with predator size. Additionally, we used multivariate statistical techniques to help explain and test the significance of the observed differences in diet across size and location.

Diet Compositions and Trophic Guild Structure of the Demersal Fish Community of the Eastern Chukchi Sea

Andy Whitehouse
University of Washington, gaw@uw.edu
Troy Buckley
NOAA Alaska Fisheries Science Center, troy.buckley@noaa.gov

The description of predator food habits is an essential part of understanding predator-prey relationships and improving our understanding of ecosystem function. Fishes are an important prey item for many upper level predators; however, information on the trophic ecology of groundfishes in the eastern Chukchi Sea is limited. Here we report on the diet compositions of 39 fish species occurring in the eastern Chukchi Sea. Fishes were collected from trawl surveys conducted during the summer of 2012 as part of the Arctic Ecosystem Integrated Survey (Arctic Eis). Predator specimens were preserved at sea and shipped back to the lab for analysis. Prey items from each stomach were identified to the lowest practical taxon, enumerated, and weighed. Some of the more important prey items included several species of fish, shrimp, copepods, amphipods, and polychaetes. Predator sample sizes ranged from very low (n = 1) for rarely encountered species, to greater than 100 for more ubiquitous species. For fish species with adequate sample size, we used a cluster analysis to identify significant guilds of species with similar trophic relationships. Clustering species of similar food habits together can help support an ecosystem-based approach to resource management by simplifying an otherwise complex web of species interactions, to interactions between discrete functional groupings. Our results may also help direct future sampling efforts by identifying trophic guilds for which previously sampling has been adequate, and those in need of greater focus.

Arctic - Fishes and Fish Habitats

Demersal Communities on the Shelf of the U.S. Beaufort Sea

Brenda Norcross
University of Alaska Fairbanks (UAF), bnorcross@alaska.edu
Brenda Holladay
UAF, baholladay@alaska.edu

Demersal fish communities were surveyed on the shelf of the US Beaufort Sea during August–September 2011. Each haul with a small bottom trawl sampled an average 375 m^2 of sea floor. Twenty-nine fish taxa were caught between 145.09°W and 154.97°W and in depths of 10–223 m. Taxa richness was highest west of 152°W and at depths shallower than 150 m. As many as 16 and as few as zero fish taxa were captured in individual hauls. The species accumulation curve was still increasing at 81 hauls, indicating the number of taxa in the area may actually be higher than 29. That fact is further indicated by the high indices of Simpson's diversity in most of the hauls. Clustering led to the assignment of six fish community groups that characterized the broad area sampled. One aggregate community included 40 hauls, whereas there were three communities that contained only two to five hauls, and two communities containing 11 and 19 hauls. Fish communities were closely related to the depth in which they were found. Stations > 150 m were distinctly separate from the shallower stations. The shallowest stations, 10–25 m formed their own group, whereas stations 26–100 m encompassed the large aggregate community and were not different from each other.

Snow Crab (*Chionoecetes opilio*) Ecology in the Alaskan Arctic

Lauren Divine
University of Alaska Fairbanks (UAF), lmdivine@alaska.edu
Katrin Iken
UAF, kbiken@alaska.edu
Bodil Bluhm
University of Tromso, bodil.bluhm@uit.no
Robert Foy
NOAA, Alaska Fisheries Science Center (AFSC), robert.foy@noaa.gov
Bob Lauth
AFSC, robert.lauth@noaa.gov
Brenda Norcross
UAF, bnorcross@alaska.edu
Kerim Aydin
AFSC, kerim.aydin@noaa.gov
Andy Whitehouse
AFSC, andy.whitehouse@noaa.gov

Warming trends and associated sea ice loss have resulted in a contraction of the commercially exploited stock of snow crabs (*Chionoecetes opilio*) in the Bering Sea, raising concerns of dispersal and migration dynamics, as well as connectivity among populations in the Bering, Chukchi, and Beaufort seas. To better predict the impacts of climate change on population characteristics of high-latitude snow crabs, an intense collaborative effort has been made in the Chukchi and Beaufort seas to establish a baseline of information regarding Arctic snow crab ecology. Briefly, we addressed questions regarding distribution and abundance, female fecundity and reproductive potential, and trophic ecology. Snow crabs are much more abundant across the Chukchi shelf (> 300,000 km^{-2} maximum in the southern Chukchi) than the Beaufort Sea shelf (< 10 km^{-2}). Snow crabs in the Beaufort Sea mostly occupy deeper shelf and slope habitats (> 200 to 1000 m); the Chukchi Sea slope was not sampled. Male and immature females are smaller in the Chukchi (up to 90 mm carapace width: CW) than those in the Beaufort Sea (up to 130 mm CW). Mature females have not been collected from the Beaufort Sea, but mature females in the Chukchi Sea are slightly smaller when compared with the long-term dataset for mature females in the eastern Bering Sea. Female fecundity is positively correlated to body size in the Chukchi Sea, and data are still lacking for mature females in the Beaufort Sea. Snow crabs occupy an intermediate trophic position within the benthic food web across the Chukchi and Beaufort Seas, based on δ^{13}C and δ^{15}N stable isotopes. Regional diet differences based on stomach content analysis occur and are presumably related to both regional prey availability and crab sizes. Predation on snow crabs seems generally low for high arctic crabs, but cannibalism on younger conspecifics may play a larger role in Chukchi crabs than Beaufort crabs. Together, these data provide a holistic view of high Arctic snow crab ecology on which to base future management decisions, such as through the Arctic Fisheries Management Plan.

Arctic - Fishes and Fish Habitats

SHELFZ Project: Pelagic Fish and Macrozooplankton in the Eastern Chukchi Sea

John Horne
University of Washington (UW), jhorne@uw.edu
Sandra Parker-Stetter
UW, slps@uw.edu
Hannah Linder
UW, lindeh@uw.edu
Jennifer Nomura
UW, jmnomura@uw.edu

The Shelf Ecology and Habitat of Fish and Zooplankton (SHELFZ) project examined aquatic organism distributions in the transition from nearshore (≤ 20 m) to offshore (≥ 20 m) waters over the Barrow Canyon in the eastern Chukchi Sea. As one component of the project, pelagic fish and macrozooplankton density distributions were quantified during daylight hours using active acoustics (38 and 120 kHz) and midwater trawls. Data were collected along 6 parallel transects between Wainwright and Barrow, AK oriented orthogonal to the coast and spaced 18 km apart. Dominant fish species in both areas included Arctic cod (*Boreogadus saida*) and Arctic staghorn sculpin (*Gymnocanthus tricuspis*), with capelin (*Mallotus villosus*) present in the offshore. A suite of five descriptive metrics were used to characterize vertical distributions of fish and zooplankton along sampled transects. Metrics included: relative density (S_a, dB re 1 $m^2 m^{-2}$), proportion of water column occupied (Oc, %), aggregation (AI, m^{-1}), dispersion (I, m^{-2}), and center of mass (CM, m). High acoustic backscatter was observed very near shore and along the north side of the Barrow Canyon. Fish occupied more of the water column compared to zooplankton, with zooplankton being more aggregated and typically closer to the bottom except in the shallowest depths. Transitions in pelagic fish and macrozooplankton densities or distributions from nearshore to offshore waters were not as strong as predicted, even with the presence of Barrow Canyon.

Energetic Value of Prey Species Utilized by Black Guillemots (*Cepphus grylle*) on Cooper Island, an Arctic Barrier Island

Ann Robertson
Under contract to NOAA Alaska Fisheries Science Center, ann.robertson@noaa.gov
George Divoky
Friends of Cooper Island, divoky@cooperisland.org
Kevin Boswell
Florida International University, kevin.boswell@fiu.edu
Ron Heintz
NOAA, Alaska Fisheries Science Center (AFSC), ron.heintz@noaa.gov
Johanna Vollenweider
AFSC, johanna.vollenweider@noaa.gov
John Moran
AFSC, john.moran@noaa.gov
Mark Barton
Florida International University, mbart034@fiu.edu

Changes in the availability of certain fish species may affect foraging strategies of black guillemots (*Cepphus grylle*) during the summer breeding season in the Arctic. Preferred guillemot prey such as ice-associated Arctic cod (*Boreogadus saida*) may become less accessible to foraging guillemots as Arctic sea ice retreats to its summer minimum; this inaccessibility may prompt guillemots to rely on less-favored prey species like fourhorn sculpin (*Myoxocephalus quadricornis*) to support growing chicks. In order to investigate differences in the caloric value of two prey species utilized by guillemots nesting on an Arctic barrier island, samples of Arctic cod and fourhorn sculpin were collected over two summers (2013-2014) near Barrow, Alaska. In 2013, fourhorn sculpin were collected adjacent to Cooper Island from Elson Lagoon and the western Beaufort Sea, water masses known to support foraging activities of black guillemots, as well as from the eastern Chukchi Sea. Arctic cod were collected at Cooper Island from foraging guillemots returning to the nesting colony. Samples of comparable size (80-160 mm) were analyzed for energy density and percent moisture to assess nutritional condition. The average energy density (kJ/g dry mass) of Arctic cod was 12.6% greater than that of fourhorn sculpin, indicating that Arctic cod are a somewhat more valuable prey item and foraging guillemots may sacrifice calories when selecting more accessible nearshore prey like fourhorn sculpin; this cost may be offset by the lower foraging effort required to collect nearby prey. Analysis of fish collected by net sampling in the same water bodies in 2014 will provide information on the gross energy of individual fish and describe possible moisture loss that occurs when prey are carried to the nesting colony.

Arctic - Fishes and Fish Habitats

Variation Between Active Acoustic and Net-based Sampling Gears in an Arctic Lagoon in Barrow, AK

Samuel George
NOAA, National Marine Fisheries Service, sjgeorge34@yahoo.com
Mark Barton
Florida International University (FIU), mbart034@fiu.edu
Ann Robertson
Under contract to NOAA Alaska Fisheries Science Center, ann.robertson@noaa.gov
Kevin Boswell
FIU, kevin.boswell@fiu.edu
Todd Sformo
North Slope Borough (NSB), Todd.Sformo@north-slope.org
Lynette Hepa
NSB, Lynette.Hepa@north-slope.org
Ron Heintz
NOAA, Alaska Fisheries Science Center (AFSC), ron.heintz@noaa.gov
John Moran
AFSC, john.moran@noaa.gov
Johanna Vollenweider
AFSC, johanna.vollenweider@noaa.gov

Climate change and increased interest in the commercialization of undeveloped portions of the Arctic Ocean raises concerns of how coastal ecosystems will be affected. Though baselines that will help quantify these effects have been established in many habitats of the Arctic Ocean, the Arctic nearshore is less well-studied due to its inaccessibility and harsh conditions. In recent years, decreases in sea ice have made the nearshore more accessible, leading to an increase in fisheries studies to establish community baselines, but it is unclear which sampling gear types provide the best description of the targeted biological communities. Active acoustics can be used for non-invasive sampling, often capturing fish that might otherwise leave the sampling area before other gear types are ready to start sampling, but net-based methods allow for better identification of species and retention of samples for laboratory analyses. We compare and contrast catch composition and catch-per-unit-effort (CPUE) between data collected using an imaging sonar (Sound Metrics ARIS) and samples collected by beach seine and fyke net in the Elson Lagoon in Barrow, Alaska.

Temporal and Spatial Variability of Nearshore Fish Communities in Three Arctic Nearshore Habitat Types in Barrow, AK

Mark Barton
Florida International University (FIU), mbart034@fiu.edu
Kevin Boswell
FIU, kevin.boswell@fiu.edu
Ron Heintz
NOAA Alaska Fisheries Science Center (AFSC), ron.heintz@noaa.gov
John Moran
AFSC, john.moran@noaa.gov
Johanna Vollenweider
AFSC, johanna.vollenweider@noaa.gov
Ann Robertson
AFSC, ann.robertson@noaa.gov

The rapidly changing climatological conditions in the Arctic have raised awareness of the potential risks that nearshore ecosystems face, particularly given their presumed role as critical nurseries and foraging grounds for a multitude of marine species, in addition to subsistence use by coastal communities. Coincident with changing climate is an increased interest in oil and gas development within the region. Central to these concerns is the paucity of information accumulated to date, and in particular a baseline for which to examine biological and ecological changes. It is therefore imperative to understand the ecosystem function of these nearshore areas prior to significant development in the coastal zones. In response we examined multi-year community-level variation in the Pt. Barrow region based on collections of beach seine data comprising 12 stations distributed among three different water bodies (Chukchi Sea, Beaufort Sea, and Elson Lagoon) during the summer season. In addition, we examined weekly physicochemical parameters (water temperature, salinity, turbidity, and wind velocity) during two consecutive summer seasons (2013-2014). Analyses indicate that the warmer/windier conditions (2013) favored dominance in relative catch by Pacific sand lance (53%), Osmeriids (22%), and sculpins (12%); whereas calmer/colder (2014) conditions favored Pacific sand lance (29%) and sculpins (63%) with a notable relative decrease in sand lance and capelin. The episodic pulsing of forage contributed to the greatest dissimilarity, suggesting that physicochemical parameters are important drivers in nearshore forage fish abundance. We examine the temporal scale at which community structure changes in response to these drivers, and compare this to data collected in the summers of 2007-2009, and 2012. A better understanding of the scales of temporal and spatial variability in nearshore community structure will improve our accuracy in linking these changes to Arctic climate change.

Energetic Content of Alaskan Arctic Forage Species

Johanna Vollenweider
NOAA, Alaska Fisheries Science Center (AFSC), johanna.vollenweider@noaa.gov
Ron Heintz
AFSC, ron.heintz@noaa.gov
John Moran
AFSC, john.moran@noaa.gov
Ann Robertson
NOAA Fisheries Affiliate, Ann.Robertson@noaa.gov

Understanding Arctic food web dynamics in the face of climate change is dependent upon accurate measures of energy content. We analyzed more than 17 species of Arctic forage fish for energy content using bomb calorimetry. Fish were collected during the ice-free season in 2005, 2007, and 2012-2014 from a variety of projects, including the Arctic Coastal Ecosystem Survey (ACES), Arctic Eis, and Shelf Ecology and Habitat of Fish and Zooplankton (SHELFZ). Samples span a grid of approximately 1,500 km from the mouth of the Yukon River to the edge of the sea ice extent north of Barrow, Alaska, and 500 km from the shoreline of Alaska to the Russian Border. Arctic cod (*Boreogadus saida*) were among the most energy rich species, as well as Pacific herring (*Clupea pallasii*), Pacific sand lance (*Ammodytes hexapterus*), capelin (*Mallotus villosus*) and several species of eelpouts (*Lycodes palearis*, *L. polaris*, *L. raridens*, and *L. turneri*). Within species, energy content varied ontogenetically, spatially and temporally. Energy content of fish will be related to environmental variables in an effort to characterize habitat quality.

Limits to Viability of a Critical Arctic Migration Corridor Due to Localized Prey, Changing Sea Ice, and Impending Industrial Development

James Lovvorn
Southern Illinois University (SIU), lovvorn@siu.edu
Aariel Rocha
SIU, aariel.rowan@gmail.com
Stephen Jewett
University of Alaska Fairbanks (UAF), scjewett@alaska.edu
Douglas Dasher
UAF, dhdasher@alaska.edu
Steffen Oppel
Royal Society for the Protection of Birds, Steffen.Oppel@rspb.org.uk
Abby Powell
UAF, abby.powell@alaska.edu

In the Arctic, combined effects of climate change and industrialization pose challenges for habitat conservation. Four species of threatened or declining eider ducks that nest in the Arctic migrate through the northeast Chukchi Sea, where anticipated industrial development may require prioritizing areas for regulation. In this nearshore corridor (10–40 m depth), the eiders' access to benthic prey is restricted to variable areas of open water within sea ice. For the most abundant species, the king eider (*Somateria spectabilis*), stable isotopes in blood cells, muscle, and potential prey indicate that these eiders ate mainly bivalves when traversing this corridor. Bivalves there were much smaller than the same taxa in deeper areas of the northern Bering Sea, probably because of ice scour in shallow water; future decrease in seasonal duration of fast ice may increase this effect. Computer simulations suggested that if these eiders forage for > 15 h/day, they can feed profitably at bivalve densities > $200 m^{-2}$ regardless of water depth or availability of ice for resting. Sampling in 2010–2012 showed that large areas of profitable prey densities occurred only in limited locations throughout the migration corridor. Satellite data in April–May over 13 years (2001–2013) indicated that access to major feeding areas through sea ice in different segments of the corridor can vary from 0–100% between months and years. In a warming and increasingly variable climate, unpredictability of access may be enhanced by greater effects of shifting winds on unconsolidated ice. Our results indicate the importance of maintaining a range of potential feeding areas throughout the migration corridor to ensure prey availability in all years. Spatial planning of nearshore industrial development in the Arctic, including commercial shipping, pipeline construction, and the risk of released oil, should consider these effects of high environmental variability on the adequacy of habitats targeted for conservation.

Assessing Hydrocarbon Sensitivity and Establishing Current CYP1A Baselines in Select Marine Birds and Waterfowl of the Beaufort and Chukchi Seas

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

The Beaufort and Chukchi seas are important habitat for many marine bird species including those of subsistence importance and conservation concern. With prospects of increasing exploration of oil and gas resources and commercial shipping in the Beaufort and Chukchi seas, establishing baselines and assessing sensitivity of Arctic birds to hydrocarbon exposure will provide essential information needed for management and conservation for species potentially impacted by an oil spill or other sources of pollution. Using a broad selection of birds we are using species-specific cell culture to assess hydrocarbon sensitivity by measuring liver cytochrome P450 (CYP1A) activity using 7-ethoxyresorufin-*O*-deethylase (EROD). Currently, we have tested assay reagents (e.g. dimethyl sulfoxide) for non-specific toxicity and used positive control reference reagents (e.g., chrysene) to establish baseline responses for cell lines in selected marine bird and waterfowl species and a control species (mallard, *Anas platyrhunchos*). EROD responses and cellular cytopathic effects for each species were measured after a reagent dose exposure time of 24 hours. Preliminary results indicate differences in species response to positive control reference reagents. Future laboratory work will expand to more species, dose concentrations, reagents and exposure times to evaluate the degree and duration of CYP1A induction. Additional ongoing work includes establishing baselines of current CYP1A activity in livers from three bird species of subsistence importance by validating field sample collection methods and using EROD. King eiders (*Somateria spectabilis),* common eiders (*Somateria mollissima),* and greater white-fronted geese (*Anser albifrons)* will be sampled by direct take or opportunistically from hunters near Barrow, Alaska during spring and fall hunts over two years. Field sampling for year one began in fall 2014 and on gross examination sampled birds were in good body condition and no lesions were noted. Further diagnostic work is planned. Year one liver samples will be analyzed during winter 2014. Cell culture sensitivity and baseline exposure results from this project will provide valuable tools for monitoring marine bird populations, identifying sensitive species, and provide information for future Natural Resources Damage Assessment in the event of an oil spill.

Genetic Characterization of Novel Adenoviruses Isolated from Long-Tailed Ducks (*Clangula hyemalis*)

Katrina Counihan
Alaska SeaLife Center (ASL) , katrinae@alaskasealife.org
J. C. Franson
U.S. Geological Survey, jfranson@usgs.gov
Tuula Hollmen
ASL , tuulah@alaskasealife.org

A mortality event in long-tailed ducks (*Clangula hyemalis*) occurred in 2000 80 km east of Prudhoe Bay, Alaska, due to an adenovirus and, until this die-off, viruses were not known to cause mortality in long-tailed ducks. Adenovirus isolates were obtained from carcasses and live long-tailed ducks at the mortality site and a reference site near Prudhoe Bay. Our current project had four objectives: 1) compare mortality and reference site adenovirus isolates using PCR; 2) sequence the PCR-amplified portion of the hexon gene; 3) conduct cross-neutralization assays on different genotypes; and 4) phylogenetically analyze the hexon sequences. Twenty-one isolates were grown in fibroblasts and amplified with PCR primer sets targeting the hexon gene. Nineteen isolates had a portion of their hexon gene sequenced, and three genotypes were identified. The hexon sequences of 12 isolates were highly similar to one another and assigned to a primary genotype, which phylogenetic analysis suggested were most related to goose adenovirus 4. Four isolates formed a secondary genotype and three formed a tertiary genotype, each genotype contained one of the two reference site isolates. The secondary and tertiary genotypes were not related to any known adenovirus. Several adenovirus isolates representing the different genotypes were tested in cross-neutralization assays with avian adenovirus serogroup I or serogroup II antisera, but no neutralization was observed. The source of the adenovirus infection in long-tailed ducks is unknown, but phylogenetic analysis placed all of the isolates in the *Aviadenovirus* genus. This genus has only been known to infect bird species; therefore, an avian source is likely. Research into the pathogenesis of the primary genotype will lead to a better understanding of how they cause disease and what birds may be at risk. Climate change and increased anthropogenic activity in the Arctic may increase stress on sea ducks in the region and heighten their disease susceptibility. Novel pathogens have the potential to cause high mortality in naïve populations.

Habitat Associations of the Seabird Community in the Northeastern Chukchi Sea

Adrian Gall
ABR, Inc., agall@abrinc.com
Tawna Morgan
ABR, Inc., tmorgan@abrinc.com
Robert Day
ABR, Inc., bday@abrinc.com

Seabirds are associated with marine habitat that varies over space and time on scales much smaller than those found on land. Understanding these species-specific habitat associations can improve our ability to predict interannual variation in the abundance and distribution of seabirds. We examined relationships between oceanography and the distribution and abundance of 8 species of seabirds in the northeastern Chukchi Sea in 2011–2012 as part of a multi-year, interdisciplinary study (Chukchi Sea Environmental Studies Program) supported by ConocoPhillips, Shell Exploration and Production Company, and Statoil. We used ship-based surveys to sample seabird abundance in the Greater Hanna Shoal study area, which extended over ~39,000 km². Concurrently with the seabird surveys, we measured temperature, salinity, and zooplankton abundance at stations located on a systematic grid throughout the study area. The distribution and abundance of all 8 seabird species were associated most strongly with temperature in the top 10 m of the water column, whereas associations with other habitat characteristics varied with the preferred prey and foraging method. Planktivorous seabirds concentrated in areas characterized by Bering Sea water. Those that feed primarily by pursuit diving (auklets and murres) were positively related to the abundance of zooplankton and showed no consistent relationship with oceanographic characteristics other than temperature, whereas those that feed primarily near or on the surface (shearwaters and phalaropes) were positively related to thermal fronts at the surface and had weak relationships with zooplankton abundance. Surface-feeding piscivorous and omnivorous seabirds concentrated in areas characterized by cold meltwater and winter water and had weak relationships with zooplankton abundance. The distribution of seabirds, particularly the planktivorous species, is strongly influenced by advective processes that transport oceanic species of zooplankton from the Bering Sea to the Chukchi Sea. Seabirds appear to use sea surface temperature as a primary environmental cue to locate suitable foraging habitat. For species that forage by diving, information about prey abundance improves predictions of seabird abundance. These models are an important step in understanding species-habitat relationships and providing reliable estimates of seabird distribution and abundance in an area of interest for oil and gas development.

Use of UAS for Photographic Re-identification of Bowhead Whales, *Balaena mysticetus*

William Koski
LGL Limited, Environmental Research Associates (LGL), bkoski@lgl.com
Gayan Gamage
Brican Flight Systems (BFS), gamageg@brican.com
Andrew Davis
LGL, adavis@lgl.com
Tony Mathews
BFS, mathewst@brican.com
Bernard LeBlanc
Fisheries and Oceans Canada (DFO), Bernard.LeBlanc@dfo-mpo.gc.ca
Steven Ferguson
DFO, Steve.Ferguson@dfo-mpo.gc.ca

Unmanned aerial systems (UAS) have the potential to collect high resolution photographs of marine mammals for life-history studies without disturbing the species being studied. We conducted a pilot study near Igloolik, Nunavut, in early July 2013 to collect identification-quality photographs of bowhead whales (*Balaena mysticetus*) and record the responses of the whales to overflights by an UAS. Operating under a restrictive line-of-sight permit from Transport Canada, we successfully collected high quality photographs of bowhead whales and none of the whales overflown responded to the overflights in an observable manner. If the UAS were operated under a beyond-line-of-sight permit, the UAS could be used to search for whales ahead of and to the side of the survey vessels making it more efficient to find whales to photograph. Even when operating under the restrictive line-of-sight permit, large numbers of whales could be photographed, which would provide important life-history information on this poorly-studied population.

A Circumpolar Assessment of Arctic Marine Mammals and Sea Ice Loss, with Conservation Recommendations for the 21st Century

Kristin
University of Washington Seattle (UW), klaidre@apl.washington.edu
Harry Stern
UW, harry@apl.washington.edu
Kit Kovacs
Norwegian Polar Institute (NPI), Kit.Kovacs@npolar.no
Lloyd Lowry
University of Alaska Fairbanks, llowry@hawaii.rr.com
Sue Moore
NOAA, National Marine Fisheries Service, sue.moore@noaa.gov
Eric Regehr
U.S. Department of Fish & Wildlife Service, Eric_Regehr@fws.gov
Steven Ferguson Fisheries and Oceans Canada, steve.ferguson@dfo-mpo.gc.ca
Øystein Wiig
University of Oslo, oystein.wiig@nhm.uio.no
Peter Boveng
NOAA, Alaska Fisheries Science Center (AFSC), peter.boveng@noaa.gov
Robyn Angliss
AFSC, robyn.angliss@noaa.gov
Erik Born
Greenland Institute of Natural Resources (GINR), ewb@ghsdk.dk
Dennis Litovka
ChukotTINRO, d-litovka@yandex.ru
Lori Quakenbush
Alaska Department of Fish & Game, lori.quakenbush@alaska.gov
Christian Lydersen
NPI, christian.lydersen@npolar.no
Dag Vongraven
NPI, dag.vongraven@npolar.no
Fernando Ugarte
GINR, feug@natur.gl

Arctic marine mammals (AMMs) are considered icons of climate change, largely because of their close association with sea ice. However, neither a circumpolar assessment of AMM status nor a standardized metric of sea ice habitat change is available. We summarize available data on abundance and trend for each AMM species and recognized subpopulation. We also examine species diversity, the extent of human use, and temporal trends in sea ice habitat for 12 regions of the Arctic by calculating the dates of spring sea ice retreat and fall sea ice advance using satellite data (1979-2013). Estimates of AMM abundance vary greatly in quality and few studies are long enough for trend analysis. Of the AMM subpopulations, 78% (61 of 78) are legally harvested for subsistence purposes. Changes in sea ice phenology have been profound with earlier retreat and later advance in all regions except the Bering Sea. From 1979-2013, the duration of the summer (i.e., reduced-ice) period increased by 5 to 10 weeks over most of the Arctic, and by > 20

weeks in the Barents Sea. In light of generally poor data, the importance of human use, and forecasted environmental changes in the 21st century, we make the following recommendations for effective AMM conservation: 1) maintain and improve co-management by local, federal, and international partners; 2) recognize spatial and temporal variability in AMM subpopulation response to climate change; 3) implement monitoring programs with clear goals; 4) mitigate cumulative impacts of increased human activity, and 5) recognize the limits of current protected species legislation.

The Effect of Changing Sea Ice Conditions on Land Use Patterns of Chukchi Sea Polar Bears

Karyn Rode
U.S. Geological Survey, Alaska Science Center (USGS), krode@usgs.gov
Ryan Wilson
U.S. Fish and Wildlife Service (USFWS), r_r_wilson@fws.gov
Michelle St. Martin
USFWS, michelle_stmartin@fws.gov
Eric Regehr
USFWS, eric_regehr@fws.gov
Dave Douglas
USGS, david_douglas@usgs.gov
Jay Olson
Brigham Young University, jayolson7@gmail.com

As Arctic sea ice loss has occurred, polar bears (*Ursus maritimus*) have increasingly spent time on shore in several parts of their range. Where that has occurred there have been negative consequences for polar bears and changes in inter-specific interactions with potential cascading ecological effects. Polar bears that come onshore eat some terrestrial foods, but primarily fast and use body reserves such that increased time onshore has resulted in declines in body condition. Here, we investigated the importance of land habitats for a remote polar bear population occupying the Chukchi Sea – one of the least studied populations in the world. We compared land use patterns between 1986-1994 and 2008-2013 and related land use to sea ice conditions for adult females fit with satellite radio collars. These data included 109 and 48 bear-years of data for the two time periods, respectively. Forty-percent of Chukchi Sea polar bears spent 95% of their time on the sea ice supporting that a segment of the population relies almost exclusively on the sea ice. However, 75% of denning occurred on land during both time periods indicating that land has been and continues to be a key denning habitat. The proportion of bears summering on land increased from 19% to 37.5% between the two time periods. Both denning and non-denning bears spent 3-5 weeks longer on land. The duration a bear was onshore was related to the availability of ice over the continental shelf during the annual sea ice minimum. Denning on the Alaskan coast declined by 14% during the study. This change corresponded with an earlier retreat of sea ice from the Alaskan coast and an observed relationship between the timing of sea ice retreat from coastlines and locations of terrestrial dens. Thus, land use patterns of Chukchi Sea polar bears have changed in recent years. Despite those changes, body condition and reproduction were maintained during the course of this study. However, the observed relationships between duration on land and sea ice conditions suggest that Chukchi Sea polar bears may continue to spend increasing durations on land during the summer and for denning with unknown long-term consequences.

Physiological Constraints to Diving: Defining the Capacity of Belugas to Alter Foraging Behaviors in Response to Habitat Degradation

Shawn Noren
University of California, Santa Cruz, snoren@ucsc.edu

Recent alterations in the Arctic, including reduced sea ice and increased industrial exploration, are poised to alter prey and habitat availability for marine mammals, including beluga whales (*Delphinapterus leucas*). Indeed, belugas were designated with the second highest ranking for negative impacts from disturbance and habitat degradation from oil and gas exploration. Quantification of the physiology that supports diving provides for calculations of aerobic dive limits (cADLs) that define marine mammals' abilities to increase submerged search times and dive depths, as is typically needed when hunting in marginal habitats. However, when marine mammals are already operating at their physiological capacities they have little behavioral flexibility to adapt to new environmental regimes, which can affect body condition and have population level effects. It is unknown how beluga populations will respond to having to forage in marginal habitats. In this study, age-specific body oxygen stores in the blood of belugas will be determined from historical records of hemoglobin content from belugas housed at Shedd Aquarium. To date 986 longitudinal sample points have been collected from 9 belugas (4 males and 5 females), ranging in age from newborn to 25 years-old. Age-specific body oxygen stores in the muscle of belugas will be determined from measuring the myoglobin content of muscle samples collected in collaboration with Pt. Lay, Alaska subsistence hunts of belugas of the North Slope Borough. During the 2014 summer harvest, 16 belugas were sampled (2 adult males, 3 adult females, 8 immature males, and 3 immature females). These physiological data are the cornerstone for calculating age-specific caDLs. Comparisons of these limits to published dive durations of free-ranging belugas will provide an index of how closely belugas are operating at their physiological capacities. This assessment will enable management agencies to consider potential outcomes of environmental perturbations on populations of belugas and could be used for defining critical habitats for this species.

Pacific Walrus Monitoring

Lori Polasek
Alaska SeaLife Center, lorip@alaskasealife.org

Pacific walruses (*Odobenus rosmarus divergens*) haul out by the thousands in specific areas throughout western Alaska. Male walruses display high site fidelity, frequenting the same beaches year after year. This provides an opportunity to monitor them using fixed position still cameras. The camera images collected allowed determination of walrus abundance and density without the excessive cost, risk, and logistics associated with hand counts by field crews. Serial images from these cameras were analyzed to determine disturbance mechanisms, impact, and time for recovery to a haulout. These camera observations were a non-invasive means to collect long term data with little to no disturbance to the study animals. Anthropogenic disturbances such as boats on the water, boats landing on the beach, human foot traffic, and aircraft were recorded as well as natural disturbances by bears. Several aspects of the project will be presented and may include: disturbance detection comparison from still images alone to still images with the addition of acoustic detectors, abundance numbers, and comparisons of types of count methods.

Regional Diving Behavior of Pacific Arctic Beluga Whales Relative to Water-column Prey

Donna Hauser
University of Washington (UW), dhauser@uw.edu
Kristin Laidre
UW, klaidre@uw.edu
Sandra Parker-Stetter
UW, slps@uw.edu
John Horne
UW, jhorne@uw.edu
Robert Suydam
North Slope Borough, Robert.Suydam@north-slope.org
Pierre Richard
Fisheries and Oceans Canada, Pierre.Richard@dfo-mpo.gc.ca

Beluga whales (*Delphinapterus leucas*) make extensive seasonal migrations in the Pacific Arctic, yet there is limited information on population-specific behavior and how diving varies by region. We used satellite tags equipped with time-depth recorders, attached to 30 individuals from two populations from 1997-2012, to assess how beluga whales use the water column by quantifying a suite of diving metrics. In the eastern Beaufort Sea, we also estimated vertically integrated densities of a presumed primary prey item, age 1+ Arctic cod (*Boreogadus saida*), based on an acoustic survey conducted in August 2008. We used generalized linear mixed models (GLMMs) to test how beluga whales dive behaviors in the survey area related to the vertical distribution of Arctic cod. Dive behavior varied among regions and between populations. Maximum and mode dive depths within 6-h periods suggested that Eastern Chukchi Sea (ECS) and Eastern Beaufort Sea (BS) beluga whales were regularly diving to the seafloor in the Chukchi and Bering seas, while more pelagic diving was common in Barrow Canyon, along slope margins of the Beaufort Sea, and in Canada Basin. Maximum dive durations were greater for ECS than BS belugas and often > 20 min. Maximum daily depths recorded for 6 ECS tags also significantly varied regionally, with depths > 900 m recorded in Canada Basin. Arctic cod in the eastern Beaufort Sea were most abundant in the 200-300 m portion of the water column and dive behaviors of ECS belugas located within the area targeted these same depths. Our GLMMs revealed that the number of beluga whale dives to 200-300 m were significantly related to Arctic cod density within 200-300 m and water depth. As cod density within
200-300 m increased, the number of beluga dives to that depth decreased and suggested that belugas need to dive less frequently when Arctic cod are abundant. These results are consistent with the hypothesis that Arctic cod are a primary prey item for Pacific Arctic belugas and that foraging belugas dive to depths that maximize prey availability relative to the energetic cost of diving.

Beluga Whale (*Delphinapterus leucas*) Vocalizations from the Eastern Beaufort Sea Population

Ellen Garland
NOAA, Alaska Fisheries Science Center (AFSC), Ellen.Garland@noaa.gov
Catherine Berchok
AFSC, Catherine.Berchok@noaa.gov
Manuel Castellote
AFSC, manuel.castellote@noaa.gov

Graded call systems are challenging to categorize in a meaningful way. Beluga whales (*Delphinapterus leucas*) are notoriously vocal with multiple call types that blend from one type into another on a continuum of calls. Here, we present the first description of spring 2011 vocalizations from the eastern Beaufort Sea beluga population using both a non-parametric classification tree analysis (CART) and a Random Forest analysis. Twelve frequency and duration measurements were made on 1,019 calls, and resulted in 34 different call types with 83% agreement in classification for both CART and Random Forest analyses. This high-level of agreement in classification with a manual classification of calls into 36 categories provides a robust set of methods for analyzing graded call systems. Further, these methods provide a more comprehensive analysis of data collected through passive acoustic monitoring methods, where calls cannot be attributed to individuals, and thus the amount of pseudo-replication of calls from individuals is unknown. This study provides a description of the partial vocal repertoire of the eastern Beaufort Sea beluga population, which can be used for understanding beluga population structure in the rapidly changing Arctic. [Work supported by the Bureau of Ocean Energy Management and National Research Council]

Bowhead Whale Earplug Exposes Lifetime Chemical Profiles

Stephen Trumble
Baylor University, stephen_trumble@baylor.edu

The bowhead whale (*Balaena mysticetus*) is the only baleen whale (Mysticeti) to spend its entire life in and around Arctic waters and while this species has been a part of Arctic life for decades, little is known about its chemical life history. Lifetime contaminant and hormonal profiles have been reconstructed for an individual female bowhead whale using the earplug collected during subsistence harvests in 2013. These unprecedented lifetime profiles included a wide range of analytes including cortisol (stress hormone), progesterone (pregnancy hormone), and organic contaminants (e.g., pesticides and flame retardants). Lamina counts were identified as lighter and darker layers with the lighter layers having twice the lipid concentrations (53%) than the darker layers (25%). An inconsistent pattern of lamina was detected throughout the 1 kg earplug. Lamina counts revealed an estimated age between 46 and 49 years of age. Cortisol lifetime profiles revealed possible seasonal trends. Progesterone profiles suggest possible pregnancy events. Early periods of the reconstructed contaminant profiles demonstrate significant maternal transfer. The use of a whale earplug to reconstruct lifetime chemical profiles will allow for a more comprehensive examination of stress, development, and contaminant exposure, as well as improve the assessment of contaminant use/emission, environmental noise, ship traffic, and climate change on these important marine sentinels.

Bile Collection Technique in Subsistence Harvested Beluga Whales (*Delphinapterus leucas*)

Raphaela Stimmelmayr
North Slope Borough (NSB), Raphaela.Stimmelmayr@north-slope.org
Gina Ytalo
NOAA, Northwest Fisheries Science Center, gina.ylitalo@noaa.gov
Leslie Pierce
North Slope Borough (NSB), Leslie.Pierce@north-slope.org
Robert Suydam
NSB, Robert.Suydam@north-slope.org
Taqulik Hepa
NSB, Taqulik.Hepa@north-slope.org

Cetaceans are at significant risk of external and internal oil exposure during a marine oil spill. Analysis of polycyclic aromatic hydrocarbon (PAH) parent compounds/metabolites in bile has been a standard approach to determine PAH exposure in fish. Cetaceans do not have a gallbladder, thus post exposure risk assessment have been limited to tissue concentration studies and activation of the P450 detoxification system (i.e., CYP1A1 expression). Most marine mammals rapidly metabolize and excrete PAH compounds. Thus tissue concentrations are limited indicators of PAH exposure. Demonstrating PAH exposure is an important step in an injury assessment during the Natural Resources Damage Assessment Process. Information on exposure is necessary to interpret data from oil spill injury studies. A proof of concept was conducted during 2014 spring harvest of beluga whales (*Delphinapterus leucas*) in Point Lay, AK to demonstrate that a) bile collection via the hepato-pancreatic duct from beluga whales is a feasible method and b) to determine PAH concentrations for EPA priority PAHs in subsistence harvested Alaskan beluga whales (NMFSC analysis pending). Preliminary Results: Visualization of the external joining of the hepato-pancreatic duct (HPD) with the duodenal wall was variable for the three examined beluga whales (2 white adults; 1 grey subadult). Visualization and access to the HPD was better when the left body side was down. The HPD (diameter ~ 1 cm; length 4-5 cm) enters the duodenum shortly after the pylorus. In two of the belugas the duct was clearly visible, but not discernible in the third animal (white adult). The joining of the hepatic and pancreatic duct can be visualized by cautious deflection of the pancreatic glandular tissue. Quantity of recoverable bile from the HPD/hepatic duct is limited and quite variable between animals (0.5 -1.5 cc); through milking of hepatic tissue additional bile collection is possible. The bile of beluga whales is of a light grass green color and of watery consistence (low viscosity). We thank the community of Point Lay and the hunters for allowing us to conduct the study. Without their efforts and cooperation, this study would not have been possible. Marine mammal tissue collection was under permit NMFS # 17350-00.

First Documentation of Gas Bubbles in Ringed Seals (*Phoca hispida*) Entangled and Drowned in Gill Nets: Two Case Reports

Raphaela Stimmelmayr
North Slope Borough, Raphaela.Stimmelmayr@north-slope.org
Anne Riddle
Alaska SeaLife Center, annr@alaskasealife.org

Gas bubble disease (aka “the bends”; decompression sickness) in marine mammals has been reported in association with naval sonar activities and by catch. We describe gas bubble lesions in two adult ringed seals (*Phoca hispida*) entangled and drowned in gill nets at shallow depths (~ 6 feet) in 2014 from Eilson Lagoon, Barrow, Alaska. Time elapsed between necropsy and time of removal from water was at a maximum 12 hours. Seals were stored outside (ambient temperature ~ 0- 5 degrees) and or refrigerated. Time of death was estimated to be within a 24 hour period or less; criteria for estimation of time of death included daily net set checking times, cold to the touch body temperature of seals, non-hemolized appearance of serum from spun blood, and general lack of rigor. Standard necropsy procedure was followed and vessels and capsules were screened for bubbles. Bubbles were photographed but not sampled. Intravascular bubbles, ranging from single large to multiple small bubbles were grossly observed in the following veins: *hepatic sinus*; *vena cava caudalis, renal plexus, adrenal vein*, and *mesenteric veins*. For the latter, intravascular gas emboli had displaced blood, giving rise to alternating clear bubbles and “blood beading” in one case. Bubbles were also observed within the *pericardial veins* and mixed with blood inside of the heart. Eyeballs were inflated in both cases and a single large displaceable gas bubble was present in the anterior chamber of one animal. Subcapsular bubbles were observed for kidney, pericardium, and within the soft retrobulbar tissue. Post-mortem off gassing from supersaturated tissues is the current proposed hypothesis to explain existence of gas bubbled in by caught pinnipeds that died at depth. Our animals did not die at depth, thus post mortem off gassing is an unlikely mechanism. Routine super saturation in foraging diving marine mammals has been proposed. To test the hypothesis gas bubble sampling and composition analysis is required.

Inter-annual Variability in the Fall Movements of Bowhead Whales in the Chukchi Sea

John Citta
Alaska Department of Fish & Game (ADFG), john.citta@alaska.gov
Lori Quakenbush
ADF&G, lori.quakenbush@alaska.gov
Stephen Okkonen
University of Alaska Fairbanks, okkonen@alaska.net
John "Craig" George
North Slope Borough, Craig.George@north-slope.org
Robert Small
ADF&G, bob.small@alaska.gov
Mads Peter Heide-Jorgensen
Greenland Institute of Natural Resources, mhj@ghsdk.dk
Lois Harwood
Fisheries and Oceans Canada, Lois.Harwood@dfo-mpo.gc.ca
Harry Brower
North Slope Borough, harry.brower@north-slope.org

Each fall, the majority of bowhead whales (*Balaena mysticetus*) in the Bering-Chukchi-Beaufort (BCB) population migrate westward, from summering grounds in the Beaufort Sea, through the Chukchi Sea, to the Northern Coast of Chukotka, Russia. The Chukchi Sea is of major interest for oil and gas development and lease areas occur in both Alaskan and Russian waters. Most industrial activity occurs in summer and fall when sea ice is at its seasonal minimum and at a time coinciding with the westward migration of bowhead whales. As such, understanding the timing and direction of whale movements in the Chukchi Sea is important for managing disturbance and mitigating the effects of industrial activities. We used satellite-linked telemetry data from 35 bowhead whales collected between 2006 and 2012 to investigate inter-annual variability in where whales spend time within the Chukchi Sea. We limited our examination to data collected from September through December and used behavioral state-space models to classify whale locations as being associated with lingering, presumably feeding, behavior or directed travel. We then examined how locations associated with feeding behavior were distributed by year. We observed two main migration patterns. The first pattern, observed in 2006, 2008, and 2010, was characterized by a high density of feeding locations near Barrow, Alaska, and along the coast of Chukotka, Russia; whales generally did not linger in the central Chukchi in these years. The second pattern, observed in 2009 and 2012, was characterized by a high density of feeding locations in the central Chukchi. Of particular interest, in 2012 whales spent more time in the central Chukchi Sea, nearer to active oil and gas leases, than near Barrow or along the coast of Chukotka. The timing of movements past Barrow and into the Chukchi Sea is likely related to the presence and density of zooplankton near Barrow. Likewise, the presence of feeding locations in the central Chukchi is inferred to be related to the availability of zooplankton and variation in how oceanographic features, such as currents and fronts, may act to concentrate

zooplankton. We are currently modeling the occurrence of feeding locations as a function of oceanographic variables.

Fat Chance – Uptake, Modification, and Storage of Fatty Acids in Bowhead Whales

Lara Horstmann
University of Alaska Fairbanks (UAF), lara.horstmann@alaska.edu
Craig George
North Slope Borough, craig.george@north-slope.org
Alexandra C. M. Oliveira
UAF, aoliveira@alaskaseafood.org

Analysis of fatty acids (FA) in marine mammal blubber is a popular tool to assess feeding ecology and food web linkages. FA interpretation relies on the assumption of predictable deposition of prey FAs in predator tissues without preferential uptake and substantial modification during digestion. Bowhead whales (*Balaena mysticetus*) are endangered baleen whales (Mysticeti) occupying seasonally ice-covered waters of the Bering, Chukchi, and Beaufort seas. Their diet consists predominately of copepods and euphausiids, and digestion (via microbial fermentation) begins in the forestomach. We sampled intestinal tract contents (forestomach, jejunum, colon), liver, and blubber from 13 bowhead whales taken during Alaska Native subsistence harvests (2011-2013). We then extracted and transesterified lipids from all samples and quantified 67 FAs to determine uptake and modification along the intestinal tract, as well as FA distribution and storage in bowhead whale tissues. FA composition and abundance differed significantly among all tissues (ANOSIM, $p < 0.05$), except jejunum and liver (ANOSIM, $p = 0.23$) indicating FAs taken up in the small intestine are delivered to hepatic short-term storage. FAs most dissimilar between forestomach (indicative of prey) and blubber (long-term storage) were the important primary production biomarkers, 16:1*n*7 and 20:5*n*3 (contribution to mean dissimilarity was 14.2% and 12.3%, respectively). Similarly, 16:1*n*7 and 20:5*n*3 contributed most to the difference between forestomach and liver (15.2% and 13.8% contribution to mean dissimilarity, respectively). Unsurprisingly, abundance of most FAs, in particular essential FAs, declined in the colon compared with forestomach. However, some of the most abundant FAs in the colon were the long chain saturated FAs, 20:0 and 22:0, as well as anteiso 15:0, which did not occur in forestomach samples or other tissues of bowheads. This suggests bacterial/microbial modification of FAs along the gastrointestinal tract. The results of this study show differential uptake, considerable modification, and variable storage of fatty acids in tissues of bowhead whales. Commonly used biomarkers of primary productivity in the Arctic were driving the difference between FA intake from prey and long-term storage in blubber. We therefore caution the use of fatty acids as indicators of food web linkages and diet in bowhead whales.

Results from Hunter-assisted Walrus Studies in Alaska, 2014

Justin Crawford
Alaska Department of Fish & Game (ADFG), Justin.Crawford@alaska.gov
Lori Quakenbush
ADFG, Lori.Quakenbush@alaska.gov
Clarence Irrigoo
Walrus hunter and resident of Gambell, Alaska, no email
Edwin Noongwook
Walrus hunter and resident of Savoonga, Alaska, no email
Joel Garlich-Miller
U.S. Fish and Wildlife Service, joel_garlichmiller@fws.gov

Pacific walruses (*Odobenus rosmarus divergens*) winter in the Bering Sea, but females with young summer in the Chukchi Sea resting on sea ice; most adult males remain in the Bering Sea where they rest on land. The rapid retreat of sea ice is changing summer walrus habitat in the Chukchi Sea and may be changing summer distributions and haulout behavior, requiring that walruses haul out on land instead of ice. In September 2014, the minimum extent of Arctic sea ice was the sixth lowest since satellite records began in 1979. The purpose of this project is to work with subsistence walrus hunters to conduct observations at terrestrial haulouts accessible from coastal communities, train hunters to deploy satellite-linked tags to monitor movements and feeding behavior, and document local knowledge regarding walrus movements, behavior, and use of terrestrial haulouts. In preparation for a potential terrestrial haulout near Point Lay in 2014, local hunters assisted in the placement of camera towers. A large (35,000 walruses) haulout formed near Point Lay in September 2014 and was monitored. Carcass surveys were conducted, when possible, without disturbance to the haulout. Two traditional and local knowledge reports for Wainwright and Point Lay, jointly, and Point Hope are now final and available. We worked with walrus hunters from Saint Lawrence Island to deploy 33 satellite-linked tags on walruses in the Chukchi Sea during a multi-agency walrus research cruise in June. Of the 33 tagged walruses, 31 were females, (12 of which were accompanied by calves of the year) and 2 were adult males. Preliminary data show the highest concentration of tagged walruses during July and August occurred in the Hanna Shoal area in the eastern Chukchi Sea, however areas north of Wrangel Island and along the Beaufort Sea coast of Alaska, and the northern coast of Chukotka were also used. Tagged walruses left Hanna Shoal from the last week of August through the third week of September. All four tags still transmitting in September were located at terrestrial haulouts near Point Lay, Cape Lisburne, or the Chukotka coast near Vankarem, Cape Schmidt or Cape Serdtse-Kamen for at least one day.

Arctic - Mammals

Influence of Sea Ice on Walrus Activity in the Chukchi Sea

Rebecca Taylor
U.S. Geological Survey, Alaska Science Center (USGS), rebeccataylor@usgs.gov
Chadwick Jay
USGS, cjay@usgs.gov
Anthony Fischbach
USGS, afischbach@usgs.gov
Mark Udevitz
USGS, mudevitz@usgs.gov

The Pacific walrus (*Odobenus rosmarus divergens*) uses sea ice to rest upon between feeding bouts to the sea floor of the continental shelf. However, the recent decline in late summer sea ice over the continental shelf has led female and young walruses to haul out onto shore, where they may not be able to obtain enough food nearby. Long foraging trips could be energetically expensive and have population-level consequences, thus activity budgets need to be fully quantified to provide optimal information for bioenergetic models to assess the energy cost of sea ice loss. We measured activity budgets of 151 female walruses in the Chukchi Sea during 2009-2013 to quantify the effect of sea ice availability on the probability of being hauled out of the water, being in the water foraging, or being in the water not foraging. Initial results suggest that on average, when ice was not available nearby, walruses were less likely to be foraging and more likely to be in the water not foraging. Furthermore, they were less likely to haul out of the water when ice was not available, but more likely to remain out of the water once hauled out. However, results varied substantially among individual walruses and individual dates and times of data collection. Our results are consistent with previous unpublished work demonstrating that some walruses travel long distances from shore haul outs to access food at particular times of year. Further analysis will provide parameter estimates for bioenergetic models to predict energetic effects of sea ice loss on walruses.

Marine Mammal Occurrence in the Distributed Biological Observatory (DBO) from Ship-based Visual and Passive Acoustic Surveys

Catherine Berchok
NOAA, Alaska Fisheries Science Center (AFSC), Catherine.Berchok@noaa.gov
Jessica Crance
AFSC, Jessica.Crance@noaa.gov
Brenda Rone
AFSC, Brenda.Rone@noaa.gov
Sue Moore
NOAA Science & Technology, Sue.Moore@noaa.gov

The Alaska Fisheries Science Center, in conjunction with the Pacific Marine Environmental Laboratory has contributed to biophysical sampling in all five regions of the Distributed Biological Observatory (DBO) since 2010, as part of the BOEM-funded CHAOZ, CHAOZ-X, and ARCWEST projects. The DBO is an international collaboration among scientists conducting research in the Bering, Chukchi, and Beaufort Seas, wherein biophysical data (i.e., temperature, salinity, sea ice seasonality and thickness, chlorophyll, nutrients, and zooplankton occurrence) are sampled along a pre-described line of sampling stations whenever possible (see http://www.arctic.noaa.gov/dbo/index.html for more information). Marine mammal sightings and call detections from passive acoustic sampling are also recorded in each DBO region. Here, we describe the occurrence of marine mammals in each DBO region, as obtained from our ship-based visual (25x big-eye and handheld binocular) and passive acoustic (sonobuoy) surveys. The most common species found in each region were: fin whales (*Balaenoptera physalus*) and humpback whales (*Megaptera novaeangliae*) in Region 1 (SW of St. Lawrence Island), gray whales (*Eschrichtius robustus*) in Region 2 (South of Bering Strait), gray, fin, and humpback whales in Region 3 (Point Hope to Bering Strait), walruses (*Odobenus rosmarus divergens*) and bowhead whales (*Balaena mysticetus*) in Region 4 (Icy Cape), and bowhead and gray whales in Region 5 (Barrow Canyon). An inter-annual comparison of results among the DBO regions will be presented, and correlations with a few basic oceanographic parameters will be explored.
[Work supported by the Bureau of Ocean Energy Management]

Bowhead Whales (*Balaena mysticetus*) in the Temperate Zone of the Okhotsk Sea: a Case Study for Populations Residing in a Rapidly Warming Arctic

Olga Shpak
A.N. Severtsov Institute of Ecology and Evolution of Russian Academy of Sciences, ovshpak@gmail.com

The bowhead whale (*Balaena mysticetus*) population residing in the Okhotsk Sea (OS) is the southernmost in the range of this species. Though the wintering grounds remain unknown, these whales spend summer in the Shantar region of the western OS, a temperate zone at 53-54° N latitude. Bowheads are regularly encountered in the shallow bays and along the coast from July to November during the ice-free period. In late July-August, bowheads aggregate at depths less than 10 m and as shallow as 3 m in Ulbansky Bay where maximum air temperatures exceed 30° C and maximum water surface temperatures can reach 20° C. Intensive skin sloughing was observed on the majority of individuals during that time. To our knowledge, no clear evidence of such molting in other bowhead populations has been presented. Whale lice were common and observed mostly on the whales' heads (including the nares) which were exposed to the sun, shed more intensively, and usually had more skin lesions than other parts of the body. Currently we have no data on the health of this population. Bowheads share the bays with high concentrations of different marine mammal species, a unique feature of the Shantar region. Killer whale (KW) (*Orcinus orca*) predation is considered to be one of the major threats for cetaceans in a rapidly warming Arctic. In summer time in the OS, mammal-eating KWs are found in the same area where bowheads aggregate. Whale carcasses with signs of KW predation were found on three occasions and local seamen regularly report KWs hunting bowhead calves. Some adult whales bear distinct scars left by KWs. Fishery interactions pose another threat to marine mammals in the ice-free Arctic. OS bowheads have been entangled in fishing gear and several individuals bear scars similar to those left by fishing nets/ropes. Bowheads that summer in the ice-free temperate climate of the Shantar region provide a unique case study for potential impacts that may affect other bowhead populations as sea ice extent retreats and Arctic waters warm.

Analysis of Knock Sequences Produced by Walruses in the Northeastern Chukchi Sea

Xavier Mouy
JASCO Applied Sciences, xavier.mouy@jasco.com
David Hannay
JASCO Applied Sciences, david.hannay@jasco.com

Walruses produce a variety of underwater sounds including bell sounds, grunts, and low frequency pulses called knocks. Knocks are usually produced in trains consisting of a sequence of pulses produced in rapid succession and often finished with a bell sound. In the High Canadian Arctic, knock sequences from Atlantic walruses (*Odobenus rosmarus rosmarus*) have been shown to be highly stereotyped and repeated over long periods of time by mature males as mating display (also referred to as knock songs). Stirling et al. (1987) observed that different male Atlantic walruses produced different knock songs and that individual knock song patterns persisted over several years. Pacific walruses walruses (*Odobenus rosmarus divergens*) summering in the eastern Chukchi Sea also produce knock sequences; however, their function is unclear. The Chukchi Sea is not a breeding ground for walruses and it is mostly frequented by females with pups and juveniles. The objective of this study is to determine the purpose of the knock sequences produced by walruses in the eastern Chukchi Sea. To answer this question we analyzed data from a large scale passive acoustic monitoring program conducted in the northeastern Chukchi Sea since July 2007. Recordings containing knock sequences with high signal to noise ratios were selected for each year of the monitoring program. Knocks were identified using a kurtosis-based automatic detector assisted by an experienced analyst. Multiple knocks separated by less than 0.5 s were grouped and considered as knock-trains. A clustering algorithm defined the different types of knock-trains encountered in the eastern Chukchi Sea based on the number of knocks and the duration of the knock-trains. Finally the Prefix-Span sequential pattern mining method defined knock songs based on the most frequent succession of knock-trains found in the data. One knock song was encountered during several years and at different locations. It is unlikely that this song was produced by the same animal, suggesting that some knock songs in the eastern Chukchi Sea may be shared at the population level.

Arctic - Mammals

Large Cetacean Occurrence in the South-Central Chukchi Sea, Summer and Fall 2014

Janet Clarke
Leidos, janet.clarke@leidos.com
Amelia Brower
NOAA, Alaska Fisheries Science Center (AFSC), amelia.brower@noaa.gov
Megan Ferguson
AFSC, megan.ferguson@noaa.gov
Christy Sims
AFSC, christy.sims@noaa.gov
Vicki Beaver
AFSC, vickibeaver@yahoo.com
Jennifer Gatzke
NOAA, Northwest Fisheries Science Center, jennifer.gatzke@noaa.gov
Bob Lynch
Center for Coastal Studies, blynch@coastalstudies.org

Systematic aerial surveys were conducted in the south-central Chukchi Sea (67°-69° N, 166°-169° W) in summer and fall 2014 as part of the Aerial Surveys of Arctic Marine Mammals (ASAMM) project, funded by BOEM and conducted by NOAA. Surveys were conducted on 9 days (3 each in July, August and September), for a total of approximately 20 hours and 3,300 km on transect. Three hundred sixty-six gray whales (*Eschrichtius robustus*) were seen from July through September, including 19 calves. Large groups of gray whales were seen on several occasions feeding at a previously documented benthic "hot spot" near the International Date Line; gray whales were also observed nearshore north of Pt. Hope and east of Cape Lisburne. Forty-six humpback whales (*Megaptera novaeangliae*) and 36 fin whales (*Balaenoptera physalus*) were seen in early and late September centered near 67.3° N, 167° W. One humpback whale calf was seen; several whales were feeding. One minke whale (*Balaenoptera acutorostrata*) was seen in early September. Fin, humpback and minke whales are known to have occurred historically in the Pacific Arctic, particularly near the Chukotka Peninsula, and recent visual and acoustic detections in the south-central Chukchi Sea suggest that use of this area may be increasing. Increased occurrence may be due to each population's abundance and range recovering from commercial whaling, or it may reflect responses to ongoing climate change. Data collected via the Distributed Biological Observatory (DBO) project provide complementary information on oceanographic parameters that may be linked to large whale distribution, behavior, and occurrence in the southern Chukchi Sea.

Satellite Tracking of Spotted Seals (*Phoca largha*) in the Okhotsk Sea in 2011-2014

Maria Solovyeva
Marine Mammal Council, Moscow, Russia, solovjova.m@gmail.com
Dmitry Glazov
A. N. Severtsov Institute of Ecology and Evolution of Russian Academy of Sciences, Moscow, Russia, dglazov@yandex.ru
Vyacheslav Rozhnov
A.N. Severtsov Institute of Ecology and Evolution of Russian Academy of Sciences, Moscow, Russia., rozhnov.v@gmail.com
Peter Boveng
NOAA, Alaska Fisheries Science Center, peter.boveng@noaa.gov

Movements of spotted seals (*Phoca largha*) in the Okhotsk sea were tracked during autumn-winter-spring period. Seals were captured and tagged in September-October 2011-2013 in three locations on the Okhotsk Sea coast: 17 seals – in two river estuaries on the western coast of Kamchatka peninsula, and 2 seals – in Sakhalinskiy Bay. Individuals of different sex and ages were tagged with10 «Pulsar» (Russian manufacturer) and 9 «SPOT-5» (USA manufacturer) transmitters. The seals were tracked for 5-269 days. The data from 15 spotted seals were included in analysis. Tracking revealed the differences in behavior between the seals from Kamchatka and animals from Sakhalinskiy Bay: the former moved between mouths of major rivers, long distance away (up to 1,000 km) from tagging locations; the latter stayed close to capture place and did not move further than 170 km. During winter, the seals from Kamchatka occupied the north-west part of the Okhotsk Sea, and the seals from Sakhalinskiy Bay went to Tartar Strait and entered the northern part of Sea of Japan. During breeding season, the tags from all animals sent signals from 2 of the 3 well-knowing breeding areas. Seals didn’t use the eastern coast of Sakhalin Island for breeding – the third well-known breeding area. Some animals crossed the Okhotsk Sea from east coast to west coast.

Satellite tracking of spotted seals revealed that the animals from the same breeding area spend summer in close parts of the Okhotsk Sea. Satellite tagging used for seals of Okhotsk Sea in the first time.

Real-time Marine Mammal and Noise Monitoring from Ocean Gliders

Kate Stafford
University of Washington, stafford@apl.washington.edu
Peter Winsor
University of Alaska Fairbanks, pwinsor@alaska.edu
Mark Baumgartner
Woods Hole Oceanographic Institution, mbaumgartner@whoi.edu

Persistently poor weather in the Arctic makes traditional marine mammal research from aircraft and ships difficult, yet collecting information on marine mammal distribution and habitat utilization is vital for understanding the impact of climate change on Arctic ecosystems. Moreover, as industrial use of the Arctic increases with the expansion of the open-water season, there is an urgent need to monitor noise from oil and gas exploration and commercial shipping. We have developed an autonomous, mobile passive acoustic system for monitoring ocean noise and the calls of Arctic and sub-arctic marine mammals in near real time. The system consists of Slocum gliders equipped with a digital acoustic monitoring (DMON) instrument; the DMON is programmed with a low-frequency detection and classification system (LFDCS) that uses an Arctic-specific call library for detecting and classifying the vocalizations of bowhead, fin, and beluga whales (*Delphinapterus leucas*), bearded seals (*Erignathus barbatus*), and walrus (*Odobenus rosmarus*) as well as low-frequency sounds produced by air guns. In addition to recording continuous low-frequency audio, the DMON/LFDCS generates (1) summary detection data for all classified calls, (2) detailed detection data for a subset of all detected sounds, and (3) background noise estimates. Every 2 hours, these data are transmitted by the glider to a shore-side computer via Iridium satellite for immediate display at a publically accessible website (dcs.whoi.edu). Estimates of species' occurrence are generated daily by an experienced analyst based on review of both the summary and detailed detection data received in near real time. Glider deployments in the Chukchi Sea during September 2013 and 2014 demonstrated and evaluated the system. During our 2013 pilot study, we found that bowhead whale (*Balaena mysticetus*) and walrus call rates were strongly associated with a warm and salty water mass of Bering Sea origin. During 2014, the glider detected the patterned 20-Hz calls of fin whales (*Balaenoptera physalus*), a subarctic species not commonly sighted in the Arctic. With a passive acoustic capability that allows both archival recording and near real-time reporting, we envision ocean gliders will become a standard tool for marine mammal and ocean noise research and monitoring in the Arctic.

Genetic Investigation of Multi-decadal Shifts in Beluga Whale Behavior in a Changing Arctic

Greg O'Corry-Crowe
Harbor Branch Oceanographic Institute - Florida Atlantic University, gocorryc@hboi.fau.edu
Robert Suydam
North Slope Borough, Robert.Suydam@north-slope.org
Lori Quakenbush
Alaska Department of Fish & Game, lori.quakenbush@alaska.gov
Barbara Mahoney
NOAA, Alaska Regional Office, Barbara.Mahoney@noaa.gov
Lois Harwood
Fisheries and Oceans Canada , Lois.Harwood@dfo-mpo.gc.ca
Willie Goodwin
Alaska Beluga Whale Committee (ABWC), argagiaq@gmail.com
Kathy Frost
ABWC, kjfrost@hawaii.rr.com
Eric Archer
NOAA, Southwest Fisheries Science Center, Eric.Archer@noaa.gov

In Arctic species, natal homing, dispersal and settlement, and their ultimate influence on population subdivision are believed to be primarily shaped by seasonal fluctuations in sea-ice and resource availability and by changing climatic and oceanographic conditions over several time scales. We investigated population structure, dispersal and migration patterns in the beluga whale (*Delphinapterus leucas*) in the western Nearctic, a region that has witnessed dramatic sea-ice loss in recent decades. Genetic profiling of 1,252 whales from multiple geographically discrete populations, summering concentrations and migrating herds across 20 years (1988-2007) revealed phylogeographic structuring within mtDNA ($_{st}$ = 0.40) and 8 microsatellite loci ($_{st}$ = 0.112) that indicate the geographically discrete population in Cook Inlet, Alaska has been effectively isolated, demographically and reproductively, from populations in the Bering, Chukchi, and Beaufort seas (BCB) for such time that the evolution of distinct genetic signatures in the small, declining Cook Inlet population is likely and rescue via immigration is remote. Genetic heterogeneity ($F_{st\ mtDNA}$ = 0.104-0.613, $F_{st\ nDNA}$ = 0.005-0.071), Bayesian cluster analysis (K = 4) and likelihood-based assignment methods revealed limited dispersal and restricted gene flow by both sexes among four geographically discrete summering concentrations in the BCB region; Bristol Bay, Norton Sound, the eastern Chukchi Sea and the eastern Beaufort Sea, despite few physical barriers to movement and the potential co-occurrence of separate summering groupings during the winter-spring breeding season. This philopatry to migration destinations likely reflects behavioral adaptations to spatially patchy but seasonally predictable resources and is facilitated by the extended period of postnatal care by females. Gene flow, when it did occur, was mediated predominantly by adult males, either via interbreeding on a common wintering ground or overlapping migration route or via limited individual transfer ($F_{st\ m\ v.\ f}$ P = 0.043, $r_{\ m\ v.\ f}$ P = 0.042). Finally, temporal analysis across 20 years of sample collection confirmed inter-generational philopatry but

also detected behavioral shifts in annual migration patterns that coincided with anomalous ice years. These shifts may represent behavioral responses to climate-induced ecosystem change the ecological and evolutionary consequences of which will depend on their frequency and duration

Identifying Marine Mammal Fall Migration Core Areas in the U.S. Beaufort Sea

Christopher Krenz
Oceana, ckrenz@oceana.org
Melanie Smith
Audubon Alaska (AA), masmith@audubon.org
Nathan Walker
AA, nwalker@audubon.org
Kristie Livingston
Oceana, klivingstonak@gmail.com
Raychelle Daniel
Pew Charitable Trusts, RDaniel@pewtrusts.org
Bruce Robson
World Wildlife Fund, mandybruce@co-eco.com

An understanding of the distribution of marine mammals is needed to minimize impacts from expanding industrial activities in the Arctic Ocean. We examined spatial patterns of observations of bowhead whales (*Balaena mysticetus*), beluga whales (*Delphinapterus leucas*), and pinnipeds during the fall migration period in the U.S. Beaufort Sea that were recorded in the Aerial Survey of Arctic Marine Mammals database. We summarized the systematic aerial surveys from 2000 to 2012 in 20 km × 20 km bins to establish an average relative abundance of observations for each species. We then used a kernel density analysis to summarize the binned data, and generated isopleth contours to identify core areas. Core areas for bowhead whales included regions north of Point Barrow, east of Cross Island, and east of Kaktovik. Core areas for beluga whales included Barrow Canyon, the shelf break to the east of Barrow Canyon, and an area on the continental shelf slope off of Kaktovik. Pinnipeds were generally more dispersed than bowhead or beluga whales. In the eastern U.S. Beaufort Sea, observations of bowhead whales tended to occur in the inner to mid shelf region with beluga whale observations occurring predominantly on the continental shelf slope. While marine mammal migrations are often considered pass-through travel corridors, our analysis of observations in the ASAMM database indicates spatial heterogeneity and varying intensity of use within those migration corridors.

Harbor Porpoise Sightings from Shipboard Surveys in the Chukchi Sea during Summer and Fall, 2008-2014

Cynthia Christman
CLC Research, christman.cl@gmail.com
Lisanne Aerts
LAMA Ecological, lisanne@lamaecological.com

While harbor porpoises (*Phocoena phocoena*) are known to inhabit coastal and inland waters throughout subarctic regions of Alaska, few studies have documented harbor porpoise presence north of the Bering Strait. Here we present harbor porpoise sightings in the Chukchi Sea from seven years of shipboard marine mammal surveys. During the summers and falls of 2008-2014, we conducted vessel-based line-transect surveys for marine mammals in the northeastern Chukchi Sea, as part of the Chukchi Sea Environmental Studies Program (CSESP). We observed harbor porpoises in the Chukchi Sea in all years from 2008-2014. Harbor porpoises were sighted in the southern Chukchi Sea, north of the Bering Strait and west of Kotzebue Sound, during transits between Nome and the study area, and in the northeastern Chukchi Sea, between Cape Lisburne and Point Barrow, Alaska. We observed harbor porpoises both nearshore and offshore; the northernmost harbor porpoises that we observed were located at 71°36 N, 164°10 W, approximately 160 km (86 nmi) northwest of Icy Cape. To our knowledge, these are the northernmost sightings of harbor porpoises in the Chukchi Sea. Harbor porpoises were seen in July, August, September, and October; however, the months during which sightings occurred varied from year to year. While the number of harbor porpoises observed has been relatively low, ranging from 1-7 animals per year, we have consistently seen harbor porpoises in the Chukchi Sea each year since CSESP surveys began in 2008. Though observations have been scarce, historical reports have described harbor porpoises along the northwestern Alaskan coast as early as the 1930s, with subsequent reports in the 1950s and 1980s. More recent observations of harbor porpoises in the northeastern Chukchi Sea include sightings made during seismic and geohazard surveys conducted between 2006 and 2010. The observations of harbor porpoises made during this study support the suggestion that harbor porpoises are regular visitors to the Chukchi Sea and that they have continued to use this region in recent years.

Arctic - Mammals

Yellow-billed Loon Youth Videography Initiative

Melanie Flamme
National Park Service (NPS), melanie_flamme@nps.gov
Stacia Backensto
NPS, stacia_backensto@nps.gov
Dev Dharm Khalsa
NPS, devdharm_khalsa@nps.gov

Cultivating the value of resource stewardship in our youth is an important goal of the National Park Service's (NPS) mission (NPS 2013a). A powerful way to plant the seed of stewardship and inspire children is to engage them in fascinating science in beautiful, outdoor places (Louv 2005, 2011; AKELP 2013). For the summer of 2013, we proposed to combine Alaska park science and outdoor education by working with two students, one from urban Anchorage and one from rural Shishmaref, to create video podcasts that highlight natural resource issues focused on yellow-billed loons (*Gavia adamsii*). In 2014, we expanded this project to include three students, one from urban Anchorage, one from rural Shishmaref, and one from urban Fairbanks, as well as a Student Conservation Association Digital Media Intern working at the Fairbanks Alaska Public Lands Information Center in an initiative to raise awareness of the rare yellow-billed loon. The yellow-billed loon is a rare candidate species warranted for listing under the Endangered Species Act (Federal Register 2009) and monitored by NPS in Bering Land Bridge National Preserve (BELA) in western Alaska (Flamme et al. 2012) (Figure 2). The NPS partnered with Alaska Teen Media Institute (ATMI), Alaska Geographic (AG), Shishmaref School (SS), West High School (WHS), Wildlife Conservation Society (WCS), and U. S Fish and Wildlife Service (USFWS), and Bureau of Land Management to recruit, train and guide students in videography and video podcast production. Students traveled with scientists to record and experience science on yellow-billed loons in Bering Land Bridge NP, the National Petroleum Reserve - Alaska, and at the Helmerick's homestead on the Colville River Delta. Students then worked with ATMI in Anchorage to create compelling video podcasts that tell the loons' story and that resonate with their communities and other youth. The video podcasts will be utilized by NPS, WCS and USFWS to facilitate proactive and collaborative community discussions throughout northern Alaska on ways to mitigate conflicts that may develop from additional regulations on the loons.

Arctic - Mammals

Gray Whale Occurrence in the Beaufort Sea

Amelia Brower
NOAA, Alaska Fisheries Science Center (AFSC), amelia.brower@noaa.gov
Janet Clarke
Leidos, janet.clarke@leidos.com
Megan Ferguson
AFSC, megan.ferguson@noaa.gov

Eastern North Pacific gray whales (*Eschrichtius robustus*) migrate seasonally from winter calving and breeding grounds in Baja California, Mexico, to summer feeding grounds in northern latitudes from northern California to the northern Bering and Chukchi seas. Aerial surveys for marine mammals occurred in summer and fall in the northeastern Chukchi Sea (169° W-157° W, 68°N-72° N) from 1982 to 1991 and 2008 to 2014, and in the western Beaufort Sea (157° W-140° W, from shore to 72° N) from 1979 to 2014. Currently, this Aerial Surveys of Arctic Marine Mammals (ASAMM) project is funded by BOEM and conducted by NOAA. ASAMM surveys have documented a gray whale foraging hotspot in the northeastern Chukchi Sea that typically extends from Icy Cape to Point Barrow, shoreward of Barrow Canyon on the continental shelf. Gray whale distribution commonly extends eastward to 155.8° W. We highlight the few gray whales sighted by ASAMM in the Beaufort Sea and discuss them in the context of sightings from other research projects, which date back to 1933 and extend to the eastern Canadian Beaufort Sea. The easternmost gray whale sighted by ASAMM occurred in 2014; it was observed swimming nearshore, immediately north of Cross Island (147.9° W), ~ 300 km east of their normal range. The remaining ASAMM gray whale sightings in the Beaufort Sea have occurred since 1997 and total 20 whales. Those sightings occurred offshore in Barrow Canyon, north of Dease Inlet, at the mouth of Smith Bay, north of Harrison Bay, and north of Gwydyr Bay. ASAMM observers recorded that most Beaufort Sea gray whales were swimming, resting, diving, or milling, although five gray whales were feeding. The milling gray whale was sighted with a group of 37 feeding bowhead whales (*Balaena mysticetus*). The occurrence of gray whales in the Beaufort Sea is not new and does not seem to be a range expansion; however, because gray whales are opportunistic foragers, their distribution and density in the Beaufort Sea may change in the future if foraging habitat shifts.

Late Summer Distribution of Bowhead Whales in the Canadian Beaufort Sea: Environmental Correlates and Predicting Future Habitat Use

Deanna Leonard
University of Alaska Fairbanks (UAF), dmleonard2@alaska.edu
Lara Horstmann
UAF, Ldehn@alaska.edu
Lois Harwood
Fisheries and Oceans Canada, lois.harwood@dfo-mpo.gc.ca

Bowhead whales (*Balaena mysticetus*) of the Bering-Chukchi-Beaufort population winter in the Bering Sea and migrate to summer feeding areas in the Canadian Beaufort Sea and Amundsen Gulf. They arrive in late May, and by early or mid-August they begin to aggregate in areas where oceanographic features concentrate their prey (crustaceous zooplankton). Extensive aerial surveys conducted throughout the Canadian Beaufort Sea in the 1980s and 2000s revealed that the same areas are repeatedly used by whales; however, the use of any specific area varied among years. In this study, patterns of bowhead distribution and associated inter-annual variation are examined retrospectively, in relation to environmental variables, including bathymetry, sea surface temperature (SST), chlorophyll *a*, wind, currents, and ice conditions. We test the hypothesis that 1) bowhead whale distribution in the late summer is a direct function of the abundance and density of their preferred prey, and 2) indicators of upwelling (productivity) and prey abundance can be used to predict bowhead whale distribution. Preliminary data analyses show that SST and bathymetry are strongly correlated to bowhead whale distribution and may be reliable indicators of favorable feeding conditions. Further analysis will test strongly correlated oceanographic features for their use in modeling bowhead whale distribution in real time. This study complements similar work underway in the Alaskan Beaufort Sea and the Chukchi Sea, which will better inform decisions regarding offshore hydrocarbon developments. Predicting bowhead distribution is especially relevant for industrial activities, such as seismic surveying, which has a potential to disturb or displace bowhead whales from important feeding areas. Our findings may also contribute to understanding how bowhead whales respond to climate-driven changes and other factors that alter their habitat.

Hunter-assisted Study on Ringed and Bearded Seal Movements, Habitat Use, and Traditional Knowledge

Mark Nelson
Alaska Department of Fish & Game (ADFG), Mark.Nelson@Alaska.gov
Lori Quakenbush
ADFG, Lori.Quakenbush@Alaska.gov
John Goodwin
Seal hunter and resident of Kotzebue, Alaska, JGoodwin@otz.net
Merlin Henry
Seal hunter and resident of Koyuk, Alaska, noemail@mail.com
Alex Whiting
Resident of Kotzebue, alex.whiting@qira.org
Kathy Frost
School of Fish and Ocean Sciences, Fairbanks, Alaska, kjfrost@hawaii.rr.com
Justin Crawford
ADFG, Justin.Crawford@Alaska.gov

Ringed (*Pusa hispida*), and bearded (*Erignathus barbatus*) seals are considered "ice associated seals" or "ice seals" because sea ice is important for pupping, nursing, molting, and resting. In Alaska, these seals are found in the Bering, Chukchi, and Beaufort seas. They are important subsistence species used by Alaska Natives for food, oil, clothing, and handicrafts. Changes in the timing and extent of sea ice have increased access to the Arctic, increasing the need to plan shipping lanes, oil and gas lease sales, and to develop mitigation measures to minimize effects on seals. Our understanding of important seal habitats and the timing and magnitude of movements by species, sex, and age, however, is limited. Cooperative hunter-biologist satellite-tagging studies in Kotzebue Sound, and more recently at Barrow and Hooper Bay, have begun to gather this information. The focus of this study is to deploy satellite transmitters on ringed and bearded seals through additional cooperative projects with coastal Alaska communities. In 2014, we trained hunter-taggers from the Norton Sound villages of Koyuk, St. Michael, Unalakleet, and Elim. Four ringed seals and one bearded seal were satellite-tagged near Kotzebue in June, as were three bearded seals near Koyuk in September. All five seals tagged near Kotzebue traveled north for the summer. The bearded seal stayed in the Chukchi Sea near Cape Lisburne. One ringed seal spent time offshore from Wainwright, one near Barrow canyon, one near Wrangel Island, and one traveled east through the Beaufort Sea to Mackenzie Bay and back to Kotzebue Sound. The Koyuk bearded seals spent time in the local rivers before moving out into Norton Sound. Tracking seals tagged at several widely-spaced locations will allow us to better understand the range and timing of movements, their use of sea ice including haul-out behavior, important habitats, and seasonal site fidelity. Future plans include training more hunter-taggers, and documenting local and traditional knowledge to better understand how seals are responding to changing sea ice, increased shipping, and oil and gas activity.

Reproductive Responses in Female Pacific Walrus to Changes in Arctic Climate

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

Female Pacific walrus (*Odobenus rosmarus divergens*) and their young depend on sea ice to serve as a resting platform near densely concentrated foraging regions. As temperatures in the Arctic increase and sea ice melts, these platforms are dispersing and disappearing. Female walrus and their calves must haul out in new locations, resulting in traveling longer distances to reach previous foraging grounds or foraging in new locations that may not have as densely concentrated prey items. Reduction in food availability or increases in energy expenditure may have reproductive consequences for female Pacific walruses. By comparing the reproductive tracts of female Pacific walruses to documentation of earlier studies, we aim to discover if changes in sea ice extent have altered the age of first reproduction and calving interval. If the ecosystem carrying capacity is changing, we anticipate that the current population will have delayed age of first reproduction and longer calving intervals than those sampled in previous literature.

What Do Bearded Seals Really Eat – A Methods Comparison

Anna Bryan
Alaska Department of Fish & Game (ADFG), anna.bryan@alaska.gov
Lori Quakenbush
ADFG, lori.quakenbush@alaska.gov
Lara Horstmann-Dehn
University of Alaska Fairbanks, lara.horstmann@alaska.edu

Stomach contents, stable isotopes, fatty acids, and more recently, fecal DNA are commonly used to infer the diet of marine mammals. How complimentary or contradictory these methods are, especially when considering individual diet variability, remains poorly understood. Differences in dietary information from stomach contents, stable isotopes, and fatty acids were evaluated for 76 adult bearded seals (*Erignathus barbatus*) harvested in Alaska for subsistence uses. Fishes were investigated using stomach contents and fecal DNA from a subset of 22 seals. As expected, stomach contents and fecal DNA provided information on recently consumed prey, while $d^{13}C$ and $d^{15}N$ of muscle and fatty acid profiles of full-thickness blubber provided information on prey consumed and integrated over a longer time frame. Taxonomic resolution of prey was highest for stomach contents. We identified at least 60 prey taxa in the stomachs; with sculpins (Cottidae) occurring most often at 66% frequency of occurrence (FO), followed by shrimp (64% FO), crab (63% FO), and cod (Gadidae) (55% FO). Proportions of indicator fatty acids from blubber were similar to other fatty acid studies of bearded seals in Alaska and suggest a benthic diet. Specific prey identification using fatty acids was not possible, because fatty acid prey libraries do not exist for the Alaskan Arctic. Some taxonomic resolution was achieved for stable isotopes using a Bayesian stable isotope mixing model (SIAR), but prey had to be combined into isotopically (i.e., not taxonomically) similar prey source groups due to model restrictions. Despite the differences in dietary time frames, the relative occurrence (RO) of prey from stomach contents and the mean proportions of prey source groups from the stable isotope mixing model were similar, except for octopus. Octopus occurred at a higher proportion using estimates from stable isotopes (13%) compared with the RO of stomach contents (3%). Using denaturing gradient gel electrophoresis (DGGE) of 16S gene fragments, only two fishes (shorthorn sculpin (*Myoxocephalus scorpius*) and an unknown snailfish species, Liparidae) could be positively identified. Overall, the methods yielded different, but not contradictory results, and none provided a complete description of diet.

2014 Aerial Surveys of Marine Mammals in the Colville River Delta (North, Slope, AK) Using Stabilized Aerial Infrared Imagery

Bonnie Easley-Appleyard
HDR, Inc., Bonnie.Easleyappleyard@hdrinc.com
Kristen Ampela
HDR, Inc., Kristen.Ampela@hdrinc.com
Dan Wilkinson
Tulugaq, Daniel.Wilkinson@fairweather.com

As part of a continuing effort to characterize marine mammal (primarily pinniped) distribution in the Colville River Delta (CRD), we conducted dedicated, systematic aerial surveys over the CRD from 29 through 31 August, 2014. Surveys were flown at altitudes at or above 1,000 feet, with transects oriented in an east-west line-transect pattern, spaced 1 nmi apart. Four survey flights were flown, and over the course of the three-day survey, all transect lines were flown at least once. The survey platform was a DA-42MPP aircraft equipped with an external nose-mounted TASE 400 HD camera system, including a mid-wave infrared imaging system and high-definition Electro Optical camera. These features were used in-flight to assist onboard observers in detection of haulouts and other marine mammal sightings. Once animals were detected, the aircraft left the transect line to fly over animals to collect photographs and additional sighting data, including species, behavior, and environmental conditions. High-resolution, geo-referenced photographs were taken with two externally-mounted Nikon D800 cameras. Pinniped haulout locations were compared to historical observations, via incidental sightings recorded back to 1956, as well as to haulout locations observed on previous (September 2013) systematic aerial surveys, in order to better understand haulout persistence patterns across time. Survey photographs are currently being examined for detailed species and group-size information. Preliminary data from 2014 indicates a total of 10 marine mammal sightings: 3 polar bear (*Ursus maritimus*) and 7 seal sightings. Two seal haulouts were observed and both correspond to previously recorded haulout locations. Spotted seals (*Phoca largha*) are predicted to be the pinniped species observed hauled out. One of these, located approximately 52 km up the Colville River, was also observed in September 2013. The other haulout was located at Seal Island's west side sandbar, and has been observed historically but not during 2013 survey efforts. There were two in-water sightings one within the delta and the other in waters adjacent to the delta. No cetaceans were observed. The 2013 and 2014 aerial surveys begin to provide a "snapshot" of the relative abundance and distribution of seals hauled out in the CRD.

Diet and Body Condition of Southern Beaufort Sea Polar Bears in a Changing Climate: Availability of Novel Food Sources or Limitations to Traditional Prey?

Melissa McKinney
University of Connecticut, melissaamckinney@gmail.com
Sara Iverson
Dalhousie University, sara.iverson@dal.ca
Elizabeth Peacock
U.S. Geological Survey, Alaska Science Center, lpeacock@usgs.gov

Over the last decade, the proportion of southern Beaufort (SB) polar bears (*Ursus maritimus*) that come ashore in the summer and fall has increased. While on shore, bears make use of bowhead whale (*Balaena mysticetus*) remains from subsistence harvests, while those that remain on the sea ice seem to persist using pelagic foraging strategies. We used quantitative fatty acid signature analysis (QFASA) to assess the contribution of traditional prey species versus bowhead whale to the diets of SB polar bears sampled from 2004 to 2012. Diet estimates indicated that ringed seal (*Pusa hispida*) (95% CI: 41-45%) and bearded seal (*Erignathus barbatus*) (35-40%) were the predominant prey items, that bowhead whale consumption was lower (13-16%) and that beluga whale (*Delphinapterus leucas*) consumption was limited (4-6%). Adult males consumed around twice as much bowhead whale as adult females and immature bears, whereas adult females consumed more ringed seal than adult males. Spring sampled bears ate more beluga whale, bowhead whale and ringed seal than fall sampled bears. Fall sampled bears ate more bearded seal than spring sampled bears (71-77% vs. 24-28%), suggesting a previously unrecognized seasonal importance of bearded seal to SB polar bear diets. Although year of collection was a significant factor, there were no significant temporal increases or decreases in consumption of any prey species over 2004-2012. Instead, mean annual ringed seal consumption (but not other prey) was negatively correlated ($r2 = 0.73$, $p = 0.003$) with the previous winter Arctic Oscillation (AO) index. That is, after highly positive AO winters, which result in subsequently lower summer ice concentrations, more open water and later onset of fall freeze, less ringed seal was measured in SB polar bear diets. It appears that onshore versus offshore resource use by SB polar bears is a function of changes in ice/access to their traditional prey. Body condition indices were generally negatively correlated with ringed seal consumption, suggesting that polar bears continuing to use the pelagic foraging strategy fare worse than those spending more time onshore.

Hindcasts of Potential Bowhead Whale Habitat: a Comparison of Two Species Distribution Models for Spatio-temporally Dynamic Estimates of Potential Habitat Quality

Dan Pendleton
New England Aquarium, dpendleton@neaq.org
Elizabeth Holmes
NOAA, Northwest Fisheries Science Center, eli.holmes@noaa.gov
Jinlun Zhang
University of Washington, zhang@apl.washington.edu

Potential impacts on marine mammals from natural resource exploration and extraction activities throughout the oceans motivates the need for spatio-temporally dynamic models of marine mammal habitat. The remoteness and pace of change in the arctic environment makes the importance of such models even more critical in those regions. Three basic components are needed in this effort: 1) information on the time and place of animal occurrence; 2) spatially continuous representations of pertinent environmental variables; and 3) a link between 1) and 2), normally a statistical or dynamical model of the relationship between the focal species and the environment.

In the present work we utilize western Arctic bowhead whale (*Balaena mysticetus*) occurrence records in the Beaufort Sea from aerial surveys along with results of a 3D physical-biological ocean model. We link these data with two presence/pseudo-absence species distribution modeling algorithms: boosted regression trees (BRTs) and maximum entropy (MaxEnt). The objectives of this work are to assess the feasibility of our workflow, to test the hypothesis that modeled prey is an important predictor given the spatial (4-10 km) and temporal (8-day) resolution of the ocean model, and to compare the performance of two machine learning algorithms.

We trained algorithms to estimate potential bowhead whale habitat for nine weeks during summer-fall season of the years 1988–2012. Environmental covariates included simulated temperature, bowhead whale prey (krill/copepod) resource, flagellated plankton, ice thickness and bathymetry. Both algorithms identified bathymetry and prey resource as the most important environmental variables, accounting for 60–80% of the variability. We found that BRTs and MaxEnt performed similarly (AUC = 0.8). Qualitatively, BRTs tended to predict higher maximum and lower minimum habitat suitability than MaxEnt, depending on the time of year, mid-season versus end-of-season. We also present the impact of pseudo-absence selection and ocean model resolution on our results. Ocean model projections to 2050 will be presented, as will our plans for forecasting bowhead whale potential habitat. We present our approach as one that could help to assess the impact of increased human activities in a changing Arctic environment.

A Comparison of Marine Mammal Sightings From Different Vessel-based Observation Platforms

Jenipher Cate
ASRC Energy Services, RTS (ASRC-RTS), jenipher.cate@asrcenergy.com
Megan Blees
ASRC-RTS, Megan.Blees@asrcenergy.com
Samantha Simpson
ASRC-RTS, Samantha.Simpson@asrcenergy.com
Meghan Larson
ASRC-RTS, Meghan.Larson@asrcenergy.com
Mari Smultea
Smultea Environmental Sciences, LLC, mari@smulteasciences.com

The ability to observe marine mammals from vessel-based platforms varies relative to the vessel specifications. In particular, the height of a vessel's observation platform affects the observational distance. With ideal conditions, it is presumed marine mammal sightings will be greater from a taller platform because observers can see further distances. On larger vessels with an observation platform of > 8 m in height, the usable strip width distance for density estimates is typically 800 m from either side of the vessel, compared to 600 m strip width for < 8 m observation platforms. Open-water seismic surveys in the Alaskan Arctic are conducted using multiple vessels including at least one seismic vessel and one or more support vessels. Most of the marine mammal sightings from these projects are compared to periods of seismic activity, which may explain ship avoidance by marine mammals. There is little data however, comparing sighting rates from multiple vessels during periods of non-seismic activity to determine if a secondary support vessel has additional beneficial uses for a seismic program in the Alaskan Arctic. This study compared marine mammal sightings in the Chukchi Sea between two vessels with varying platform heights, 12 m and 6.5 m, during two sampling scenarios. The first scenario includes both vessels travelling in a similar path towards a single destination. The second includes the smaller vessel travelling 7.5 km in front of the larger vessel, acting as a monitoring vessel. In both scenarios, marine mammals were observed twice as often from the smaller vessel. Positive species identification was also higher from the smaller vessel. As seen by these and other reported data, the smaller vessel is more likely to observe more mammals, assisting the seismic vessel in preparing for necessary mitigation actions. The use of a smaller vessel in front of the seismic vessel may also "deflect" mammals from the larger vessel; encouraging animals to leave the area before encountering the larger seismic vessel. This study supports utilizing smaller monitoring vessels during seismic operations.

A Year in the Acoustic World of Bowhead Whales in the Northern Bering, Chukchi, and Beaufort Seas

Christopher Clark
Cornell University, cwc2@cornell.edu
Catherine Berchok
NOAA, Alaska Fisheries Science Center, Catherine.Berchok@noaa.gov
Susanna Blackwell
Greeneridge Sciences, Inc., susanna@greeneridge.com
David Hannay
JASCO Applied Sciences, David.Hannay@jasco.com
Josh Jones
Scripps Institution of Oceanography, j8jones@ucsd.edu
Dimitri Ponirakis
Cornell University, dwp22@cornell.edu
Kathleen Stafford
University of Washington, Stafford@apl.uw.edu

Bowhead whales (*Balaena mysticetus*) in the Bering-Chukchi-Beaufort (BCB) population, experience a highly variable acoustic environment among the regions that they inhabit throughout the year. We analyzed acoustic data from a 14-month period, August 2009 through September 2010, collected with a suite of seafloor recorders distributed at 20 sites throughout a 2,300 km transect. These recorders sampled areas in which bowhead whales occur seasonally and in which there are seasonally natural and anthropogenic sources that produce varying amounts of underwater noise. We analyzed these acoustic data to describe, quantify and compare a) the spatial-temporal occurrence of bowhead whales throughout their range over the 14-month period and b) the spatial-temporal variability in the acoustic environment, as segmented into five contiguous zones and three, 4-month seasons spanning a 12-month period. The results map a) the seasonal acoustic occurrence of bowhead whales in the Bering Sea, Bering Strait and southern Chukchi Sea, northeastern Chukchi Sea, western Beaufort Sea, and eastern Beaufort Sea zones, and b) the spatial and temporal variability of background noise levels encountered by bowhead whales throughout their annual cycles of seasonal migration and residency. GLM analysis showed there was a statistically significant relationship between acoustic occurrence and season, distance offshore and water depth. For the spring 2010 migration, there was a statistically significant inverse relationship between acoustic occurrence and distance offshore. Within a season, K-W analysis revealed there were only significant ambient noise level differences between the Bering Sea and all other zones during the winter season. Within the Bering Sea, Bering Strait, and southern Chukchi Sea, northeastern Chukchi Sea zones there were significant ambient noise level differences between the summer and winter seasons. Singing bowhead whales during the winter in the Bering Sea zone were the greatest single contributor to ambient level. A number of interesting events of unknown origin were evident on recorders > 600 km apart. The timings and distributions of these phenomena suggest that they represent some type of large-scale oceanographic environmental event (e.g., ice movement). Overall, these

results provide a basis by which to explore linkages between marine mammal distributions and sound-generating activities over ecologically appropriate scales.

Spring 2014: Ice-associated Pups Ashore - a Comparison Between Region

Gay Sheffield
University of Alaska Fairbanks, gay.sheffield@alaska.edu
Brandon Ahmasuk, Kawerak
Subsistence Program, sub.dir@kawerak.org
Raphaela Stimmelmayr`
North Slope Borough, raphaela.stimmelmayr@north-slope.org

In the Bering Strait region, reports of 38 seal pups from ice-associated species on beaches during May-July from the villages of Nome, Shaktoolik, Teller, and Wales. These pups included 19 ringed seals (*Phoca hispida*), 10 spotted seals (*Phoca largha*), one bearded seal (*Erignathus barbatus*), and 8 for which species was not reported. Of these pups, 12 were reported dead and 26 were alive.

Pups hauling out on the beaches of Nome can occur any spring but the number of reports was elevated this year and most likely due to the early timing of the ice retreat during spring 2014.

We will present the results of seal pups reported on shore during spring 2014 from Barrow to the Bering Strait and compare numbers and ice conditions.

Arctic - Humans

Sea Ice in Barrow Project Jukebox

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

In this NPRB funded project, we have created a Project Jukebox website featuring oral history recordings of local residents talking about their observations of and experiences with sea ice in northern Alaska (www.jukebox.uaf.edu/seaice). It includes recordings made: in 1978 by Ron Metzner and Dr. Lew Shapiro of the UAF Geophysical Institute about sea ice in the Beaufort Sea area and around Barrow; in 2008 and 2009 by Matthew Druckenmiller for his Ph.D. work at the University of Alaska Fairbanks mapping sea ice trails in Barrow; and in 2013 by Karen Brewster and Oliver Dammann with whalers in Barrow discussing recent unusual sea ice conditions. These recordings present traditional knowledge about ice conditions, ice travel, and human adaptation and the changing environment.

By providing access to historical and current oral history recordings about sea ice this website creates a retrospective database of traditional knowledge and long-term observational records. In addition to documenting traditional knowledge, the Sea Ice Project Jukebox also addresses how changes in the sea ice are impacting subsistence and marine resources, and how climate change is affecting the ecosystems and the local people. Using the people's own words, this project demonstrates how the sea ice has changed over the past thirty-four years and how the Inupiat are adapting to these changes.

In this presentation, I will demonstrate the Sea Ice Project Jukebox website, play excerpts of interviews, and highlight some of the associated resources available on the site.

Using the website is the best way to show people the highly interactive and synchronized aspect of Project Jukebox and play excerpts from the oral history recordings. The full effect of Project Jukebox is lost if using screen captures in Microsoft's PowerPoint. Therefore, I will need a reliable internet connection and a way to play audio/video through the room's sound system so everyone can see and hear what is being played.

This presentation represents a final report of the project as required under NPRB grants. We did not give a presentation in 2014, as the project was not yet fully underway by the abstract submission deadline.

Guidelines for Collecting High Priority Ephemeral Data for Oil Spills in the Arctic in Support of Natural Resource Damage Assessment

Sarah Allan
NOAA Office of Response & Restoration, sarah.allan@noaa.gov
Adriana Bejarano
Research Planning, Inc (RPI), abejarano@researchplanning.com
Jacqueline Michel
RPI, jmichel@researchplanning.com

The Alaskan Arctic region faces changing conditions that increase the likelihood of a marine oil spill. Natural Resource Damage Assessment (NRDA) is a legal process conducted by State and Federal natural resource trustees in the event of an oil spill that impacts public resources. The NRDA process identifies and quantifies injuries to resources and determines the types and amounts of restoration required. The first phase of the process includes collecting time-sensitive, ephemeral data to assess exposure to oil and effects of those exposures. Ephemeral data collection will be especially challenging in the Arctic and requires knowledge and methods that are appropriate for the environmental conditions, logistics and unique habitats, organisms, resources, and human uses of resources in the region. High-priority ephemeral data needs for exposure and injury assessment were identified through a conceptual model, meetings with communities in the Alaskan Arctic, and consultation with NRDA practitioners and Arctic experts. Ephemeral data collection guidelines were developed based on guidance documents for other regions, published sampling methods, lessons learned from other spills and shared traditional knowledge. Seventeen guidelines for collecting data from environmental media, nearshore habitats and associated communities, and biological resources were reviewed by NRDA practitioners and Arctic resource experts. The guidelines were field tested on nearshore areas and lagoons along the Beaufort and Chukchi coasts in northern Alaska in spring and summer, 2013 and 2014. Results of the field validation exercises further improved the guidelines. Different methods for collecting fish, plankton, and invertebrates were compared. Additionally, multiple methods for assessing exposure to oil chemicals were compared by analyzing background levels of polycyclic aromatic hydrocarbons (PAHs) in invertebrate tissue, fish bile, water samples and low-density polyethylene passive samplers. The final guidelines are now available to support NRDA and other sampling efforts in the event of a spill in the Arctic and can be used to inform ongoing baseline data collection efforts. This information significantly improves preparedness to respond to an oil spill in the Arctic and helps ensure that appropriate data, of sufficient quality and quantity to support NRDA, are collected, especially immediately during or after a spill.

Estimating an Oil Spill Response Gap for the Aleutian Islands and U.S. Arctic Ocean

Tim Robertson
Nuka Research and Planning (NUKA), timrobertson@nukaresearch.com
Bretwood Higman
NUKA, hig@nukaresearch.com
Sierra Fletcher
NUKA, sierra@nukaresearch.com
Andrew Mattox
NUKA, mattox@nukaresearch.com

It is common knowledge that weather and darkness can impact the ability to deploy an oil spill response. Understanding how often this is likely to occur and how these effects vary with season or geography can inform contingency planning; the selection of oil spill response tactics and preparedness efforts; research and development priorities; training; and the consideration of limitations on exploration, production, or transport of oil in or through a particular area. Two oil spill response gap analyses were conducted in 2014 that estimate the likelihood that different response tactics may be precluded by one or more environmental conditions. In the U.S. Arctic Ocean, the primary spill response options would be precluded from 50-84% of the time year-round. Vessel-based tactics would be most likely to operate effectively in summer, when tactics requiring aircraft may still be hampered by poor visibility. In winter, *in situ* burning with ignition by a vessel is by far the most likely to be deployable, but it would be prevented by weather approximately 60% of the time. Farther south in the Bering Sea, north of the Aleutian Islands, a wider range of emergency response options was considered including emergency towing (precluded 2% of the time) and lightering with a helicopter (precluded 20% of the time). The deployment of mechanical recovery and chemical dispersants would be precluded from 52-72% of the time year round. The application of dispersants from an aircraft would be more likely to be precluded than when applied from a vessel.

The studies applied the same method of comparing response limits to historical data on environmental factors. When two or more factors are considered marginal during a particular time period, then a response would be assumed to be precluded by the combined effect of those conditions. The studies varied in the response systems studied, environmental factors included (ice was not considered as a factor in the Aleutian Islands but was dominant in the Arctic Ocean) and the quality and quantity of available data. The degree to which any one environmental factor was found to impact response deployment also varied in these two environments.

Teachers: Communicators of Climate Change

Janet Warburton
Arctic Research Consortium of the U.S. (ARCUS), warburton@arcus.org
Sarah Bartholow
ARCUS, sbartholow@arcus.org
Angela Larson
Goldstream Group Inc., alarson@goldstreamgroup.com

The notion of teachers as leaders and communicators is not new but rather it has been limited in scope. Teachers have long served as team leaders, department chairs, and curriculum developers. But what happens when you go beyond these typical roles in professional development? Can teachers become lead communicators beyond the classroom? Can they become leaders of change on important topics like the climate?

For nearly a decade, PolarTREC (Teachers and Researchers Exploring and Collaborating) has been teaming teachers with research projects in all fields of polar science. Teachers participate in hands-on field research experiences in the polar regions which focus heavily on climate change and climate science. Administrated by the Arctic Research Consortium of the United States, the goal of PolarTREC is to invigorate polar science education and understanding by bringing K-12 educators and polar researchers together.

The program fosters a teacher and researcher network, which accelerates the cross-pollination of knowledge in science practices, findings, and classroom implementation throughout disciplines. Evaluation data exposes a crucial dynamic that increases the potential for a successful climate change science campaign. Data indicates that teachers can tackle challenges such as re-framing climate change science to better address the need for a particular campaign, as well as garnering the science project the necessary support through effective, authentic, and tangible communication efforts to policymakers, funders, students, and the public.

Researchers reported the value of explaining their science, in-situ, allowed them to reframe and rework the objectives of the science project to attain meaningful outcomes. More than half of the researchers specifically noted that one of the strengths of the PolarTREC project is its benefit to the scientific process. The researchers also viewed PolarTREC as an essential outreach activity and improved the public perception of their scientific endeavors.

This presentation will speak to the PolarTREC program's best practice and findings on improved polar science communications as well as how the teachers have become the lead communicators in at this time of rapid global change across all disciplines.

Arctic - Humans

Creating Common Understanding - Multi-Partner Pilot to Communicate Coastal Storm Hazards

Aimee Fish
National Weather Service (NWS), aimee.fish@noaa.gov
Louise Fode
NWS, louise.fode@noaa.gov
Nicole Kinsman
Division of Geological & Geophysical Surveys, nicole.kinsman@alaska.gov
Amy Holman
NOAA, Alaska Regional Office, amy.holman@noaa.gov

Fall storms in western Alaska rival hurricanes in impact and the need for clear and advanced early warning. Many of our coastal communities need multiple days for preparation and potential evacuation and with limited weather and ocean observations, communicating expectation and risk effectively is paramount. During the 2011 November superstorm, the National Weather Service could only give qualitative guidance to many affected communities. Two years later in 2013, new tools became available to model water heights, but communicating the impact and meaning of that information remained a challenge. This fall (2014) the National Weather Service (NOAA) working with 5 communities, the State Emergency Operations Center, and Alaska Division of Geological & Geophysical Surveys implemented a pilot project employing common maps and community relevant reference points tied to water levels to provide more effective hazard communication. This poster will describe the all of the collaborations and data the partners pulled together and the next steps toward creating an inundation modeling capability for the entire Western Alaska coast.

A New Bird in the Alaskan Arctic: Lessons Learned During Coordination of Manned and Unmanned Aerial Operations in 2013 and 2014

Megan Ferguson
NOAA, Alaska Fisheries Science Center, megan.ferguson@noaa.gov
Janet Clarke
Leidos, janet.clarke@leidos.com
Andrew Harcombe
Clearwater Air, Inc., andrew.harcombe@clearwaterair.com
Willow Hetrick
Olgoonik/Fairweather LLC, willow.hetrick@fairweather.com
Sheyna Wisdom
Olgoonik/Fairweather LLC, sheyna.wisdom@fairweather.com

Airspace over the northeastern Chukchi and western Beaufort seas is one of three locations in the Arctic where the Federal Aviation Administration (FAA) plans to establish permanent operational areas and corridor routes (to access coastal launch sites) for operating small unmanned aircraft system (sUAS) for research and commercial purposes. This action would enable over-water flights from the surface to at least 2,000 ft above ground level (AGL). The airspace in this Alaskan Arctic area has been used for decades by manned aircraft transporting passengers and cargo, conducting scientific research, military missions, search and rescue operations, and other activities. The level of sUAS activity in the Alaskan Arctic has increased in recent years and is expected to continue to increase in the future; however, this increased UAS traffic precedes the development and standardization of UAS technology to detect and avoid other aircraft. While the FAA is working to develop rules, standards, and regulations specific to UAS operations, the arctic airspace user community is proactively working to develop protocols to create an environment where a variety of aerial operations can occur safely, efficiently, and successfully. In 2013 and 2014, the airspace users worked together and with the FAA to deconflict the Alaskan Arctic airspace. We report on the lessons learned during the coordination of aerial operations in 2013 and 2014. Some of the achievements made during those years were: 1) creation of an Arctic Aerial Survey Coordination Group (AASCG), that included representatives from manned and unmanned aerial projects; 2) daily simultaneous operation ("SIMOP") phone calls to allow the AASCG to communicate directly with field teams; 3) distribution of detailed flight plans throughout the AASCG; and 4) evaluation and revision of communication protocols once projects commenced. Recommendations for improving coordination among manned and unmanned aircraft projects in the Alaskan Arctic in the future include designating a central authority to coordinate all flights in the sUAS airspace, developing a grid-based system that can be referenced when communicating flight plans, and requiring that all airspace operators distribute detailed information about their proposed projects to airspace users well in advance of project start dates.

Climate Change: A Human Rights Issue Needing Attention

Leif Monnett
monnett.leif@gmail.com

There is broad scientific acceptance of the fact that climate change is having, and will have, adverse, environmental effects on many ecosystems, including arctic and subarctic ecosystems in Alaska. There is also rapidly growing recognition at the international level, and in some national governments, that many effects of climate change threaten basic human rights. The United Nations Human Rights Council summarized that "…[C]limate change poses an immediate and far-reaching threat to people and communities around the world and has implications for the full enjoyment of human rights". Thus, in addition to being an environmental issue, climate change is a human rights issue. More focused efforts are needed to identify the potential linkages between climate change and human rights at the national, state, and local levels. Only then can steps be taken to address such impacts. The main objectives of this presentation are to 1) raise awareness among biological scientists who are studying climate change effects on natural ecosystems in Alaska that their findings are relevant to human rights issues; 2) encourage such scientists to actively seek collaborations and engage in interdisciplinary research with human rights practitioners and social scientists to determine environmental impacts that are likely to lead to threats to human rights in Alaska; and 3) to make the case to both research funders and researchers that such interdisciplinary efforts are needed now. In order to accomplish this, I succinctly define what is meant by human rights; iterate internationally agreed upon human rights; show that under international law, countries have obligations and duties to protect and promote human rights; review and summarize current international, national, and state efforts to recognize and prepare for human rights impacts of climate change; identify examples of environmental threats of climate change to arctic and/or subarctic ecosystems that are likely to result in threats to human rights and conversely; identify examples of human rights threatened by climate change impacts to ecosystems in Alaska; and present suggestions for ways in which local entities can encourage cross-disciplinary investigation of climate change impacts on human rights in Alaska in both ongoing and future arctic research.

Correlation of Arctic Marine Debris to Human Occupation Distributions in Northwest Alaska

Tahzay Jones
National Park Service (NPS), tahzay_jones@nps.gov
Peter Neitlich
NPS, peter_neitlich@nps.gov

Alaska's remote coasts are well known for accumulations of marine debris that can degrade the habitat and can pose hazards for wildlife. Marine debris clean-up and management actions are typically positively correlated with coastal accessibility, where beach clean-ups are typically focused on the most accessible beaches. Preparing for a 2015 implementation of a large scale clean-up effort within the park boundaries, the National Park Service conducted marine debris surveys in Bering Land Bridge National Park in 2013 and 2014, and Cape Krusenstern National Monument in 2014, using roving aggregated accumulation surveys and Alaska modified NOAA marine debris shoreline survey protocols. The results of these surveys demonstrated an increase in debris accumulation with proximity to human occupation. While much of the coastline of Bering Land Bridge has a relatively low level of debris accumulation, accumulations of debris concentrations in Cape Krusenstern National Monument are positively correlated to inholdings within the Park. The results of these surveys will be used to prioritize Park areas for debris removal.

Community Integrated Coastal Incident Preparedness Project

Peter Neitlich
National Park Service (NPS), peter_neitlich@nps.gov
Tahzay Jones
NPS, tahzay_jones@nps.gov

Decreases in summer arctic ice extent have increased arctic marine traffic and energy resource exploration, increasing the risks of marine incidents along the sensitive 1,600 km of BELA and CAKR coastlines. Ecological risk assessments of the area have identified a myriad of challenges associated with a marine incident response in the area. Additionally, the Geographic Response Strategies (GRS) established by the State and Federal partners to protect sensitive areas have never been examined to determine logistical feasibility.

This project aims to conduct field evaluation of 32 tactical GRS sites along the BELA and CAKR coasts. Goals are to provide information to support or revise protection strategies; quantify and visualize shipping traffic to better understand and inform the local communities of increases in marine traffic and associated risks through analysis of AIS satellite data; develop a simulation model to better understand increasing marine traffic in the Bering Strait region; and better prepare local communities for a marine incident by providing informational workshops designed to understand the stages of a response, command and operations structure, and areas of support needed during a response.

This project achieves several recommendations from the 2011 Northwest Arctic ecological risk assessment (Aurand and Essex 2012): 1) Build on existing capacity in the village by providing training to prepare local residents for spill response and ICS; 2) Engage local stakeholders and provide more opportunity for area planning in the local community; and 3) Increase outreach to expand community understanding of threats to oil spills and obtain input on natural resources via an exchange of indigenous and western knowledge bases. This will be accomplished over a total of 3 years in cooperation with the Alaska Department of Environmental Conservation, Alaska Chadux, National Oceanic and Atmospheric Administration, U.S. Fish and Wildlife Service, U.S. Coast Guard, Aleutian and Bering Sea Island LCC, and the Wildlife Conservation Society; as well as engaging with the communities of the Northwest Arctic region.

Arctic Shield 2014: Arctic Oil Spill Response and Tool Interoperability

Zachary Winters-Staszak
NOAA, Office of Response & Restoration (NOAA-ORR), zachary.winters-staszak@noaa.gov
Amy Merten
NOAA-ORR , amy.merten@noaa.gov
Kurt Hansen
U.S. Coast Guard, Kurt.A.Hansen@uscg.mil
Jill Bodnar
NOAA-ORR, jill.bodnar@noaa.gov
Aaron Racicot
NOAA-ORR, aaron.racicot@noaa.gov

As the Arctic becomes more accessible to industrial activities and tourism, new tools must be identified and tested to prepare for oil spills in the region. Harsh weather and remoteness will limit spill response techniques proven in more temperate environments. Oil and sea ice interaction, movement and freeze-thaw events create additional complexities to survey, track and recover oil. In August of 2014, the National Oceanic and Atmospheric Administration (NOAA) participated in the U.S. Coast Guard Research and Development Center's Arctic Technology Evaluation aboard the U.S. Coast Guard Cutter *Healy* to investigate technologies for potential use in an arctic oil spill response.

During the evaluation, fluorescein dye and oranges were applied as oil simulants. Both media were surveyed and tracked by multiple technologies. Surveying at altitude, NOAA's Unmanned Aerial System, the Puma, recorded high-resolution imagery as an Aerostatic balloon tethered to the *Healy* recorded the dye plume footprint. The Oil Spill Recovery Institute provided GPS-enabled tracking buoys to record ice floe movement and surface ocean currents.

Data from each technology were visualized in an offline instance of NOAA's Environmental Response Management Application (Stand-alone ERMA®), a mapping tool that assists emergency responders, environmental resource managers, and communities in dealing with incidents that may harm the environment. Stand-alone ERMA provides situational awareness where unreliable Internet bandwidth exists. Data from the various technologies were integrated into Stand-alone ERMA in near real-time by scripting unique code to streamline data standardization. Ship-board satellite Internet was utilized to synchronize the data from Stand-alone ERMA with the online ERMA site so results could be viewed by agency leadership back home.

Results from the evaluation provided valuable insight into the need for a comprehensive suite of technologies that can operate in concurrence and in harsh conditions. Due to the remote nature of the Arctic, rapid dissemination of data from the field to decision-makers will rely on novel solutions and require significant investment in planning for hazardous incidents. As such, this presentation will discuss the importance of tool interoperability,

results from the technology evaluation and recommendations for subsequent evaluations focused on oil spill response in the Arctic.

Summer Zoogeography of the Northern Bering and Chukchi Seas

Mike Sigler
NOAA, Alaska Fisheries Science Center (AFSC), mike.sigler@noaa.gov
Franz Mueter
University of Alaska Fairbanks (UAF), fmueter@alaska.edu
Bodil Bluhm
University of Tromso, bodil.bluhm@uit.no
Morgan Busby
AFSC, morgan.busby@noaa.gov
Ned Cokelet
NOAA, Pacific Marine Environmental Laboratory, edward.d.cokelet@noaa.gov
Seth Danielson
UAF, sldanielson@alaska.edu
Alex De Robertis
AFSC, alex.derobertis@noaa.gov
Lisa Eisner
AFSC, lisa.eisner@noaa.gov
Ed Farley
AFSC, ed.farley@noaa.gov
Katrin Iken
UAF, kbiken@alaska.edu
Kathy Kuletz
U.S. Fish and Wildlife Service, kathy_kuletz@fws.gov
Bob Lauth
AFSC, bob.lauth@noaa.gov
Libby Logerwell
AFSC, libby.logerwell@noaa.gov
Alexei Pinchuk
UAF, aipinchuk@alaska.edu
Chris Wilson
AFSC, chris.wilson@noaa.gov

Ocean currents, water masses, and seasonal sea ice formation determine linkages among and barriers between the biotas of the Bering and Chukchi Seas. The Bering Sea communicates with the Chukchi Sea via northward advection of water, nutrients, and plankton through Bering Strait. However, continuity of the ocean's physical properties is modulated by regional differences in heat, salt, and sea ice budgets, in particular, along the meridional gradient. We will use summer abundance data from zooplankton, benthic epifauna, fish (bottom and surface trawl, acoustic midwater), and seabird surveys conducted concurrently during 2012 and 2013 to identify the environmental factors that most influence distributions of biota within the Chirikov-Chukchi Province (the eastern Bering Sea shelf north of Saint Lawrence Island [Chirikov Basin] and the U.S. portion of the Chukchi Sea). Regional differences in summer distributions of biota largely reflect the underlying hydrography, although sediment characteristics also play a role for benthic fauna. Although annual variation may affect our results, our comprehensive ecosystem

survey approach should yield new insights into the ecological relationships of this Arctic region.

AMBON – a U.S. Arctic Marine Biodiversity Observing Network

Katrin Iken
University of Alaska Fairbanks (UAF), kbiken@alaska.edu
Bodil Bluhm
University of Tromso, bodil.bluhm@uit.no
R. Eric Collins
UAF, recollins@alaska.edu
Lee Cooper
University of Maryland (UM), cooper@cbl.umces.edu
Seth Danielson
UAF, sldanielson@alaska.edu
Jacquline Grebmeier
UM, jgrebmei@cbl.umces.edu
Russ Hopcroft
UAF, rrhopcroft@alaska.edu
Kathy Kuletz
U.S. Fish and Wildlife Service, Kathy_Kuletz@fws.gov
Franz Mueter
UAF, fmueter@alaska.edu
Sue Moore
NOAA, Pacific Marine Environmental Laboratory, sue.moore@noaa.gov
Kate Stafford
University of Washington, stafford@apl.washington.edu
Rob Bochenek
Alaska Ocean Observing System (AOOS), rob@axiomalaska.com

The goal of the new Arctic Marine Biodiversity Observing Network (AMBON) project is to build an operational marine biodiversity observing network for the Chukchi Sea continental shelf in the US Arctic. The AMBON has four main goals: 1) to close current gaps in taxonomic and spatial coverage in biodiversity observations on the Chukchi shelf; 2) to integrate past and ongoing research programs on the U.S. Arctic shelf into an Arctic biodiversity observation network; 3) to demonstrate how an observing network could be developed in other regions and ecosystems; and 4) to link with international programs on the pan-Arctic level (e.g., through the Circumpolar Biodiversity Monitoring Program (CBMP)).The AMBON aims to develop a sustainable model of continuous biodiversity observation including all levels of diversity from genetic to organismal to ecosystem. The AMBON will fill taxonomic (from microbes to mammals), functional (food web structure), spatial and temporal (continuing time series) gaps of other field programs, and link to environmental oceanographic observing systems. AMBON is a 5-year partnership between university and federal researchers, funded through the National Ocean Partnership Program, with contributions from the National Oceanographic and Atmospheric Administration, the Bureau of Ocean and Energy Management, and the Shell Exploration and Production Company. AMBON will allow us to better coordinate, sustain, and synthesize research efforts, and make data

available to a broad audience of users and stake holders, from local to pan-Arctic to global.

Assessment of Marine Oil Spill Risk and Environmental Vulnerability for the State of Alaska

Jason Lehto
NOAA, Office of Habitat Restoration (NOAA-OHR), jason.a.lehto@noaa.gov
Danielle Reich
Applied Science Associates (ASA), DReich@asascience.com
Richard Balouskus
ASA, RBalouskus@asascience.com
Dagmar Schmidt Etkin
Environmental Research, Inc, etkin@environmental-research.com
Jacqueline Michel
RPI, jmichel@researchplanning.com
Margaret McBrien
Louis Berger, MMcBrien@louisberger.com
Jennifer Steger
NOAA-OHR, jennifer.steger@noaa.gov

Alaska's waters are rich in biological resources that are sensitive to spilled oil. These waters are also host to oil exploration/ production activities and heavy vessel traffic, and are bordered by land-based facilities that handle oil. This combination of sensitive resources and potential oil spill sources increases the risk of a damaging spill. Planning for oil spills and Natural Resource Damage Assessments (NRDA) in Alaska and the arctic must start with an analysis of the risk. Many spill and NRDA planning resources have been and will continue to be used to plan and prepare for oil spills in Alaska's and in arctic waters. To ensure that these resources are being used to best effect, it is vital that a risk analysis is conducted. Although there have been many studies that have focused on oil spill risk in Alaskan marine waters, none have looked at the State holistically.

The objectives of this risk analysis were to determine the probabilities of spills occurring with respect to geographic region, oil type, and season, as well as the potential impacts from an oil spill, considering oil characteristics and the vulnerability of the state's environmental resources. This assessment involved the development of a detailed model of region- and season-specific environmental vulnerability for Alaska, which was combined with spill incident rates and potential volumes of oil spills to construct the overall risk model and determine the regions/seasons of highest relative risk.

The analysis also included an assessment of future relative risk for the year 2025, based on expected changes in oil spill likelihood and volume that might occur with changes in vessel traffic, oil exploration and production activities, and the regional economy.

With the immense size of Alaska, the remoteness of potential spill sites, and the limited response resources available, it's imperative that these resources are efficiently positioned. This risk analysis will provide spill planners and NRDA practitioners with data to guide their strategic planning processes in Alaska and the arctic to ensure resources are being used effectively.

Establishing Pre-Development Baseline Concentrations of Hydrocarbons and Metals in Sediments and Marine Invertebrates From the Chukchi Sea, Alaska

Gregory Durell
Battelle Memorial Institute (BMI), durell@battelle.org
John Trefry
Florida Institute of Technology, jtrefry@fit.edu
John Hardin
BMI, hardinj@battelle.org
Brenda Lasorsa
Pacific Northwest National Laboratory, brenda.lasorsa@pnnl.gov
Waverly Kallestad
Fairweather LLC, waverly.kallestad@fairweather.com

Oil and gas exploration is being planned for the Chukchi Sea, including the Burger Prospect where exploratory drilling occurred in 1989 and 1990. In 2008, a multi-disciplinary program was initiated to establish baseline environmental conditions and thereby enable detection of any potential future impacts from offshore activities. The program includes studies of physical, chemical and biological oceanography. This presentation focuses on the distribution of metals and hydrocarbons in sediments and marine invertebrates.

Oceanographic surveys were conducted in 2008, 2012, and 2013 to collect sediment and invertebrates. During 2013, samples were collected at 41 stations in the Burger Prospect, including reference locations. Somewhat fewer stations were sampled in 2008 and 2012. Samples were analyzed for polycyclic aromatic hydrocarbons (PAH), saturated hydrocarbons, petroleum biomarkers and a series of major and trace metals required by the NPDES permit. The chemical concentrations in sediment and organisms are discussed. Natural and anthropogenic processes are considered to help explain the sources, concentrations and distribution of the chemicals and their ecological significance.

Sediment hydrocarbon and metal concentrations were somewhat variable, reflecting different sediment characteristics (e.g., grain size, TOC content), but were low and at background levels throughout most of the study area. Subtle petrogenic hydrocarbon signatures were observed in the regional sediments, as have been reported previously (e.g., COMIDA), but concentrations were within the range found in other similar Arctic environments. Total PAH concentrations, for instance, were generally in the 200 to 400 µg/kg range. Sediment trace metal concentrations were demonstrated to be present at natural background levels when normalized to Al, a major constituent of the sediment. Sediment core data showed a uniform historical record. Concentrations of Ba and PAH were above background at a historic drilling site. PAHs and metals in invertebrates were within the background range for the adjacent Beaufort Sea and the rest of the Chukchi Sea; the lipid content and clam species influenced the accumulation of PAH. This

baseline information greatly enhances our understanding of the Chukchi Sea and helps establish reference values for detecting potential future chemical changes (e.g., from O&G production and climate change) and for carrying out impact assessments.

Benthic Community Assessment at Three Locations within the Chukchi Sea

Meg Pinza
ENVIRON, mpinza@environcorp.com
Jay Word
ENVIRON, jdword@environcorp.com
Lucinda Word
ENVIRON, cword@environcorp.com
Jack Word
ENVIRON, jqword@environcorp.com
Waverly Kallestad
Olgoonik-Fairweather, LLC , waverly.kallestad@fairweather.com

ENVIRON conducted an initial benthic community assessment in three locations in the Chukchi Sea as part of a baseline environmental sampling program for Shell Exploration and Production Company. The objective of the program is to evaluate the existing environmental conditions prior to and after exploratory drilling. Twenty-one grab samples were collected at each of study locations from the R/V *Westward Wind* in the summer of 2013.The samples were inventoried, preserved and shipped to the ENVIRON laboratory in Port Gamble, Washington, for processing and identification. Whenever possible, identification of species was to the lowest taxonomic level. A benthic atlas of the key species was created to provide a sense of the diversity of species present in the Chukchi Sea. Standard metrics of benthic diversity and abundance were conducted on the data set. In addition, cluster analysis was performed to provide patterns of similarity and differences among the three study locations. There were distinct community differences among the study areas in terms of species diversity however abundance of organisms was fairly similar across all three study locations. In addition, sediment profile image analysis (SPI) was conducted which provided a digital record of the seafloor and fauna within the first 20 cm of the sediment. The results of SPI images and benthic community analysis were used to assess benthic community; some similarities and differences were noted between these two types of assessments. The SPI and benthic community analysis observed the abundance of ophiuroids particularly in one area. However, the SPI did not show the dominance presence of maldanids or clam communities within various locations in the study area whereas benthic community analysis did observe these communities. Our conclusion is the use of both the benthic infaunal samples and the SPI camera provides a more complete understanding of the community than either tool used alone. This benthic community dataset represents a comprehensive baseline of conditions prior to any operations at the prospect areas. Before-After-Control-Impact (BACI) analysis will be used to compares differences in the “before” samples from farfield and nearfield to differences in any samples collected after drilling.

The Synthesis of Arctic Research (SOAR) Program: Status and Plans

Sue Moore
NOAA, Pacific Marine Environmental Laboratory (PMEL), sue.moore@noaa.gov
Phyllis Stabeno
PMEL, phyllis.stabeno@noaa.gov
Lisa Sheffield-Guy
University of Washington, lisa.guy@noaa.gov

The Synthesis of Arctic Research (SOAR) was initiated in 2011 to bring together a multidisciplinary group of arctic scientists and Alaskan coastal residents to integrate information from completed and ongoing marine research in the Pacific Arctic (www.arctic.noaa.gov/soar). The goal of the SOAR is to improve our understanding of the relationships among oceanographic conditions (physics, chemistry, sea ice), benthic and lower trophic pelagic species (forage fish and zooplankton), and upper trophic species (marine birds and mammals), with particular emphasis on the Chukchi Sea oil and gas lease sale areas. The SOAR program is supported via an inter-agency agreement between the BOEM and NOAA, with analytical work conducted by scientists and community representatives from a range of academic institutions, government agencies, and villages. Following the establishment of a SOAR Science Steering Committee and a community workshop, synthesis teams were formed to conduct analyses aimed at producing peer-reviewed papers for publication in a Special Issue of *Progress in Oceanography*. During 2012-13, synthesis teams met to compile and discuss available data and observations to address specific deficiencies in our understanding of the Pacific Arctic marine ecosystem. Once the teams identified project goals, they began the complex task of synthetic analyses and manuscript production. The results of these efforts are now coming to fruition. The SOAR Special Issue of sixteen peer-reviewed papers is anticipated for full publication in 2015, with two papers now available online in Open Access. This presentation will highlight results addressing three inter-related SOAR themes: 1) the new biophysics of the Pacific Arctic sector, including sea ice loss, primary production, ocean acidification and acoustic ecology; 2) responses of lower-trophic (benthos and fishes), and 3) upper-trophic (marine birds and mammals) species. The SOAR program will continue through 2016, with a 'Phase II' effort that could include targeted workshops and a smaller set of peer-reviewed publications. Since 2012, the SOAR program has been conducted in collaboration with the Pacific Marine Arctic Regional Synthesis (PacMARS), with the goal of both activities an improved understanding of the Pacific Arctic marine ecosystem in an era of rapid change.

The Pacific Arctic Marine Regional Synthesis: Status and Plans

Lee Cooper
University of Maryland Center for Environmental Science (UM), cooper@umces.edu
Jacqueline Grebmeier
UM, jgrebmei@umces.edu
Bodil Bluhm
University of Tromso, bodil.bluhm@uit.no
Carin Ashjian
Woods Hole Oceanographic Institution, cashjian@whoi.edu
Ken Dunton
University of Texas Marine Science Institute, ken.dunton@utexas.edu
John Trefry
Florida Institute of Technology, jtrefry@fit.edu
Jim Moore
National Center for Atmospheric Research (NCAR), jmoore@ucar.edu
Robert Campbell
University of Rhode Island, rcampbell@gso.uri.edu
Gay Sheffield
University of Alaska Fairbanks (UAF), gay.sheffield@alaska.edu
Steve Okkonen
UAF, okkonen@alaska.net
Sveta Yamin-Pasternak
UAF, syamin@alaska.edu
Eddy Carmack
Department of Fisheries and Oceans Canada, Eddy.Carmack@dfo-mpo.gc.ca
Robert Ulanowicz
UM, ulan@umces.edu

The Pacific Arctic Marine Regional Synthesis (PacMARS), supported by Shell Oil and ConocoPhillips, and managed by the NPRB, was initiated to facilitate new synergies in our understanding of the marine ecosystem of the northern Bering, Chukchi and Beaufort seas. The objectives of the PacMARS research team and collaborators were to: 1) identify and synthesize existing data sets that are critical for evaluating the current state of knowledge of this marine ecosystem, including human dimensions, and 2) define the high-priority, overarching scientific themes and research needs for the next decade or more of marine ecosystem studies in the Pacific Arctic Region. The PacMARS program has been conducted in collaboration with the Synthesis of Arctic Research (SOAR). The coordinated goal for both activities is to contribute effectively to an improved understanding of the Pacific Arctic marine ecosystem in an era of rapid change.

During the project we compiled multiple data sets and/or identified internet-based linkages to data that have now been assembled for public use with other products at the Earth Observing Laboratory of the National Center for Atmospheric Research (http://pacmars.eol.ucar.edu). Organization of this data inventory and related products facilitated our second objective of identifying science needs for potential integrated, multi-agency research and modeling efforts in the northern Bering/Chukchi/Beaufort region.

Major findings, research gaps, and topics of relevance to local communities has now been identified. We outline a prospectus for interdisciplinary research that would evolve around four core topics: 1) advective fluxes involving heat and freshwater, as well as nutrients and biology, 2) sea ice production and melt, 3) biological and physical phenology of key system processes, and (4) nearshore processes. Two broad-scale questions involving advection and phenology can be woven into these four core study themes: 1) How does advection in the Pacific Arctic drive regional gradients between the Bering Strait, southern and northern Chukchi Sea, with connections to the Beaufort Sea including both offshore and coastal systems? 2) How do sea ice conditions drive the phenology of the biological system and what influences those sea ice conditions?

Synthesis of Arctic Research (SOAR) – Physics to Marine Mammals in the Pacific Arctic

Lisa Sheffield Guy
University of Washington, lisa.guy@noaa.gov
Sue Moore
NOAA, Office of Science & Technology, 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 2001 with funding from 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, with particular emphasis on the Chukchi Sea oil and gas lease sale areas. The first phase of the synthesis will produce a special issue of *Progress in Oceanography* comprised of 15 papers addressing 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 (4 papers); 2) Response of mid-level trophic species to the 'New State' of the Pacific Arctic: Benthic and pelagic invertebrates and forage fishes (3 papers); and 3) Response of upper-trophic species to the 'New State' of the Pacific Arctic: Marine mammal and seabird distribution, relative abundance, and phenology (8 papers). Two of these papers have been published online and with open access. The special issue represents the combined effort of more than 100 authors from over 30 institutions. The second phase of SOAR will build upon this synthesis to explore questions generated by Phase I and continue to provide a strong platform to support collaborations among scientists, resource managers and Alaskan Arctic residents.

How Do You Monitor an Ecosystem?: CSESP Studies in 2014

Robert Day
ABR, Inc., bday@abrinc.com
Thomas Weingartner
University of Alaska Fairbanks (UAF), tjweingartner@alaska.edu
Lisanne Aerts
LAMA Ecological, lisanne@lamaecological.com
Arny Blanchard
UAF, alblanchard@alaska.edu
Adrian Gall
ABR, Inc., agall@abrinc.com
David Hannay
JASCO Applied Sciences, David.Hannay@jasco.com
Russell Hopcroft
UAF, rrhopcroft@alaska.edu
Ann Knowlton
UAF, alknowlton@alaska.edu
Jeremy Mathis
UAF, jtmathis@alaska.edu
Jennifer Questel
UAF, jmquestel@alaska.edu
Sheyna Wisdom
Fairweather, LLC, Sheyna.Wisdom@fairweather.com
John Burns
Living Resources, Inc., jburnssr@gci.net
Caryn Rea
ConocoPhillips Alaska Inc., Caryn.Rea@conocophillips.com
Michael Macrander
Shell Exploration and Production Company, a.macrander@shell.com

In 2008–2013, the interdisciplinary Chukchi Sea Environmental Studies Program (CSESP) studied the ecology of the northeastern Chukchi Sea during the open-water season in an area of offshore oil and gas prospects. In 2014, the CSESP sampling design was modified from prospect-specific sampling grids to one consisting of lines of oceanographic stations and bird/mammal surveys perpendicular to and parallel to the coastline and covering ~50,350 km^2 of the northeastern Chukchi Sea. This approach incorporated many of the important aspects of the original CSESP study design (e.g., consistent grid of sampling stations and survey lines that sampled across water-masses; multidisciplinary, ecosystem-sampling approach that examined most trophic levels; seasonal and interannual sampling) and provided a broad-scale description of the region. The study's 76 stations and 6 survey lines sampled physical oceanography, nutrients, chlorophyll-a, zooplankton, benthic macrofauna, seabirds, and marine mammals during 2 cruises (August, September), and the study's 23 acoustic moorings sampled marine-mammal acoustics during the entire summer and fall in 2014. The layout of the sampling grid included sampling across water-masses (5 station lines and survey lines), sampling

in areas of high ecological interest (Ledyard Bay Critical Habitat Unit for Spectacled Eiders, Hanna Shoal Walrus Use Area), sampling within the nearshore zone (1 station and survey line), and sampling a set of oceanographic stations and acoustic-mooring arrays that have been sampled since 2008 and 2006, respectively, increasing the data-set's ability to detect change in the system.

A Synthesis of Important Areas in the U.S. Chukchi Sea

Melanie Smith
Audubon Alaska, masmith@audubon.org
Christopher Krenz
Oceana, ckrenz@oceana.org
Nathan Walker
Audubon Alaska, nwalker@audubon.org
Raychelle Daniel
Pew Charitable Trusts (PEW), rdaniel@pewtrusts.org
Bruce Robson
World Wildlife Fund, mandybruce@co-eco.com
Eleanor Huffines
PEW, ehuffines@pewtrusts.org
Andrew Hartsig
Ocean Conservancy, ahartsig@oceanconservancy.org
Henry Huntington
PEW, hhuntington@pewtrusts.org

A thorough understanding of arctic marine ecology and habitat usage patterns is necessary for making well-informed management decisions in the Arctic Ocean. The objective of our study was to identify and map important areas critical to the functioning of the marine ecosystem in the U.S. Chukchi and Beaufort Sea federal planning areas through a synthesis of best available scientific data. We used spatial analyses and mapping to examine patterns of use and overlap of high-value habitats, including information on wildlife migration routes and foraging areas, subsistence use areas, seafloor habitats, ice habitat areas, and places with high primary productivity. Our maps drew from an extensive literature and data review of the current body of knowledge of the Arctic scientific community. Spatial data sources included telemetry, aerial and boat surveys, maps and area descriptions in published studies, scientifically documented local and traditional knowledge and personal communication with experts. In the Chukchi Sea, interpretation of important-area boundaries was based foremost on the most reliably and precisely mapped spatial datasets, and further documented with supporting information that was less precisely mapped. We collected a library of over 800 related papers and reports, presented spatial data from more than 70 sources, and created 25 new maps of the Chukchi Sea. Based on this information, we identified and described four areas known to be critical to ecosystem functioning and resilience: the Chukchi Corridor, Barrow Canyon Complex, Hanna Shoal Region, and Herald Shoal. Omission from our maps did not necessarily indicate that an area was considered unimportant; additional field data collection from the area could reveal ecological patterns that were not apparent in our analysis. This synthesis brought together information on the current understanding of different aspects of the U.S. Chukchi Sea ecosystem to provide spatial information for management, conservation, and further research.

A Synthesis of Important Areas in the U.S. Beaufort Sea

Raychelle Daniel
Pew Charitable Trusts (PEW), rdaniel@pewtrusts.org
Christopher Krenz
Oceana, ckrenz@oceana.org
Melanie Smith
Audubon Alaska, masmith@audubon.org
Nathan Walker
Audubon Alaska, nwalker@audubon.org
Kristie Livingston
Oceana, klivingstonak@gmail.com
Bruce Robson
World Wildlife Fund, mandybruce@co-eco.com
Eleanor Huffines
PEW, ehuffines@pewtrusts.org
Andrew Hartsig
Ocean Conservancy, ahartsig@oceanconservancy.org
Henry Huntington
PEW, hhuntington@pewtrusts.org

A thorough understanding of Arctic marine ecology and habitat usage patterns is necessary for making well-informed management decisions in the Arctic Ocean. The objective of our study was to identify and map important areas critical to the functioning of the marine ecosystem in the U.S. Chukchi and Beaufort Sea federal planning areas through a synthesis of best available scientific data. We used spatial analyses and mapping to examine patterns of use and overlap of high-value habitats, including information on wildlife migration routes and foraging areas, subsistence use areas, seafloor habitats, ice habitat areas, and places with high primary productivity. Our maps drew from an extensive literature and data review of the current body of knowledge of the Arctic scientific community. Spatial data sources included telemetry, aerial and boat surveys, maps and area descriptions in published studies, scientifically documented local and traditional knowledge and personal communication with experts. In the Beaufort Sea, we used kernel density and isopleth analyses to identify core areas using the Aerial Survey of Arctic Marine Mammals database. We collected a library of over 800 related papers and reports, presented spatial data from more than 50 sources, and created 30 new maps of the Beaufort Sea. Based on this information, we identified and described four important marine areas: the Barrow Canyon Complex, Harrison Bay, and core areas in both the Central and the Eastern U.S. Beaufort. While each of these areas stands out, the U.S. Beaufort Sea shelf and slope are also important migration corridors for marine species that encompass waters in the Beaufort Sea within 75 miles of shore, as well as being identified as important for future ecosystem resilience. Omission from our maps did not necessarily indicate that an area was considered unimportant; additional field data collection from the area could reveal ecological patterns that were not apparent in our analysis. This synthesis brought together information on the current understanding of

different aspects of the U.S. Beaufort Sea ecosystem to provide spatial information for management, conservation, and further research.

Year Two: Ecological Implications of Background PAH and Biomarker Analyses of Nearshore Fish and Sediments of the Central Beaufort Sea, Alaska

John Hardin
Battelle Memorial Institute (BMI), hardinj@battelle.org
Greg Durell
BMI, durell@battelle.org
Sean Burril
LGL Alaska Research Associates, Inc. (LGL), sburril@lglalaska.com
Matt Nemeth
LGL, mnemeth@lglalaska.com
Steve Shaner
ExxonMobil Development Company (EMDC), steve.shaner@exxonmobil.com
Chris Warren
EMDC, christopher.s.warren@exxonmobil.com

Marine invertebrates and fish in the Beaufort Sea naturally bioaccumulate PAHs from ambient seawater, sediments, and food. The concentrations of polycyclic aromatic carbons (PAHs) in nearshore fish are assumed to be a function of concentrations of bioavailable forms of PAH compounds in the water, sediments, and in food sources. In late July of 2013 and 2014, we collected baseline nearshore fishes and sediments in the Central Beaufort Sea using fyke nets and a sediment grab sampler. Fishes were analyzed for PAHs and two types of biomarkers to detect response to potential PAH exposure (fluorescing aromatic compounds (FACs) and Cytochrome P450 1A (CYP1A)). Sediment samples were analyzed for key petroleum hydrocarbons; PAH, chemical biomarkers (such as steranes and triterpanes), saturated hydrocarbons (such as alkanes and isoprenoids), and total petroleum hydrocarbons. Sediment grain size and total organic carbon were also analyzed to strengthen data interpretation. The same fish species were analyzed from both years (Arctic cisco (*Coregonus autumnalis*), Dolly Varden char (*Salvelinus malma*), Least cisco (*Coregonus said*), Broad whitefish *Coregonus nasus*), Arctic cod (*Boreogadus saida*), and Fourhorn sculpin (*Myoxocephalus quadricornus*)) and the same sediment stations were occupied in both years. The hydrocarbon data were analyzed and interpreted to understand the observed distribution and concentrations, and the relationships between sediment and fish data. Results show background levels of PAHs consistent with earlier studies of sediments and biota in the Beaufort Sea. Data are consistent with the hypothesis that the PAHs found in fish tissues and sediment are derived from natural terrestrial sources such as peat that are found in Arctic Alaska coastal and riverine ecosystems.

North Slope Beach Survey Monitoring Program

Ionjon Brower
North Slope Borough (NSB), ionjon.brower@north-slope.org
Lynette Hepa
NSB, Lynette.Hepa@north-slope.org
Shaylyn Storms
NSB, Shaylyn.Storms@north-slope.org
Robert Sarren
NSB, robert.sarren@north-slope.org
Joe Skin
NSB, joe.skin@north-slope.org
Isaac Levitt
NSB, isaac.levitt@north-slope.org
Cyd Hanns
NSB, cyd.hanns@north-slope.org
Dave Ramey
NSB, dave.ramey@north-slope.org
Craig George
NSB, craig.george@north-slope.org
Raphaela Stimmelmayr
NSB, Raphaela.Stimmelmayr@north-slope.org
Taqulik Hepa
NSB, taqulik.hepa@north-slope.org

It is to be expected that with the increasing presence of anthropogenic influences in the Arctic and ongoing climate change effects ARCTIC marine mammal health is being affected by various stressors (i.e., diseases; oil spills; maritime traffic etc.). In the interest of collecting baseline information on live and beach cast marine mammals, the North Slope Borough Department of Wildlife Management (NSB DWM; since 2009 a member of the Alaska Marine Mammal Stranding Network), has been conducting weekly beach surveys in Barrow (2011-2014) during the open water period (June-Oct.). Using a buddy system, beaches [site 1: Barrow to Skull cliff (~56 km) and site 2: Barrow to Plover Point (~ 13 km)] along the coasts are surveyed with ATVs and or boats. Common hazards associated with beach surveys up north are deep water crossings, polar bear encounters, gun safety, engine break downs, communication, and boat safety. *Preliminary results:* With the exception of 2011 where live and dead strandings were dominated by ringed seals (2011 Northern Pinniped Unusual Mortality event; n = 116) marine mammal species observed (2012-2014) in order of importance included walruses (*Odobenus rosmarus divergens*), ice seals (ringed (*Pusa hispida*), bearded (*Erignathus barbatus*), spotted (*Phoca largha*)), grey whale (*Eschrichtius robustus*), bowhead whale (*Balaena mysticetus*), beluga whale (*Delphinapterus leucas*), and harbor porpoise (*Phocoena phocoena*). Total carcass numbers (post 2011) have ranged between 20 and 38 carcasses. Live strandings of orphaned walrus calves (1-3) have occurred on an annual basis and several have been placed at Zoos. Carcass sightings vary between months, with most cases being observed during July and August. In general carcass sightings are increased

after big storms. The determination of cause of death in pinnipeds and walruses is often not possible due to carcass composition. Injuries consistent with killer whale predation have been observed in several grey whales and one bowhead whale. Community input in particular on large whale carcass sightings is significant and aids the response network greatly. In conclusion, the NSB DWM stranding response program is working well and provides baseline health data on important marine mammal subsistence species, information on local ocean currents through large whale carcass drift data, and serves as an important wildlife health surveillance tool for the detection of emerging diseases and unusual mortality events.

Data Management Strategy for the Distributed Biological Observatory (DBO)

Don Stott
National Center for Atmospheric Research (NCAR), stott@ucar.edu
Janet Scannell
NCAR, anstett@ucar.edu
James Moore
NCAR, jmoore@ucar.edu
Steve Williams
NCAR, sfw@ucar.edu

The Distributed Biological Observatory (DBO) is a national and international sampling, shared-data approach to the investigation of biological responses to a rapidly changing Arctic marine ecosystem. The DBO is specifically included in the draft U.S. National Ocean Policy Strategic Plan. The DBO links physics with biology through sampling on transects centered on locations of high productivity, biodiversity and rates of biological change, effectively producing a change detection array that runs along a latitudinal gradient extending from the northern Bering Sea to the Barrow Arc.

The Earth Observing Laboratory (EOL) of the National Center for Atmospheric Research (NCAR) is managing the data and archiving the research products developed by the NSF-sponsored DBO Principal Investigators. The data archive that is being developed for the DBO (http://dbo.eol.ucar.edu) is envisioned as a visualization of this change detection array with free access to the data from each of the stations on the transects. EOL will be coordinating with AXIOM Consulting of Anchorage, AK, to incorporate visualization products developed using the AXIOM Workspace within the EOL online data archive, geospatially linking products with the data. All data and metadata archived within the project-specific DBO Data Archive will also become listed and available through the Advanced Cooperative Arctic Data and Information Service (ACADIS) Gateway (https://www.aoncadis.org). Expanding from the Pacific Arctic sector, the DBO will also serve as a framework for international research coordination via the Arctic Council Circumpolar Biodiversity Monitoring Program (CBMP), and is recognized as a task of the pan-arctic Sustaining Arctic Observing Network (SAON) program. EOL is charged with the archiving of data and metadata of the NSF-funded DBO PIs, but a goal to be worked toward is for the data archive to also serve the international members of the DBO Program and provide a source for their data that comes out of the multi-year, international effort.

Preliminary Findings of an Oil-in-Ice Mesocosm Experiment

Kyle Dilliplaine
University of Alaska Fairbanks (UAF), kbdilliplaine@alaska.edu
Marc Oggier
UAF, moggier@alaska.edu
Hajo Eicken
UAF, hajo.eicken@gi.alaska.edu
Bodil Bluhm
University of Tromso, bodil.bluhm@uit.no
Rolf Gradinger
Institute of Marine Research, rolf.gradinger@imr.no
Eric Collins
UAF, recollins@alaska.edu

The recent journey of the M/V *Nunavik* through the Northwest Passage without the accompaniment of an icebreaker is a first for a cargo vessel and highlights the rise in maritime activities in the Arctic. Concurrently, hydrocarbon exploration in coastal and offshore regions of the Chukchi and Beaufort seas has increased. Both sectors bring with them an increased risk of a spill. The infiltration of oil into sea ice poses significant risk to arctic biota, specifically the ice algae and invertebrates that inhabit the brine channel system and support the arctic food web. This work seeks to evaluate small scale infiltration and distribution of Alaskan North Slope crude oil in sea ice and its impact on sea ice biota. We designed cold-room simulated in-situ experimental mesocosms to grow sea ice from 360 L of artificial sea water, including inoculation with natural ice biota cultures, and to simulate an oil spill from below. Artificial lighting mimicked field measurements at the time of biota collection. Duplicate treatments include an oil control (Oil+, Biota-), a biological control (Oil-, Biota+) and an experimental treatment (Oil+, Biota+). During the spring 2014 experiment, ice was grown to a thickness of 35 cm at ambient air temperatures ranging between –5 and –15 ˚C. 5 cm diameter cores were extracted from each tank two days prior to oil release (OR-2) and at days three (OR+3) and/or thirteen (OR+13) days post oil release. The initial findings showed an unexpectedly high degree of oil permeation through lab grown ice, manifested as pooled surface oil. Chlorophyll *a* concentration in bottom ice from biotic treatments without oil was higher than tanks containing oil by one order of magnitude. Bacterial abundance varied greatly between tanks and cores but declined in horizons containing oil while increasing in unoiled tanks up to two orders of magnitude within fifteen days. Data analysis of additional biological parameters and sea ice microstructure is ongoing. The findings from this pilot study will guide upcoming experiments in 2015 and continued efforts in the evaluation of oil toxicity to ice meiofauna and ice microstructural constraints on oil migration.

Temporal Variability of Biodiversity in Arctic and Subarctic Marine Benthic Communities

Arny Blanchard
University of Alaska Fairbanks, alblanchard@alaska.edu

An emerging question in understanding arctic biodiversity is the influence of climatic variations on observed patterns of marine biota. Northward water circulation along Alaska's coastline results in transport of larvae to high latitude seas resulting in high similarity of benthic faunal assemblages from southeast Alaska to the Arctic. Expectations of faunal changes with climatic warming are that species introductions may increase. Yet, pathways through which regional climate variations might influence locally-measured biodiversity are not clear. Temporal variations in density and richness of benthic macrofauna collected with a van Veen grab from a sub-arctic glacial fjord in Port Valdez, Alaska, were compared to regional climate indices to evaluate sources for observed patterns from 1989 to 2012. Density and species richness of subtidal communities demonstrated significant positive correlations with the Pacific Decadal Oscillation (PDO), an index of regional climate change in the North Pacific. Likewise, a short-term correlation was observed between macrofaunal density and richness in the northeastern Chukchi Sea and the Arctic Oscillation (AO: an index of sea-level atmospheric pressure). Intertidal community richness (determined via nondestructive, quadrat sampling) in Port Valdez demonstrated a weaker correlation with the PDO but a high correlation with the North Pacific Gyre Oscillation (NPGO: significantly correlated with seawater salinity and nutrient concentrations) from 1988 to1992. Positive PDO values are associated with increased water circulation along coastal Alaska presumably leading to greater benthic density and richness via increased transport of larvae. Increased nutrient levels suggested by positive NPGO values might lead to enhanced development of intertidal regions in Port Valdez. Observed biodiversity patterns are mediated by regional-scale factors and biodiversity estimates from short-term studies will be incomplete with potentially less than 50% of biodiversity captured irrespective of the spatial extent of sampling. Thus, regional climate variations may in part, drive inferences concerning biodiversity in short-term studies regardless of scale and sampling intensity.

ShoreZone Imaging and Mapping in Alaska

Cindy Hartmann Moore
NOAA, Alaska Regional Office (AKRO), cindy.hartmann@noaa.gov
Steve Lewis
AKRO, steve.lewis@noaa.gov
John Harper
Coastal and Ocean Resources, Inc., john@coastalandoceans.com
Mandy Lindeberg
NOAA, Alaska Fisheries Science Center, mandy.lindeberg@noaa.gov
Mary Morris
Archipelago Marine Research Ltd., marym@archipelago.ca
Susan Saupe
Cook Inlet Regional Citizens Advisory Council, saype@circac.org
Amalie Cauvillion
Nature Conservancy, acouvillion@tnc.org

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

Approximately 112,592 km of ShoreZone imagery exists for the Pacific Northwest coastline including the entire shoreline of Oregon (1,795 km), Washington (4,933 km), British Columbia (37,619 km), and 68,245 km of the Alaskan coastline (~86%).The Alaska ShoreZone imaging and mapping project is ongoing with 85% of the coastal imagery mapped or with mapping in progress and ~ 14% (9,300 km) of the coastline remaining to be imaged. The Alaska imagery can be viewed online at http://alaskafisheries.noaa.gov/shorezone/.

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

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

Food for Thought: Regional Response to Avian Cholera in the Bering Strait Region of Alaska

Gay Sheffield
University of Alaska Fairbanks, gay.sheffield@alaska.edu
Vera Metcalf
Eskimo Walrus Commission, VMetcalf@kawerak.org
Brandon Ahmasuk
Kawerak Subsistence Program, sub.dir@kawerak.org
Raphaela Stimmelmayr
North Slope Borough, raphaela.stimmelmayr@north-slope.org

The Bering Strait is the narrow international waterway that connects the North Pacific Ocean to the Arctic Ocean, divides Alaska from Russia, and forms a maritime corridor for access in-between. Concurrently, reliance on marine resources remains essential to the regional American population of approximately 10,000 Alaskans. Decreasing ice conditions herald not only ecosystem changes but increased opportunities for novel disease outbreaks.

During November 2013, an unusual marine bird mortality event off the north coast of Saint Lawrence Island located in the Bering Strait was reported by community residents. A multi-agency (Federal and State) response ensued resulting in not only the first confirmed report of avian cholera in Alaska but the first documentation of avian cholera in several of the marine species involved.

Lessons learned:

With communication networks and collaborative regional efforts, marine wildlife disease detection in remote coastal areas is more in areas with active subsistence utilization of marine resources.

Remote response capacity by authorized state and federal wildlife agencies located in urban centers is most efficient and comprehensive when integrated with existing regional comprehensive communication networks and traditional ecological knowledge.

Assessment and mitigation of novel disease as it relates to marine wildlife in northern and western Alaska cannot be viewed solely as a wildlife conservation concern. Rather, investigations of diseased marine wildlife events must consider research strategies and management issues – in terms of regional public health and food security concerns.

Simulation of Seasonal Phytoplankton Variations in the Bering-Chukchi Sea with a 3-D Physical-biological Model

Haoguo Hu
University of Michigan, hghu@umich.edu
Jia Wang
NOAA Great Lakes Environmental Research Laboratory, jia.wang@noaa.gov

A three-dimensional physical-biological model (ice ocean model, nutrients, phytoplankton, zooplankton, and detritus) was applied to the Bering and Chukchi seas for 2007-2012. The model reasonably reproduced the seasonal phytoplankton variations in the Bering-Chukchi seas. The spatial distributions of the phytoplankton are predominantly controlled by sea ice, light, and nutrients. A particular vertical phenomenon **—**subsurface chlorophyll-*a* maximum is simulated, the key role to the phenomenon is thermocline and it is tuned by light and nutrients. The model results are compared to data and it captured the basic structure of the measured temperature, salinity, nutrients and chlorophyll-a on the Bering shelf. Sensitivity studies were conducted to reveal the underlying mechanisms of the Bering-Chukchi ecosystem in response to changes in sea ices, light and nutrients.

Seasonal Circulations on the Southeast Bering Sea Shelf

Wei Cheng
University of Washington, wei.cheng@noaa.gov
Carol Ladd
NOAA, Pacific Marine Environmental Laboratory (PMEL), carol.ladd@noaa.gov
Phyllis Stabeno
PMEL, phyllis.stabeno@noaa.gov

The ocean circulation in the area north of the Unimak Pass is examined using a multi-year (2007-2012) integration of the Regional Ocean Modeling System (ROMS). This area is located at the eastern rim of the Bering Canyon where flow through the relatively shallow Unimak Pass meets and interacts with the Aleutian North Slope Current. As a result, the circulation there is influenced by local as well as remote wind forcings, ocean bathymetry, tides, and exhibits high spatial and temporal variability on multiple scales. The simulation suggests that on seasonal time scales, flow entering the area from the Unimak Pass and the slope region roughly balances the eastward transport onto the shelf plus the strong northwestward flow. Unimak Pass throughflow and the northwestward flow have stronger seasonal variations than the eastward transports, and of the latter, the further inshore component has larger seasonal changes than the transport from the slope region. Such seasonality of the modeled transports is consistent with observations. We will place these results in the context of shelf-wide Bering Sea circulation and discuss their biological and fishery implications.

Toward the Accurate Estimation of a Passive Species Biological Mortality

Gleb Panteleev
International Arctic Research Center, UAF (IARC-UAF), gleb@iarc.uaf.edu
Jacob Stroh
IARC-UAF, jnstroh@alaska.edu

The framework to estimate the mortality coefficient of a biological species population is proposed. This method is based on a four-dimensional variational (4Dvar) algorithm using an advection-diffusion equation with mortality to describe the behavior of passive biological content, such as small larvae, fish eggs and etc. The approach is validated using a set of Observing System Simulation Experiments (OSSEs) configured for the Bering Sea. To illustrate the approach, we use two idealized data sets, modeling those which could be obtained from biological surveys, and realistic velocity fields for the Bering Sea as reconstructed through 4Dvar data assimilation into two nested models with spatial resolutions of 15 km and 7 km, respectively. The variety of assimilated data includes both *in situ* (e.g., temperature, salinity, velocity, surface drifters) and satellite (Sea Surface Height (SSH), Sea Surface Temperature (SST), ice concentration, velocity) observations. The ocean model reanalysis is used to supply the necessary environmental context of the equation modeling the species' mortality. The OSSEs show that proper planning of biological surveys and an accurate velocity field are critical for obtaining a accurate estimates of biological species' mortality rates.

The Bering Sea CO_2 Sink: New Autumn and Winter Observations of a Seasonally Ice-covered Continental Shelf

Jessica Cross
University of Alaska Fairbanks (UAF), jncross@alaska.edu
Jeremy Mathis
UAF, jtmathis@alaska.edu
Karen Frey
Clark University, kfrey@clarku.edu
Cathy Cosca
NOAA, Pacific Marine Environmental Laboratory (PMEL), cathy.cosca@noaa.gov
Seth Danielson
UAF, sethldanielson@alaska.edu
Nicholas Bates
Bermuda Institute of Ocean Sciences, nick.bates@bios.edu
Richard Feely
PMEL, richard.a.feely@noaa.gov
Taro Takahashi
Lamont-Doherty Earth Observatory, Columbia University, taka@ldeo.columbia.edu
Wiley Evans
UAF, wiley.evans@alaska.edu

The eastern Bering Sea is a dynamic region that supports some of the highest rates of primary productivity in the global oceans. As a result, the coastal ocean in this area is typically believed to be a moderate to strong sink for atmospheric CO_2 on the annual scale. However, this assumption is based primarily on CO_2 fluxes observed during the growing season, as winter observations have previous been limited. Recently, new high-resolution data collected through several programs have greatly increased the spatiotemporal resolution of CO_2 flux data in the Bering Sea, including the first autumn and winter observations on this scale. Using data from 2008-2012, here we constructed monthly climatologies of sea-air CO_2 fluxes for the period between April and December. While CO_2 fluxes during autumn and winter have historically been assumed to be zero due to the mechanical inhibition of gas exchange by ice cover, we found that the Bering Sea behaves as a source of CO_2 to the atmosphere during autumn and winter months as weakening primary production and strengthening respiration processes cause CO_2 to accumulate in the water column. After accounting for the moderating impacts of wintertime cooling and the mechanical inhibition of CO_2 flux by ice cover, we estimated that winter efflux balance 65% of spring and summer CO_2 uptake by the oceans. Overall, we estimate that the Bering Sea shelf is an annual CO_2 sink of ~6.8 Tg C yr-1. In a changing climate, we expect that warming sea surface temperatures, reduced ice cover, and greater wind speeds with enhanced gas exchange will decrease the size of this CO_2 sink by augmenting conditions favorable for greater wintertime outgassing.

Communities Associated with Crustose Coralline Algae Reef Habitat in the Western Aleutian Islands

Alexandra Ravelo
University of Alaska Fairbanks, amravelo@alaska.edu
Benjamin Weitzman
U.S. Geological Survey, Alaska Science Center, bweitzman@usgs.gov
Douglas Rasher
University of Maine (UM), douglas.rasher@maine.edu
Robert Steneck
UM, steneck@maine.edu

The reef-forming coralline algae *Clathromorphum nereostratum* dominates the rocky subtidal of the North Pacific. This slow growing species has been documented to survive for millennia accumulating mass over centuries of growth (specimens 50 cm thick have an estimated age of at least 1,500 years). In rocky subtidal habitats *C. nereostratum* constitutes habitat for a variety of infaunal and boring invertebrates, although diversity and community composition has not been quantified across variable spatial scales or habitats. *C. nereostratum* structure and integrity may be affected by ocean acidification and bio-erosion from urchin grazing, which in turn could influence associated fauna. The objectives of this study were 1) to describe invertebrate communities associated with *C. nereostratum* as a benchmark for understanding future variation, and 2) contrast communities associated with *C. nereostratum* collected in kelp bed and urchin barren habitats. A total of 35 *C. nereostratum* specimens of various sizes (average thickness ranged from 4.8 to 82 mm) were collected at three western Aleutian Islands in the summer of 2014. All organisms found on and within the sample specimens were identified to the lowest practical taxonomic level and counted. Ninety taxa were identified from twelve invertebrate and three algal phyla. Total abundance was highly correlated to average specimen thickness (r^2: 0.85), while the total number of taxa had a moderate correlation to average specimen thickness (r^2: 0.55). The largest difference in community composition was between islands and to a lesser extent between kelp and urchin barren habitats (ANOSIM test, Global R: 0.67 and 0.457, respectively, at a 0.01 significance level). Results from this study quantify the use of *C. nereostratum* as habitat by a diverse community of associated fauna. Also, the variability in these communities (between habitats and among islands) indicates that particular environmental drivers may be affecting these communities locally and regionally.

The Relative Importance of Advective Versus In-situ Processes to Mesozooplankton Biomass on the Eastern Bering Sea shelf

Georgina Gibson
University of Alaska Fairbanks (UAF), ggibson@iarc.uaf.edu
Albert Hermann
NOAA, Alaska Regional Office, Albert.J.Hermann@noaa.gov
Kate Hedstrom
UAF, kshedstrom@alaska.edu
Enrique Curchitser
Rutgers University, enrique@marine.rutgers.edu

Biomass of large crustacean zooplankton on the eastern Bering Sea varies quite substantially inter-annually and appears negatively correlated with temperature. The mechanisms giving rise to these changes are not yet well understood, including whether changes are due to bottom-up processes driven by physical processes, or by top-down effects due changes in predation pressure. Using model estimates, we have explored the mechanisms, timing, and location of the transport of zooplankton onto and over the eastern Bering Sea shelf. Results indicate that the timing of on-shelf transport and the distribution of oceanic zooplankton on the shelf can vary substantially between one year and another. The Bering, Pribilof, and Zhemchug canyons and Cape Navarin appear to be regions of elevated on-shelf transport and wind direction is the primary factor controlling inter-annual variability in the timing, amount, and location of the on-shelf zooplankton transport. The response of both zooplankton production and on-shelf advection to environmental changes in the Bering Sea will likely not be uniform as the north and south appear to respond in opposite directions to environmental variability. In-situ production by zooplankton appears to be generally more important to biomass accumulation than the transport of zooplankton biomass by advective processes. However, advection of zooplankton biomass may be an important contributor to standing stock biomass in some regions at certain times of year – notably the northern and southern middle shelf regions.

Do Modeled Zooplankton Abundances Increase the Hindcast and Prediction Strength of Fish Recruitment Models?

Mette Skern-Mauritzen
Institute of Marine Research (IMR), mette.mauritzen@imr.no
Mike Sigler
NOAA, Alaska Fisheries Science Center (AFSC), mike.sigler@noaa.gov
Solfrid Hjøllo
IMR, solfrid.hollo@imr.no
Kirstin Holsman
University of Washington (UW), kirstin.holsman@noaa.gov
Cecilie Hansen
IMR, cecilie.hansen@imr.no
Jan Arge Jacobsen
Faroe Marine Research Institute, janarge@hav.fo
Guðmundur Óskarsson
MRI, gjos@hafro.is
Kjell Rong Utne
IMR, kjell.rong.utne@imr.no
Kerim Aydin
AFSC, kerim.aydin@noaa.gov
Albert Hermann
UW, Albert.J.Hermann@noaa.gov
Georgina Gibson
University of Alaska Fairbanks, ggibson@iarc.uaf.edu

The recruitment of many fish stocks is highly variable because of large interannual fluctuations in survival during early life stages. Prediction of year-class strength is critical in fisheries management, and may improve if the effects of environmental factors that influence pre-recruit mortality are accounted for in recruitment models. However, recruitment predictions are often challenged by non-stationary recruitment-environment correlations, indicating that the environmental correlates used only partially reflect the causal mechanisms involved. Typically, environmental correlates tested in recruitment models reflect ocean climate, primary production and/or predator abundances, whereas information on food availability is rarely available due to the inability to sample zooplankton at relevant locations and spatio-temporal scales. Here we examine if zooplankton fields from coupled ROMS-NPZ models are positively associated with the recruitment of 9 stocks in the Bering, Norwegian and the Barents Seas, and if such zooplankton fields increase the hindcast and prediction strength of the fish recruitment models. Preliminary results support positive associations between modeled seasonal zooplankton abundances and fish recruitment.

Comparison of Carbon (δ13C) and Nitrogen (δ15N) Stable Isotope Ratios of Atka mackerel (*Pleurogrammus monopterygius*) and Pacific cod (*Gadus macrocephalus*) in the Central and Western Aleutian Islands

Katherine Opp
University of Alaska Fairbanks (UAF), kropp@alaska.edu
Todd O'Hara
UAF, tmohara@alaska.edu
J. Margaret Castellini
UAF, jcastellini@alaska.edu
Andrew Cyr
UAF, andrew_cyr@hotmail.com
Susanne Mcdermott
NOAA, Alaska Fisheries Science Center, susanne.mcdermott@noaa.gov
Todd Loomis
Ocean Peace Inc., tloomis@oceanpeaceinc.com
Lorrie Rea
UAF, ldrea@alaska.edu

δ^{13}C and δ^{15}N stable isotopes measured in muscle tissue is a useful tool in determining where, geographically, an animal feeds and at what trophic level. In some situations diet composition of a predator can be estimated if the isotope signatures of major prey is known. This study tests the null-hypothesis that there are no differences in stable isotope ratios in two important prey species for Steller sea lions (*Eumetopias jubatus*), neither between fish species nor geographically or seasonally within species. For Atka mackerel (*Pleurogrammus monopterygius)* and Pacific cod (*Gadus macrocephalus*) we compare muscle δ^{13}C and δ^{15}N levels from samples collected from two regions in the Aleutian Islands [western Aleutian Islands (n = 18 and n = 20, respectively, July 2013) and central Aleutian Islands (n = 20 for each species, July 2014)] during the summer. We compare muscle samples collected in the central Aleutian Islands in summer (n = 20 for each species, July 2014) and in the spring (n = 20 for each species, March 2013) to assess seasonal differences. The null hypothesis will be accepted if the δ^{13}C and δ^{15}N values for each species show no significant difference between location and time using a GLM analysis of variance. If accepted, prey data from any point along the Aleutian Islands could be collectively used when modeling Steller sea lion diet. The null-hypothesis will be rejected if significant differences in δ^{13}C and/or δ^{15}N levels are found within the same species of fish between regions. This would suggest that diet modeling could only be undertaken using fish collected in the foraging area of each sea lion.

An Age-Length Structured Population Dynamics Model for Fish and Invertebrate Stocks

Andre Punt
University of Washington (UW), aepunt@uw.edu
Caitlin Allen
UW, cia2@uw.edu

The models on which stock assessments for fish stocks are based tend to be age-structured while the models on which stock assessments for invertebrate stocks are based tend to be length- or stage-structured. However, the dynamics of fish and invertebrate stocks are based on processes which are both age- and length/stage-structured. A model which unifies the age-structured and length/stage-structured models commonly used for assessments of North Pacific stocks is developed. It is unclear how severely biased results of assessments will be when they are ignore either age- and length/stage-structured dynamics. Consequently, simulations based on eastern Bering Sea Tanner crab are conducted to evaluate the magnitude of such biases, as well as the imprecision which results when fitting age- and length/stage-structured models to data typically available for the North Pacific.

Early Marine Ecology of Juvenile Chinook Salmon (*Oncorhynchus tshawytscha*) on the Yukon Delta, Alaska

Katharine Miller
NOAA, Alaska Fisheries Science Center, katharine.miller@noaa.gov

Chinook salmon (*Oncorhynchus tshawytscha*) is an important commercial, recreational, and subsistence resource in the Yukon River, and recent declines have resulted in declaration of a fishery disaster for this area. While there is extensive information on juvenile Chinook salmon marine ecology during later summer and early fall along the eastern Bering shelf, there is virtually no information on early marine ecology from outmigration through the first marine summer. Adult abundance has been positively correlated to juvenile abundance following the transition from freshwater to the marine environment, but mortality during this phase is high. It is hypothesized that juvenile salmon that fail to reach a critical size during their first summer in marine waters have higher mortality rates in late fall and winter. The objectives of this 2-year study are to 1) quantify the spatial distribution and habitat use of juvenile Chinook salmon from outmigration through the summer in relation to biotic and abiotic variables on the Yukon River delta front and pro-delta, 2) quantify and contrast age, size, nutritional condition, and prey of fishes associated with Yukon Delta front/pro-delta habitats, and 3) characterize the fish community associated with the Yukon River delta front and pro-delta. We present preliminary data from our first year of sampling showing spatial distribution of Chinook and chum (*O. keta*) salmon catches in relation to environmental variables and summary information on species composition at sampling stations.

Feasibility of Direct Age Determination in Commercially Important Crustaceans in Alaska

Raouf Kilada
University of New Brunswick, rkilada@unb.edu
Joel Webb
Alaska Department of Fish & Game (ADFG), joel.webb@alaska.gov
Laura Stichert
ADFG, laura.stichert@alaska.gov
Quinn Smith
ADFG, quinn.smith@alaska.gov
Kevin McNeel
ADFG, kevin.mcneel@alaska.gov

Management of commercially important crab and shrimp stocks in Alaska has been hindered by the inability to directly determine individual age. A lack of comprehensive age information leads to poor understanding of life history schedules, difficulty in estimation of parameters necessary for modeling population dynamics, and uncertainty in the determination of appropriate harvest levels. This study evaluated the feasibility of applying a novel direct age determination method based on band counts in thin sections of gastric mill ossicles of red king crab (*Paralithodes camtschaticus*) and Tanner crab (*Chionoecetes bairdi*), and in the eyestalk of spot shrimp (*Pandalus platyceros*). Molting in captivity confirmed that the gastric mill of red king and Tanner crab were retained through ecdysis. The endocuticle region of the cuticle, where bands are formed, was identified in the gastric mill of the crabs and eyestalks of both crab and shrimp by histological staining. Gastric mills of crab and eyestalks of shrimp were processed by standard techniques similar to otoliths or scales in fish. Visible bands were present in these structures and band counts generally increased with increasing body size in all species. Controlled experiments to understand the band formation processes and application of this technique to known-age individuals will be necessary to validate band counts as indicators of chronological age.

Oceanic Dispersal and Behavior of Chinook Salmon in the Bering Sea

Andrew Seitz
University of Alaska Fairbanks (UAF), acseitz@alaska.edu
Mark Evans
UAF, mdevans@alaska.edu
Trey Walker
UAF, rvwalker@u.washington.edu
James Murphy
NOAA, Alaska Fisheries Science Center, jim.murphy@noaa.gov

To examine the oceanic ecology of Chinook salmon (*Oncorhynchus tshawytscha*) in the Bering Sea, about which little is known, we are conducting a proof-of-concept study in which large, immature Chinook salmon are tagged with pop-up satellite archival transmitting tags. While externally attached to the fish, the tags measure and record ambient light (for daily geoposition estimates), and depth and temperature data. On a pre-programmed date, the tags release from the fish, float to the surface of the ocean and transmit the recorded data to overhead satellites which are then retrieved by project investigators. To date, seven tags have been deployed, of which one has reported to satellites. This tag was attached to an 85-cm fish near Dutch Harbor in December 2013 and reported to satellites from the central Gulf of Alaska in April 2014. Based on temperature and depth recorded by the tag, the fish demonstrated three distinct behavioral phases, including Bering Sea feeding, Gulf of Alaska feeding, and movement towards southern British Columbia or the U.S. Pacific Northwest. The data from each behavioral phase provide valuable information about regional oceanic ecology of Chinook salmon, which may be used in a variety of ways, such as for improving bioenergetics models, avoiding bycatch, and improving evaluation of salmon survey data.

Informing Rebuilding Efforts: Understanding the Effects of Red King Crab, Temperature and Fish Predation on Survival and Habitat Selection by Age-0 Pribilof Islands Blue King Crab

Courtney Lyons
University of Alaska Fairbanks (UAF), cdlyons@alaska.edu
Ginny Eckert
UAF, gleckert@alaska.edu

The Pribilof Islands blue king crab (*Paralithodes platypus*) stock, which once supported a commercial fishery worth $13 million per year, crashed in the 1980s and has not recovered in the absence of fishing and with significant protection measures implemented through fishery rebuilding plans. To better understand Pribilof Islands blue king crab recovery failure, we conducted a suite of laboratory experiments to assess the influence of habitat, red king crab (*Paralithodes camtschaticus*), temperature, and fish predation on survival and habitat preference of age-0 blue king crab. In single species trials, blue king crabs preferred shell hash habitat, while red king crabs preferred shell hash habitat with vertical structure added. These habitat preferences were similar when both species were mixed, except at higher densities in which blue king crabs showed a preference for shell hash habitat with vertical structure. Blue king crab juveniles in warmer water were more active and showed less habitat preference than when in colder water, while temperature did not influence red king crab juvenile behavior or habitat preference. In fish predation trials run separately for the two crab species, blue king crabs had much higher survival (60%) than red king crabs (33%) when exposed to fish predators. A similar pattern was observed when the two species were mixed and then exposed to fish predators (71% and 12% survival for blue and red king crabs, respectively). Fish predators were most efficient on red king crab prey, with a higher ratio of crabs eaten per strike and target as well as a lower ratio of strikes per target. The two species exhibited different behaviors in the presence of predators, as blue king crabs were more likely to “hunker down” and red king crabs to climb actively within the habitat. Blue king crab juveniles were less vulnerable to fish predation than red king crab. Predation of one crab species on another was not observed during these short trials. Future studies should further explore behavior, predation risk, and distribution of juveniles in the field to better explore potential bottlenecks in the first few years after settlement that could limit recovery.

Movement, Size Composition, Potential Essential Habitat, and Handling of Norton Sound Red King Crab *Paralithodes camtschaticus*

Jenefer Bell
Alaska Department of Fish & Game (ADFG), jenefer.bell@alaska.gov
Hamachan Hamazaki
ADFG, toshihide.hamazaki@alaska.gov

We examined spring/summer movement, size composition, potential essential habitat, and handling of Norton Sound red king crab (*Paralithodes camtschaticus*). During 2012–2014, a total of 19,489 crab were tagged and released, of which 1,384 were recovered over 3 years by crab fishermen and observers. Examination of tag recovery locations suggests Norton Sound red king crab is a single population that is harvested throughout regional commercial fishing areas. Contrary to prior understanding, our evidence suggests not all legal crab move from nearshore winter habitat to offshore summer habitat in a given year. Consequently, brood stock remaining in nearshore waters may be protected from harvest because regulatory closures prohibit summer commercial fishing within nearshore waters. We examined size composition data and found the proportions of legal crab within size classes were consistent with prior assumptions. However, we collected growth information over 2 years and have demonstrated sublegal crab have a larger molt increment than legal crab, which may help redefine the carapace lengths used to establish pre-recruit size classes to more accurately predict future recruitment into the fishery. We have identified potential essential habitat and locations of higher abundances of non-target crab: waters around Cape Nome and between Topkok Head and Rocky Point have higher incidences of sublegal and females crab than other areas in eastern Norton Sound suggesting possible breeding/rearing areas. We have also located areas with higher abundances of non-target crab on the commercial fishing grounds. Incorporation of this information into fisheries management may enable us to refine fishing locations to minimize the handling of non-target red king crab.

An Exploratory Assessment of Thiamine Status in Yukon River Chinook Salmon (*Oncorhynchus tshawytscha*)

Dale Honeyfield
U.S. Geological Survey, honeyfie@usgs.gov
James Murphy
NOAA, Alaska Fisheries Science Center (AFSC), jim.murphy@noaa.gov
Kathrine Howard
Alaska Department of Fish & Game (ADFG), kathrine.howard@alaska.gov
Sean Larson
ADFG, sean.larson@alaska.gov
Lawrence Schaufler
AFSC, lawrence.schaufler@noaa.gov
Wesley Strasburger
AFSC, wes.strasburger@noaa.gov
Angela Matz
U.S. Fish and Wildlife Service, angela_matz@fws.gov

Thiamine (vitamin B_1) status in Yukon and Kuskokwim rivers Chinook salmon (*Oncorhynchus tshawytscha*) was examined through egg thiamine concentration from returning females and the presence of thiaminase (an enzyme that destroys thiamine) was also explored in juvenile muscle and liver tissues collected from the northern Bering Sea. In 2012, 74% of the females had egg thiamine concentrations associated with secondary effects of thiamine deficiency (1.5 – 8.0 nmol/g), while three percent of the returning females had egg thiamine concentrations low enough to produce overt fry mortality (< 1.5 nmol/g); only 23 % of the eggs were thiamine replete (> 8.0 nmol/g). Egg thiamine in Chinook salmon from upper Yukon River was higher in 2001 (11.7) than in 2012 (6.2). In 2001, Chinook and chum (*O. keta*) salmon egg thiamine concentrations were similar at the Bethel, Kuskokwim River site. Average Yukon River Chinook salmon egg thiamine concentrations decreased with migratory distance of females in 2012. Thiamine concentrations in juvenile muscle tissue were all above critical levels (> 3 nmol/g) and varied with dietary thiaminase-positive prey fish. Total thiamine concentrations (nmol/g) in juvenile Chinook salmon muscle (3.8) were similar to coho salmon (*O. kisutch*) (4.15), but lower than chum salmon (8.9) and pink salmon (*O. gorbuscha*) (9.6). Thiaminase was present in Chinook salmon (73%) and coho salmon (54%) diets, and was lower in diets of chum salmon (4%) and pink salmon (11%). These results provide evidence that insufficient thiamine may contribute to the poor production levels observed in Yukon River Chinook salmon.

Estuarine Ecology of Juvenile Salmon on the Yukon River Delta

Kathrine Howard
Alaska Department of Fish & Game, kathrine.howard@alaska.gov
Katharine Miller
NOAA, Alaska Fisheries Science Center (AFSC), katharine.miller@noaa.gov
James Murphy
AFSC, jim.murphy@noaa.gov
Ragnar Alstrom
Yukon Delta Fisheries Development Association, ragnaraydf@aol.com

Little is known about estuarine ecology of juvenile Yukon River salmon (*Oncorhynchus* spp.) during the first critical period: from outmigration through the first marine summer. We present the first year of a two-year study aimed at improving our understanding of juvenile salmon outmigration timing, size, condition, and use of Yukon River Delta habitats. Additional objectives of this study link our findings to the only previous study documenting Yukon Delta outmigration and marine entry of juvenile salmon (conducted in 1987), and to a concurrent survey that occurs in the Northern Bering Sea nearshore marine rearing habitat.

In late May through July 2014, juvenile salmon were collected using a variety of gear types to sample all three mouths of the Delta. Most sampling employed 2-boat tow nets, as was used in the 1987 study. All four salmon species representing major spawning populations in the Yukon River were caught: sockeye salmon (*O. nerka*) are uncommon in the Yukon River. Coho salmon (*O. kisutch*) were noticeably absent from the 1987 Yukon Delta study, and catches in the present study represent the first indication of marine entry timing and size for these fish. Although all species were present at the onset of sampling, coho salmon peak outmigration appears to be earlier than that for Chinook (*O. tshawytscha*), pink (*O. gorbuscha*) and chum (*O. keta*) salmon. Between marine entry and September of nearshore summer rearing, average increase in fork length was 285%, 276%, 196%, and 122% for pink, chum, coho, and Chinook salmon, respectively. There may be greater selective pressure for smaller, sub-yearling smolt (chum and pink salmon) to grow quickly. Chinook salmon experienced least relative growth among these species, likely because Yukon Chinook salmon may outmigrate as freshwater age-0, 1 or 2 fish and there is age-specific variation in size and growth patterns for this species. Average Chinook salmon size in the Yukon Delta was 98 mm in 2014, compared to 96 mm in 1987. Chum salmon in the 1987 study were found to be in three distinct length groups; chum salmon in 2014 were not found to be in distinct length groups, but increase in size was evident over the course of summer outmigration.

Small-scale Atka Mackerel Population Abundance and Movement in the Western Aleutian Islands, an Area of Continuing Steller Sea Lion Decline

Susanne McDermott
NOAA, Alaska Fisheries Science Center (AFSC), susanne.mcdermott@noaa.gov
James Ianelli
AFSC, jim.ianelli@noaa.gov
Kimberly Rand
AFSC, kimberly.rand@noaa.gov
Mike Levine
Lab Temps under contract to the Alaska Fisheries Science Center, mike.levine@noaa.gov
Elizabeth Logerwell
AFSC, libby.logerwell@noaa.gov
Todd Loomis
North Pacific Fisheries Foundation, tloomis@oceanpeaceinc.com

Groundfish stocks in Alaska are managed at large scales, however important ecological interactions, such as predation, spawning and habitat selection occur on local scales. Furthermore, commercial fishing is an activity with potential for localized effects. Improved understanding of the local abundance and movement of fish is critical to understanding the potential for localized depletion by fishing. In 2000, the National Marine Fisheries Service concluded that the Alaska groundfish fishery posed a threat to the recovery of the endangered Steller sea lion (*Eumetopias jubatus*) population. Protection measures were put in place, including Trawl Exclusion Zones in Critical Habitat around sea lion rookeries and haulouts. The designation of these zones mitigates against the possibility that competition between fisheries and sea lions occurs at local scales. Thus, advances in Alaska groundfish fisheries management with regard to their impacts on Steller sea lions require information on local abundance and movement of sea lion prey. Our project assessed the small-scale abundance and local exploitation rates of Atka mackerel (*Pleurogrammus monopterygius*), the dominant prey of sea lions in the Aleutian Islands, in three local areas in the Aleutian Islands, Seguam Pass, Tanaga Pass and Petrel Bank. We accomplished this goal through tagging, releasing and recovering Atka mackerel at each of the study sites and analyzing the data using an integrated mark-recapture model. The model estimated that Atka mackerel population sizes at Seguam Pass and Petrel Bank were approximately 190,000 metric tons, whereas Tanaga Pass was only 29,000 metric tons. Exploitation rates in all 3 areas were below 7%, well below the projected fishing mortality in the stock assessment. In general, the results from this study indicate that Atka mackerel abundance, movement and fishing patterns are variable throughout the Aleutian Islands. It is therefore important to understand fishery dynamics at this scale to assess the variable effect of fishing Atka mackerel subpopulations. This study was the result of NPRB #1007.

Atka Mackerel Essential Fish Habitat on a Local Scale in the Aleutian Islands, Alaska

Mike Levine
Lab Temps under contract to the Alaska Fisheries Science Center, mike.levine@noaa.gov
Susanne McDermott
NOAA, Alaska Fisheries Science Center (AFSC), susanne.mcdermott@noaa.gov
Kimberly Rand
AFSC, kimberly.rand@noaa.gov

This study aims to characterize the habitat of Atka mackerel (*Pleurogrammus monopterygius*), one of the primary prey items for the endangered western Steller sea lions (*Eumetopias jubatus*). This study examines 3 Aleutian Island locales in Alaska: Seguam Pass, Tanaga Pass, and Petrel Bank. During Atka mackerel tagging studies (2011-2012), biological data were collected which included length, weight, sex, maturity, and stomach fullness (proxy for feeding intensity). To characterize the environment, we examined oceanographic conditions using conductivity, temperature and depth (CTD) casts, and the substrate associated with fish presence using underwater camera tows. Seguam is a productive, dynamic pass with ample rocky substrate. Atka mackerel at Seguam were consistently larger by size and weight than those from Tanaga or Petrel. In addition, Seguam had the highest proportion of ripe male Atka mackerel, and the largest number of males in spawning coloration. Stomach fullness was not remarkably higher at Seguam than at Tanaga or Petrel. However, it was consistent during all study periods, indicating that access to prey at Seguam may be seasonally reliable. At Tanaga Pass, near-surface water temperature and salinity values were intermediate between those at Seguam and Petrel; because these measures are associated with upwelled (and, therefore, productive) water, Tanaga may be an area of intermediate productivity at the time of the research charters. Atka mackerel from Tanaga are considerably smaller than those captured at Seguam. This may be due to seasonally limited food availability, or food quality. Petrel Bank is a narrow underwater ridge that is situated far offshore. It rises very quickly from deep (> 300 m) water to a plateau at 100 m - 200 m. We observed the highest average surface water temperatures and lowest salinity at Petrel. Atka mackerel were shorter in length and lighter in weight at Petrel than fish at either Tanaga or Seguam. Future studies will incorporate nearshore habitat characterization (e.g., near sea lion rookeries and haulouts) and how this relates to Atka mackerel life history and abundance. This study was the result of NPRB #1007.

Observations of Seasonal Movement of a Single Tag Release Group of Pacific Cod in the Eastern Bering Sea

Kimberly Rand
NOAA Alaska Fisheries Science Center (AFSC), kimberly.rand@noaa.gov
Peter Munro
AFSC, peter.munro@noaa.gov
Sandra Neidetcher
AFSC, sandi.neidetcher@noaa.gov
Daniel Nichol
AFSC, dan.nichol@noaa.gov

The eastern Bering Sea's Pacific cod (*Gadus macrocephalus*) is the target of one of the most lucrative fisheries in Alaska, however, relatively little is known about movement of cod and how this interacts with intense fishing on local spawning aggregations of cod every spring (January – April). This study aims to draw inferences on cod movement using a single tag release group of fish and the fishery as a representative for movement by qualitatively examining both temporal and spatial patterns of tag recoveries. Based on the tag recoveries in this study and past genetic studies, there is evidence that Pacific cod show both homing tendencies and site fidelity during the spring when large aggregations of cod form to spawn. This study also supports results from an earlier study on Pacific cod movement in this region and presents new insights into cod movement patterns. The cod in this tag release group were widely distributed across the Bering Sea during the summer and fall months and returned to the vicinity of the release site in the spring, presumably to spawn. Understanding the movement of cod and the interactions with the fishery is essential to the successful management of the Pacific cod stock. This study is a result of NPRB #815.

The Ups and Downs of Capelin (*Mallotus villosus*) and Pacific Herring (*Clupea pallasii*) in the Eastern Bering Sea

Alex Andrews
NOAA, Alaska Fisheries Science Center (AFSC), alex.andrews@noaa.gov
Wess Strasburger
AFSC, wes.strasburger@noaa.gov
Ed Farley
AFSC, ed.farley@noaa.gov
James Murphy
AFSC, jim.murphy@noaa.gov
Ken Coyle
University of Alaska Fairbanks, kocoyle@alaska.edu

Data on abundance, biomass, size, and diet of capelin (*Mallotus villosus*) and Pacific herring (*Clupea pallasii*) were collected from a fisheries and oceanographic survey conducted in the eastern Bering Sea from mid-August to early October 2003 through 2011. During warm years (2003 – 2005) capelin catches were low, while during cool years (2006 – 2011) catches were high. Herring catches experienced less variation between climate conditions. Catches for both species were higher in the northern region. Capelin lengths remained relatively constant between climate conditions and among domains, while herring displayed larger lengths in cool years and larger lengths further offshore. Diets were significantly different for both species between climate conditions although not for all domains for herring. Large crustacean prey increased in most domains from warm to cool periods. High proportions of age-0 pollock (*Gadus chalcogrammus)* occurred in the diets during the warm years agreeing with studies that examined diets of other species (e.g., juvenile Pacific salmon; age-0 Pacific cod (*Gadus macrocephalus*); and larger walleye pollock) suggesting limited preferred prey availability during warm years. While the large crustacean zooplankters are considered to be lipid rich, age-0 pollock are a sub-optimal prey source that may be contributing to lengthened pelagic energy pathways. For both capelin and herring, a switch to less energetic prey during warm years may have implications on fitness and future recruitment.

Impact of Climate Variability and Change on Winter Survival of Bristol Bay Sockeye Salmon

Ed Farley
NOAA, Alaska Fisheries Science Center (AFSC), ed.farley@noaa.gov
Greg Ruggerone
Natural Resources Consultants, Inc., gruggerone@nrccorp.com
Ellen Yasumiishi
AFSC, ellen.yasumiishi@noaa.gov
Phil Mundy
AFSC, phil.mundy@noaa.gov
Bev Agler
Alaska Department of Fish & Game (ADFG), bev.agler@alaska.gov
Lorna Wilson
ADFG, lorna.wilson@alaska.gov

Overwinter survival of Pacific salmon (*Oncorhynchus* spp.) is believed to be a function of size and energetic status they gain during their first summer at sea. We test this hypothesis for Bristol Bay sockeye salmon (*O. nerka*), utilizing data from large-scale fisheries and oceanographic surveys conducted during mid-August to September 2002 to 2007. Specifically, we compared distributions of mean circuli spacing during the first year at sea between juvenile salmon and adult sockeye salmon scales to evaluate the magnitude of size-selective mortality during this life stage. A probability curve of size-selective mortality in relation to length (mm) of juvenile salmon was constructed. The juvenile size (length) was then compared to summer/fall oceanographic characteristics on the eastern Bering Sea shelf that may impact their growth rates and probability of survival during winter. This analysis is placed within the context of previously published results on summer/fall and winter marine ecology of Bristol Bay sockeye salmon and how continued warming on the eastern Bering Sea shelf may impact their future growth (during summer and fall) and survival during winter.

Genetic Analysis of Blackspotted Rockfish (*Sebastes melanostictus*) in the Bering Sea and Aleutian Islands

Alex Godinez
University of Alaska Fairbanks (UAF), rkteuthis@gmail.com
Anthony Gharrett
UAF, a.gharrett@alaska.edu
Megan McPhee
UAF, mvmcphee@alaska.edu
Paul Spencer
NOAA, Alaska Fisheries Science Center, paul.spencer@noaa.gov

Rockfishes (genus *Sebastes*) are commercially and ecologically important in the North Pacific Ocean and Bering Sea. Preliminary genetic studies of blackspotted rockfish (*Sebastes melanostictus*) in the Bering Sea and Aleutian Islands (BSAI) found evidence of population structure on a scale that is smaller than current management units. That study was based on a small sample size and few microsatellite loci. Population sub-structure within a single management unit could result in decreased productivity, if uneven fishing effort leads to localized overfishing. Consequently, it was important to verify that observation. In the original project, 173 individuals were analyzed at seven microsatellite loci. In this project, genetic data were analyzed from 1,013 individuals at twelve microsatellite loci, including 168 individuals and six loci from the original study along with six additional informative loci. No strong population genetic structure was detected with this greater sampling. This observation appears to be at odds with analyses of fishery catch and trawl survey data, which indicate relatively high fishing rates and a population decline in the western Aleutian Islands with relatively little replenishment from neighboring areas. It is clear that studies of population genetic structure based on small numbers of individuals and few loci may give misleading results. It is also important to acknowledge the limitations of applying population genetic data to understanding and managing the demographics of exploited fish populations.

The Assessment of Benthic Impacts of Raised Groundgear for the Eastern Bering Sea Pollock Fishery

Susie Zagorski
Alaska Pacific University (APU), szagorski@alaskapacific.edu
Bradley Harris
APU, bharris@alaskapacific.edu
Craig Rose
NOAA, Alaska Fisheries Science Center (AFSC), fishnextresearch@gmail.com
Carwyn Hammond
AFSC, carwyn.hammond@noaa.gov
Scott McEntire
AFSC, scott.mcentire@noaa.gov

The Alaska pollock (*Gadus chalcogrammus*) fishery is working programmatically with scientists from Alaska Fisheries Science Center and Alaska Pacific University, as well as net manufacturers to develop less impactful trawls for capturing pollock near the seafloor. Six groundgear configurations were tested during spring 2014 fieldwork, to compare seafloor contact characteristics and benthic impacts. The aim is to determine the nominal, contact adjusted and susceptibility adjusted swept areas of each new configuration and compare impacts at the component specific level. The nominal swept area, based on the spread of the net while fishing, is the total possible affected area whether or not impact to the seafloor occurred. Contact adjusted swept area is based on actual groundgear encounters with the seafloor; it's determined using a contact index, calculated from seafloor track measurements. The susceptibility adjusted swept area is based on the condition of biological features after contact with groundgear. It's determined using a susceptibility index, calculated by comparing conditions in the affected area to the control area. Contact and susceptibility adjusted swept areas are more accurate calculations of habitat impact than nominal swept area. This entire evaluation is conducted in the context of a fishery habitat impacts assessment that addresses bycatch and essential fish habitat concerns of the North Pacific Fishery Management Council. DIDSON sonar observations, tow length and net mensuration equipment measurements are used to systematically evaluate the seabed contact and ultimately nominal and contact adjusted swept areas. Video observations are used to collect biological feature condition observations to calculate susceptibility adjusted swept area. These evaluations are performed for each new groundgear configuration and every component individually. The component specific comparisons allow for new configurations of less impact to be conceptually designed. We expect the new raised groundgear to have significantly less seabed contact and enough clearance from the seafloor between contact points to limit susceptibility of biological features and thus a smaller adverse impact on benthic habitats than the nominal swept area might otherwise indicate. This presentation focuses on the direct observations of affected seafloor with video cameras and the DIDSON sonar, and applicability of results to habitat impacts assessments.

Capturing Effects of Alternative Groundgear for the Bering Sea Pollock Fishery

Carwyn Hammond
NOAA, Alaska Fisheries Science Center (AFSC), carwyn.hammond@noaa.gov
Craig Rose
AFSC, craig.rose@noaa.gov
Bradley Harris
Alaska Pacific University (APU), bharris@alaskapacific.edu
Scott McEntire
AFSC, scott.mcentire@noaa.gov
Susan Zagorski
APU, szagorski@alaskapacific.edu

In the United States, federally managed fisheries need to minimize both bycatch and the adverse impacts of fishing on Essential Fish Habitat while maintaining commercially viable catch efficiencies of target species. Like many other large scale commercial fisheries, the Alaska pollock (*Gadus chalcogrammus*) fishery operations are increasingly constrained by efforts to avoid bycatch (salmon (*Oncorhynchus* spp.), crab and halibut (*Hippoglossus stenolepsis*)) and the rising cost of fuel. The Alaska pollock fishing industry, in collaboration with scientists at Alaska Pacific University, the Alaska Fisheries Science Center, and members of the fishing gear design and fabrication industry are actively pursuing new trawl designs to address these bycatch and seabed contact issues while maintaining a viable pollock capture efficiency. Adult Alaska pollock aggregate on or near the seafloor, particularly during the day (e.g., Mecklenburg, et al. 2002, Tsuji, S. 1989). Conventional pollock trawls use simple chain footropes that have continuous contact across portions contacting the seafloor. We tested several trawl groundgear configurations designed to capture pollock aggregated near the seafloor while reducing bycatch and impacts to the benthic habitat. Most of the weight of these footropes was concentrated in short sections designed to raise the rest of the footrope, divided into 7 - 90 foot sections, several inches above the seafloor. We tested six different pollock trawl footrope configurations with these long sections made up of different materials with varying weights per foot and diameters (elevated and non-elevated 2” combination wire, elevated and non-elevated 2” Blue line, and ¾’ spectra). A total of 14 trawl tracks were laid down parallel to each other. We used altimeters and tilt meters to monitor seafloor clearance at various points across the footropes. After a week’s time, we ran 10 transects perpendicular to the trawl tracks using a camera/sonar sled. Imagery from the DIDSON sonar on that sled allowed direct observation of the component-specific (e.g., footrope) seabed contact for each groundgear configuration. Acceptance of any alternative footrope would also require that they not foul excessively during setting and retrieval. Experience handling the footropes indicated that any such problems would likely be tractable.

Bioeffects Assessment in Kvichak and Nushagak Bay, Alaska: Characterization of Soft Bottom Benthic Habitats, Animal Body Burdens and Contaminant Baseline

Ian Hartwell
NOAA, National Ocean Service (NOS), ian.hartwell@noaa.gov
Dennis Apeti
NOS, dennis.apeti@noaa.gov
Tony Pait
NOS, tony.pait@noaa.gov
Todd Radenbaugh
University of Alaska Fairbanks, taradenbaugh@alaska.edu
Ron Britton
U.S. Fish and Wildlife Service, ron_britton@fws.gov

The goal of this project is to assess habitat conditions that influence biodiversity and distribution of benthic infaunal communities, contaminants, and chemical body burdens of resident organisms as measures of environmental health in Bristol Bay. Bristol Bay boasts one of the largest commercial and subsistence salmon fisheries in the world. Significant mining activities have been proposed within the bay's watershed that could impact Bristol Bay chemistry and biology, but baseline data are lacking. The NOAA National Status and Trends sediment quality triad approach using a stratified random design for aquatic habitat characterization was used. Field work was initiated in September 2013 and samples were collected in Dillingham harbor and a subset of stations in upper Nushagak Bay including sediment for chemical and toxicity analysis, benthic community samples, and fish for histological and body burden analysis. Sampling was suspended due to poor weather conditions. Additional sampling was carried out during August 2014 in Kvichak Bay and finished at Dillingham in Nushagak Bay. Only data from the 2013 samples are currently available. Additional analyses are in progress. Dillingham harbor is entirely muddy sediment, while the bay is coarse sand, which affects chemical distributions. One sample from the harbor was above detection limits for tri-butyl tin. Chlorinated pesticides and polychlorinated biphenyls (PCBs) were found only at trace levels. Polycyclic aromatic hydrocarbons (PAHs) were higher in the harbor than the bay, but at very low concentrations overall, and was dominated by perylene. Body burdens in fish were relatively low, but rainbow smelt accumulated higher levels of mercury, PCBs and chlorinated pesticides than starry flounder. *Clostridium perfringens* counts, a bacteria indicator of fecal pollution, were higher in the harbor than in the bay. The benthic community in the harbor and the upper bay were low in diversity and abundance, and were dominated by oligochaetes. This was a collaborative effort between the NOAA National Centers for Coastal Ocean Science (NCCOS), the Univ. of Alaska Fairbanks (UAF), and the U.S. Fish and Wildlife Service (FWS). Data and information derived from this project will be essential for monitoring pollution control effectiveness in the watershed and the bay.

Intra-guild Predation Among Early Benthic Phase Red and Blue King Crabs: Evidence for a Habitat-mediated Competitive Advantage

Benjamin Daly
NOAA, Alaska Fisheries Science Center (AFSC), ben.daly@noaa.gov
W. Christopher Long
AFSC, chris.long@noaa.gov

The apparent shift in predominance of commercial crab species from blue king crab *Paralithodes platypus*) to red king crab (*Paralithodes camtschaticus*) around the Pribilof Islands, Alaska, USA, may be driven by ecosystem-level processes such as competitive displacement or predation during early life stages. Specifically, intra-guild predation among species during the early benthic phase might be a source of mortality limiting blue king crab population recovery. In a laboratory experiment, we evaluated how varying ratios of prey species (year-0 blue and red king crabs) and habitat type (shell and cobble) affect prey preference of year-1 red king crabs. Year-0 red king crabs were preferentially consumed over blue king crabs in shell habitat, but not cobble, likely because the smaller interstitial spaces in shell reduced predator foraging efficiency and predator-prey encounter rates. Blue king crabs had high levels of crypsis regardless of habitat type or predator presence/absence, while red king crabs were less cryptic overall compared to blue king crabs, but crypsis increased when predators were present. Preference for red king crabs in shell may reflect divergent adaptations between species for minimizing predation. Blue king crab light, mottled coloration and relatively smooth, flat carapace is well adapted for visual and physical crypsis in shell habitat, while the monochromatic, dark coloration and pronounced spination of red king crabs may make them more conspicuous. Our results show that habitat can mediate intra-guild predation between *Paralithodes* species and suggest that shell material may provide blue king crabs a competitive advantage over red king crabs. The extent or availability of shell habitat to recently settled blue king crabs may be an important factor regulating their distribution and the recovery of depleted populations around the Pribilof Islands.

Blue King Crab, Habitat, and the Ecosystem: Data Rescued From the 1980s

William Long
NOAA, Alaska Fisheries Science Center, chris.long@noaa.gov
David Armstrong
University of Washington (UW), davearm@uw.edu
Janet Armstrong
UW, janeta@u.washington.edu
Alexandra Doty
UW, dotya@uw.edu
Jake Kvistad
UW, jakekvistad@gmail.com
P. Sean McDonald
UW, psean@uw.edu

The Pribilof Islands blue king crab (*Paralithodes platypus*) is currently the only federally managed fishery stock in Alaska that is designated as overfished. The fishery was closed in 1998 and the stock declared overfished in 2002. Despite no directed fishing, the stock abundance has not improved since 2002. The reasons for the decline and the lack of recovery are unknown and data are needed to help answer these questions. In 1983 and 1984, during a period when the stock was healthy, Dr. David Armstrong led a series of three cruises that extensively examined every life-history stage of the blue king crab from larvae to adults. These data included zooplankton tows, to examine larval crab distributions; beam trawl and rock dredge samples, to examine the distribution and abundance of both the crabs and the benthic community; and side-scan sonar traces, to determine habitat type. This data set is an invaluable reference point for researchers trying to determine if and how the ecosystem has changed since the blue king crab stock crashed, and what factors may be inhibiting their recovery. We have performed a data-rescue project with support from NPRB because the data were not available in electronic format. The data from these cruises are now available to all researchers. This poster summarizes the research plan for the cruises and gives examples of the data were collected.

Examining the Effects of Offshore Mining Activities on Habitat Features Important for Norton Sound Red King Crab

Bradley Harris
Alaska Pacific University (APU), bradley.harris@alaskapacific.edu
Mabel Baldwin-Schaeffer
APU, mbaldwin-schaeffer@alaskapacific.edu

The intensity and distribution of Norton Sound seabed mining operations off Nome, Alaska, are increasing rapidly due to high gold prices, advances in underwater mining technologies, and a reality television series produced by the Discovery Channel. Since 1996, the number of permitted offshore mining operations has grown from 3 to more than 200 and the total area designated for mining has increased from 320 to nearly 24,000 acres. Mining activities may adversely impact benthic structures (e.g., cobbles, shell hash, hydroids) thought to be important for Norton Sound red king crab (*Paralithodes camtschaticus*). The photo/video methods typically used to assess benthic structures are problematic in Norton Sound due to near 0-visibility conditions resulting from Yukon River sediments, shallow depths and frequent wind-driven wave events. Our aims were 1) to develop collaborative partnerships in Nome to support a mining impacts study. This step is critical to engaging Alaskan communities in research, particularly when addressing potential resource use conflicts, and 2) to test acoustic methods for sampling and mapping seabed complexity in shallow highly turbid waters. During July 2014 we worked closely with the researchers from Florida International University, NOAA, Alaska Department of Fish and Game, and local residents including crab and mining industry members to test an Unmanned Surface Vessel (USV) equipped with a Kongsberg M3 Multibeam Sonar and a DIDSON. More than 50 km of transects were surveyed near Nome and benthic structures were readily apparent. Analyses are ongoing.

Spatial Analysis of Pribilof Islands Blue King Crab Reveals Novel Implications for the Conservation and Management of a Threatened Species

Jake Kvistad
University of Washington (UW), jakekvistad@gmail.com
P. Sean McDonald
UW, psean@uw.edu
David Armstrong
UW, davearm@uw.edu
Janet Armstrong
UW, janeta@u.washington.edu
Christopher Long
NOAA, Alaska Fisheries Science Center, chris.long@noaa.gov

The commercial fishery for Pribilof Islands blue king crab (*Paralithodes platypus*; henceforth BKC) has been closed since 1999. Populations of BKC have remained low despite having no directed and limited non-directed commercial fishing pressure for about 15 years. In this study, we used historic data from a Pribilof Island survey cruise (1983-1984) to explore the possibility of spatial overlap between juvenile BKC and potential predators that that may contribute to continued low recruitment of the species. The spatial extent of available BKC habitat was digitized and geo-referenced in ArcGIS (ESRI, Redlands, CA) from original maps created following the 1983-1984 cruises. A list of potential predators was determined using historic data and available literature, which we then compared to ongoing National Marine Fisheries Service (NMFS) catch data to determine if patterns in growth of abundance of potential predators could account for the depression in Pribilof Islands BKC. This analysis contributes insight to for the conservation and recovery of blue king crab stocks by revealing important predator-prey interactions based on spatial proximity. We believe these data are useful for ongoing efforts to conserve and recover Pribilof Islands BKC and may contribute to future management.

Examining the Effects of Offshore Mining Activities on Habitat Features Important for Norton Sound Red King Crab

Mabel Baldwin-Schaeffer
Alaska Pacific University, mbaldwin-schaeffer@alaskapacific.edu
Brad Harris
Alaska Pacific University, bharris@alaskapacific.edu

The intensity and distribution of Norton Sound seabed mining operations off Nome, Alaska, are increasing rapidly due to high gold prices, advances in underwater mining technologies, and a reality television series produced by the Discovery Channel. Since 1996, the number of permitted offshore mining operations has grown from 3 to more than 200 and the total area designated for mining has increased from 320 to nearly 24,000 acres. Mining activities may adversely impact benthic structures (e.g., cobbles, shell hash, hydroids) thought to be important for Norton Sound red king crab (*Paralithodes camtschaticus*). The photo/video methods typically used to assess benthic structures are problematic in Norton Sound due to near 0-visibility conditions resulting from Yukon River sediments, shallow depths and frequent wind-driven wave events. Our aims were 1) to develop collaborative partnerships in Nome to support a mining impacts study. This step is critical to engaging Alaskan communities in research, particularly when addressing potential resource use conflicts, and 2) to test acoustic methods for sampling and mapping seabed complexity in shallow highly turbid waters. During July 2014 we worked closely with the researchers from Florida International University, NOAA, Alaska Department of Fish and Game, and local residents including crab and mining industry members to test an Unmanned Surface Vessel (USV) equipped with a Kongsberg M3 Multibeam Sonar and a DIDSON. More than 50km of transects were surveyed near Nome and benthic structures were readily apparent. Analyses are ongoing.

Temporal Fluctuations in Pacific Salmon Diets in the Bering Sea

Wesley Strasburger
NOAA, Alaska Fisheries Science Center, wes.strasburger@noaa.gov

Food habits from all five species of Pacific salmon (*Oncorhynchus* spp.) collected during the Bering Aleutian Salmon International Survey (BASIS) project were investigated during late summer/early fall from 2003 through 2011. Samples were grouped by thermal conditions, Bering Sea Integrated Ecosystem Research Project (BSIERP) region, species, and life history stage (immature or juvenile). The largest dietary shift in all species and life history stages occurred during a period of warmer temperatures. Almost all species and life history stages of salmon, regardless of location (exception off shelf-southeast), consumed primarily walleye pollock (*Gadus chalcogrammus*) from 2003 – 2005. After a period of cooling, region had the largest influence on dietary changes, followed by species and life history stage. Region likely had a large influence due to macro-zooplankton distribution and habitat. The goal of this work was to investigate linkages between salmon growth and environmental conditions via changing prey fields.

Effects of Marine Debris: Phthalate and PCB Contamination in Seabirds from the Western Aleutian Islands

Veronica Padula
University of Alaska Fairbanks, vmpadula@alaska.edu
Douglas Causey
University of Alaska Anchorage (UAA), dcausey@alaska.edu
Sydney Stewart
UAA, smstewart5@alaska.edu
Birgit Hagedorn
UAA, bhagedorn@uaa.alaska.edu
John Kennish
UAA, jmkennish@uaa.alaska.edu

We are investigating the levels of phthalates and polychlorinated biphenyls (PCBs) in various seabird species inhabiting the far western Aleutian Islands. This is the first contaminants work ever done in the most western region of the Aleutian archipelago, thus establishing baseline contaminant levels in an isolated region. This is also the first study quantifying phthalates – the plasticizing chemicals that coat plastic objects – in any seabird species globally. Currently these islands have no point sources of contamination, but they are influenced by ocean currents carrying contaminants and debris from other regions of the Pacific Ocean. We are using species from different trophic levels in our analyses: crested auklets (*Aethia cristatella*) (planktivores), tufted puffins (*Fratercula cirrhata*) (mid-trophic), and pelagic and red-faced cormorants (*Phalacrocorax urile*) (upper trophic). Differences in contaminant levels in tissues from these species may be indicative of biomagnification of phthalates and PCBs through the food chain. Finally, research shows that plastic debris not only carries phthalate pollution to wildlife, but plastics also absorb organic pollutants like PCBs. We will use our data to investigate associations between elevated phthalate levels and elevated PCB levels in tissues from seabirds.

The Pribilof Island Seabird Youth Network

Carley Bourdukofsky, Chauncey Bourdukofsky, Miles Bourdukofsky, Nathan Bourdukofsky, Aiden Bristol, Leslie Jones, Heather Kozloff, Anna Warner, Henry Kushin, Brittney Lestenkof, Courtney Lestenkof, Diamond Lestenkof, Ethan Lestenkof-Mandregan, Ezra Melovidov, Ian Melovidov, Sonia Merculief, and Sean Roever
Pribilof Island School District, seabirdyouth@gmail.com
Doug Causey
University of Alaska Anchorage, dcausey@uaa.alaska.edu
Lauren Divine
Aleut Community of St. Paul Island Tribal Government, lmdivine@aleut.com
Trevor Haynes
University of Alaska Fairbanks, thaynes9@alaska.edu
Karin Holser
St. George Island Institute, karinholser@gmail.com
Pamela Lestenkof
Aleut Community of St. Paul Island Tribal Government, pmlestenkof@aleut.com
Kendra Bush-St. Louis
U.S. Department of Fish & Wildlife Service, kendra_bush-stlouis@fws.gov
Veronica Padula
University of Alaska Anchorage, vmp2011@gmail.com
Ram Papish
self employed, rampapish@yahoo.com
Marc Romano
U.S. Fish and Wildlife Service, Marc_Romano@fws.gov
Tonia Kushin
Pribilof Island School District, kushint@psd-k12.org
Chris Merculief
St. George Traditional Council, chris_merculief@yahoo.com
Ann Harding
Auk Ecological Consulting, a.m.a.harding@gmail.com

The Seabird Youth Network (SYN) is a partnership between the Pribilof School District, the Aleut Community of St. Paul Island, the St. George Traditional Council, the Alaska Maritime National Wildlife Refuge (AMNWR), and the wider scientific community. The network creates exciting opportunities for youth on the Pribilof Islands to learn about seabirds and contribute to long-term seabird monitoring programs. The network is dedicated to creating opportunities for Pribilof youth in four key areas: (a) Opening doors to careers in science and natural resource management; (b) Increasing sense of ownership and understanding of local resources; (c) Providing training in marketable multi-media skills, and (d) Providing education in seabird ecology, research and conservation. A website is used as a platform for sharing seabird lesson plans, posting project updates, and communicating stories of seabirds and marine conservation in the news. The network was initiated in 2012, and continued during 2014 with a summer Seabird Camp held on St. Paul Island and dedicated sessions on seabirds conducted during Bering Sea Days, a week-long annual program developed by the Aleut Community of St. Paul Island and the

Pribilof School District where students of all ages learn about career routes and research projects from resident and visiting scientists. Activity highlights of the year included: learning about seabirds and marine debris, the cultural use of seabirds, and the Refuge's seabird population monitoring program, the creation of "Garbie" the marine debris tufted puffin, and participation in 4th of July celebrations.

Increasing Variability of Ecological Response by Beringian Endemic Seabirds to Rapid Environmental Change

Douglas Causey
University of Alaska Anchorage (UAA), dcausey@alaska.edu
Veronica Padula
University of Alaska Fairbanks, vmp2011@gmail.com
McKenna Hanson
UAA, mckhanson@live.com

Understanding the complex dynamics of environmental change in northern latitudes is particularly critical for arctic avian communities, which are integral components that maintain biological teleconnections between the mid- and northern latitudes. We report on studies done 2009 - 2014 in the far Western Aleutians focused on the coastal dynamics related to climate change of marine bird communities. We use several data sources and analysis techniques, including diet data, stable isotopes, and Bayesian inference, to understand the relationships between increased freshwater runoff from glacier melt, inshore oceanographic change, and ecological response. Our preliminary results indicate that the community-wide spatial and temporal dynamics of marine bird ecosystems are far greater in our study period than in previous decades. In particular, we show that the ecological foraging patterns observed for key Beringian endemics as Red-faced Cormorants (*Phalacrocorax urile*), Tufted Puffins (*Fratercula cirrhatus*), and auklets (Alcidae) are strongly perturbed on very small geographic and temporal scales of 10 km and subdecadal years. Moreover, we find that the variance in observed ecological response to change is increasing rapidly over time. We hypothesize that these fine-scale changes are related to mid-scale oceanographic and trophic-level changes, in addition to larger-scale perturbations possibly related to a cascade of climate-related factors.

Geolocators Reveal the Migratory Patterns and Wintering Distributions of Three Aleutian-Breeding Auklet Species

Katherine Robbins
Memorial University of Newfoundland (MUN), kfr056@mun.ca
Carley Schacter
MUN, crs634@mun.ca
Ian Jones
MUN, ianljones60@gmail.com

Auklets (*Aethia* spp.) are the numerically dominant seabirds in Alaska, nesting in the millions on islands in the Bering Sea, yet little is known about their movements outside the short breeding season (May-August). To address this issue, we used geolocation tags to quantify the year-round movements of crested *(Aethia cristatella*), parakeet (*A. psittacula)* and whiskered (*A. pygmaea*) auklets originating from breeding colonies at Buldir and Gareloi islands in the Aleutian Islands (230 miles apart). The main objectives of our study were to measure the extent of inter-specific and inter-colony variation in migration patterns, timing, and wintering areas. Here we present our preliminary results. In 2013, we deployed 158 geolocators on adult breeding Auklets; 96 were deployed on crested auklets (45 on Buldir, 46 on Gareloi), 39 on parakeet auklets (35 on Buldir, 4 on Gareloi), and 23 on whiskered auklets (Buldir only). We recovered 54% of tags deployed, of which 86% logged useable data for part or the entire year-long deployment. Our preliminary results suggest that breeding whiskered auklets from Buldir remain on or close to their breeding grounds and roost on land at night year-round. In contrast, parakeet and crested auklets are true oceanic seabirds. Crested auklets show no consistent inter-colony differences, but some intra-specific variation. All individuals undertook a northerly migration to a wintering area in the Bering Sea shelf or Chukchi Sea, followed by a second migration to a more southerly location, usually southwest to the Sea of Japan or Sea of Okhotsk, but sometimes southeast to the coastal waters of Unimak Island. Parakeet auklets winter mainly in the Bering Sea, although there are colony-specific differences, with most individuals from Buldir making an initial trip north to the Chukchi Sea or Gulf of Anadyr, while those from Gareloi head east along the Alaskan peninsula. Future work will concentrate on analyzing the marine habitat variables and anthropogenic stressors that overlap with auklet winter habitat use. Our results will have profound implications for our understanding of the link between seabird distribution and oceanic processes while providing a major advance in the risk assessment of these species.

Testing a New Tape-based External Transmitter Attachment Technique for Sea Ducks Using Captive Long-tailed Ducks During Winter

Sadie Ulman
Alaska SeaLife Center (ASLC) , sadieu@alaskasealife.org
Tuula Hollmén
ASLC, tuulah@alaskasealife.org
January Frost
ASLC, januaryf@alaskasealife.org
Manfred Enstipp
Université de Strasbourg, manfred.enstipp@iphc.cnrs.fr
Russel Andrews
ASLC, russa@alaskasealife.org
Charles Frost
ASLC, charles_frost@fws.gov
Pamela Tuomi
ASLC, pamt@alaskasealife.org

The ability to track sea ducks through telemetry is a critical research tool used to better understand population movements and resource use. Extensive telemetry studies have been conducted on various sea duck species, with well established transmitter attachment techniques. However, the attachment of external tracking devices can have negative consequences for the health and fitness of carriers, hence the importance of attachment techniques that minimize such effects. Transmitter attachment in a diving duck can be more challenging because of their underwater foraging behavior, the importance of maintaining waterproofing of feathers, and the exposure of transmitters to the marine environment. For this study, the long-tailed duck (*Clangula hyemalis*) was chosen as a representative of a diving duck species and was used to test a novel transmitter attachment technique in a sea duck. We attached external transmitters to the back of captive long-tailed ducks using either an already established attachment technique of two subcutaneous anchors (‘Prong’) or a novel adhesive tape/sutures technique (‘Tape’), with a third group serving as Control. We monitored the retention time and transmitter attachment sites of each individual throughout the study. Mean retention time for the Tape attachment technique was 26.0 ± 3.2 days, while the Prong attachment in four out of four birds lasted for the entire pre-determined attachment period (i.e., 59 days). The potential for adverse effects from transmitter attachments should be considered, such as potential for bacterial infection due to the more invasive nature of the Prong technique. Our results indicate that a tape based attachment technique might not be suited for a sea duck study extending over several months, however further development of the technique may improve retention time.

Seabird Die-off Detected During a Major Coccolithophore Bloom in the Bering Sea in 2014

Elizabeth Labunski
U.S. Fish and Wildlife Service (USFWS), Elizabeth_Labunski@fws.gov
Kathy Kuletz
USFWS, Kathy_Kuletz@fws.gov
Ed Farley
NOAA, Alaska Fisheries Science Center (AFSC), Ed.Farley@noaa.gov
Alex Andrews
AFSC, Alex.Andrews@noaa.gov
Lisa Eisner
AFSC, Lisa.Eisner@noaa.gov

In mid- to late August 2014, we found evidence of a seabird die-off event in the southeastern Bering Sea, during a year with unusually warm ocean temperatures. Dead birds were encountered during U.S. Fish & Wildlife surveys for marine birds in conjunction with National Oceanic and Atmospheric Administration's (NOAA) Bering-Aleutian Salmon International Survey (BASIS). Surveys were conducted from western Bristol Bay to St. Lawrence Island from 18 August – 3 October, 2014. The seabird die-off was detected on 19-21 August, on 11 transects totaling 222 km (66.6 km^2), during which we recorded 31 dead birds, mainly murres (*Uria* spp.) within 300 m of the vessel and an additional 20 birds off-transect. During the same period we recorded only 64 live murres. The main seabird die-off event covered an estimated area of 16,616 km^2, and was centered at 57° N latitude, 163° W longitude. The average density of dead birds in this region was 0.47 birds km^{-2}. By extrapolation to the potentially affected area, approximately 7,800 dead birds could have been present, although mortality was likely higher due to low carcass detectability > 100 m from the vessel. During the BASIS survey, corresponding oceanographic and fisheries data documented unusual conditions in the Bering Sea, including a shift in distribution of age-0 pollock similar to that observed during the last warm period (2002 – 2005). In addition, a major coccolithophore (*Prymnesiophyceae* spp.) bloom was detected ~20 km northeast of the main seabird die-off area. Coccolithophores are nontoxic small (~ 5 μm) phytoplankton with calcium carbonate plates which give the water a cloudy/milky appearance. This taxa can flourish in the presence of nutrient poor waters, and has previously been associated with warm water, and seabird die-off event, possibly due to poor foraging conditions. The extent of the coccolithophore bloom was monitored by ship-based surveys and MODIS satellite imagery. Due to the vastness of the bloom, seabirds could have been impacted beyond our survey area.

Pre-Weaning Growth and Blubber Deposition in Pacific Walruses

Shawn Noren
University of California, Santa Cruz, snoren@ucsc.edu
Mark Udevitz
U.S. Geological Survey, Alaska Science Center (USGS), mudevitz@usgs.gov
Chadwick Jay
USGS, cjay@usgs.gov

Walruses (*Odobenus rosmarus*) may be challenged to meet daily energetic demands in their changing Arctic ecosystem. Immature walruses, with limited ability to capture prey, may be vulnerable as they transition from a complete reliance on their mother's milk for nutrition. Mature walruses have the ability to buffer short term energetic deficits by using energy stored as blubber, but little is known about caloric intake or the sequestration and mobilization of blubber in immature walruses. Two orphaned wild walrus calves raised in human care provided the opportunity for controlled study of daily caloric intake and body mass, as well as quarterly measurements of morphology and blubber thickness (21 body sites). During the two year study, the animals increased body mass 2.9 - 5.1-fold and body length 1.3 - 1.4-fold. Caloric intake ranged from 0 to 27,777 kcal day^{-1}, with mass-specific intake decreasing with age. Blubber thickness varied topographically (range: 1.45 - 6.60 cm), with average blubber depth generally increasing with age. Estimates of the proportion of blubber indicated that the 0-2 year-old walruses were comprised of 24 - 30% fat. The influence of caloric intake on body condition in dependent young may have important implications for population dynamics because body condition is related to survival and first year survival is among the most important density-dependent demographic parameters. These food consumption and body morphology data will provide useful inputs to construct bioenergetics models for free-ranging walruses.

Causes of On-land Mortality in Northern Fur Seals (*Callorhinus ursinus*): Long-term Observation on St. Paul Island, Alaska (1986–2014)

Terry Spraker
Colorado State University, Terry.Spraker@ColoState.edu
Tetiana Kuzmina
Institute of Zoology NAS of Ukraine, taniak@izan.kiev.ua
Eugene Lyons
University of Kentucky, elyons1@uky.edu
Tom Gelatt
NOAA, Alaska Fisheries Science Center, Tom.Gelatt@noaa.gov

The population of northern fur seals (*Callorhinus ursinus*) (NFS) on the Pribilof Islands consist of about 50% of the world population. During the last 5 decades, a decline of the NFS population on these islands has occurred. The aim of this investigation was to determine the causes of on-land mortality of the NFSs of all ages on St. Paul Island, Alaska, and was done from 1986 to 2014. Dead NFS pups were primarily collected from two rookeries (Reef and Vostochni rookeries) and necropsied. Totally, 3,206 pups were examined. It was found that the main cause of death of pups was starvation (54.7%). Other causes of mortality included perinatal mortality (19.9%), trauma (18.3%), infections (2.8%), miscellaneous conditions/autolysis (4.6%) and congenital anomalies (2.2%). Necropsies were done on 106 subadult males. Causes of mortality included hyperthermia (40%) and blunt trauma (37%) both related to the subsistence harvest, sharp trauma (6%) rookery/fighting, entanglement (6%) with fishing industry. Non-fatal condition found in subadult males included convulions-6 seals, salmon-orange fat-4 seals, skin neoplasia fibromas-2 seals, squamous cell tumor -1 seal, partially albino pelage with vision impairment-2 seals, complete albino and totally blind-1 seal. Adult females (n = 158) were examined at necropsy. Causes of death of females collected from the rookeries included bites/cellulitis (64%) and dystocia (16%). Female also were accidently killed in the harvest (20%). A total of 70 adult males were examined. The most common cause of death in these adult males was bite wounds with secondary infections 64 animals (91.4%) associated with fighting for territories, however, 3 died from hyperthermia probably following a battle, one was killed by gunshot (.22 caliber rifle), one had a cardiomyopathy and one had a severe infection of the penis with a severe bacterial urinary cystitis.

Gastrointestinal Parasite Community in Northern Fur Seals (*Callorhinus ursinus*): Relation of Seal Age and Parasite Burden

Tetiana Kuzmina
Institute of Zoology NAS of Ukraine, taniak@izan.kiev.ua
Terry Spraker
Colorado State University, Terry.Spraker@ColoState.edu
Eugene Lyons
University of Kentucky, elyons1@uky.edu

Previous studies of the gastrointestinal helminthes in northern fur seals (*Callorhinus ursinus*) (NFS) on St. Paul Island, Alaska, revealed 18 species parasitized these animals: 5 species of Nematoda, 3 – Cestoda, 3 – Trematoda and 7 – Acanthocephalas (Kuzmina et al. 2013, 2014). The goal of the present study was to analyze the relationship of the prevalence and intensity of gastrointestinal helminthes with regard to the age of the NFSs. Analysis of stomach lesions caused the nematodes in NFSs of different ages also was of particular interest.

The study was carried out during July–August 2014 on St. Paul Island, Alaska. Gastrointestinal tracts of 147 subadult NFS males 3-years-old (108 seals) and 4-years-old (39) were collected during the annual Aleut subsistence harvests. All helminthes (5,700 specimens) were collected, fixed in 70% ethanol and identified. Mann–Whitney test (U) was used to compare differences between age groups.

All NFSs examined were infected with helminthes. Totally, prevalence of NFS infection by nematodes was 92.5%, cestodes – 99.3%, acanthocephalans – 49.7%, trematodes – 20.4%. Mean intensity of NFS infection by nematodes was 10.2 (1–82), cestodes – 24.7 (1–107), acanthocephalans – 5.8 (1–28), trematodes – 9.4 (1–127). NFSs 4 years old had a higher abundance of gastrointestinal parasites compared to 3-year olds. Statistically significant differences in NFS infection were observed for Nematoda ($U = 1{,}202$, $p = 0.0001$) and Acanthocephala ($U = 1{,}507$, $p = 0.016$). Differences for Cestoda and Trematoda were insignificant ($p > 0.05$).

Number of gastric lesions caused by nematodes and their severity increased with the age. Prevalence of healed ulcers and nodules in 4-year-old NFSs was 71.7% and 33.3% in 3-year olds. Active ulcers were found only in 4-year-old seals (prev. = 5.1%). Healed ulcers ($\geq$ 0.5 cm) were found in 38.5% of 4-year-old and in 9.3% of 3-year-old NFSs. Small ($\leq$ 0.5 cm) healed ulcers and nodules were observed in 24.1% of 3-year-old and in 28.3% of 4-year-old NFSs. Despite an increase in the of level of NFS infection with age of seals, comparison of our current finding with results of previous studies (Keyes 1964, 1965; Spraker et al. 2003) showed decreasing of NFS infection with gastrointestinal parasites.

Digenean Parasites of the Northern Fur Seals (*Callorhinus ursinus*): Prevalence and Biodiversity on Different Rookeries of St. Paul Island, Alaska

Tetiana Kuzmina
Institute of Zoology NAS of Ukraine (IZ-NAS), taniak@izan.kiev.ua
Terry Spraker
Colorado State University, Terry.Spraker@ColoState.edu
Olena Kudlai
IZ-NAS, kudlai@gmail.com
Eugene Lyons
University of Kentucky, elyons1@uky.edu

Twenty-five species of gastro-intestinal helminth parasitize the northern fur seals (*Callorhinus ursinus*) (NFS) in the Northern Pacific. Digenetic trematodes are the least studied group of them; currently, 4-5 species have been recorded from NFSs. Almost no data on prevalence and intensity of NFS infection with trematodes are published. The aim of the work was to study the biodiversity of the intestinal trematodes as well as their prevalence and intensity in NFS from separate rookeries on St. Paul Island, Alaska.

The studies were carried out during July-August 2012-2014 on St. Paul Island, Alaska. Gastrointestinal tracts of 651 subadult NFS males (3-4 years old) were collected during the annual Aleut subsistence harvests from five rookeries: Morjovi (99), Polovina (136), Lukanin (139), Gorbatch (95), Zapadny (182). Trematodes (3,867 specimens) were collected under light microscope, fixed in 70% ethanol and identified. The Mann-Whitney test (U) was used to compare differences in NFS infection between rookeries.

Intestinal trematodes were registered in 210 NFSs (32.3%). Intensity of NFS infection varied from 1 to 1,540 specimens (average = 18.4±111.1 SD) with median intensity = 2. Prevalence and intensity of NFS infection varied during 3 years: in 2012 prevalence was 45.2%, mean intensity = 26.8 ± 152.7; in 2013 prevalence = 36%, mean intensity = 9.2 ± 19.9; in 2014 prevalence = 19%, mean intensity = 10.1 ± 27.4. However, these differences in NFS infection between three years were statistically insignificant ($p > 0.05$).

Detailed morphological study resulted in the discovery of two common trematode species of NFSs, *Phocitrema fusiforme* and *Pricitrema zalophi*, and one putative new species from the genus *Stictodora*. *Phocitrema fusiforme* was the most prevalent (prevalence = 27.6%, intensity = 10.7 ± 36.1); *P. zalophi* was registered in 1.4% of NFSs; intensity = 3.7 ± 3.0 and *Stictodora* sp.was found in 5.2% of NFSs with mean intensity 17.6 ± 35.0

Significant differences in prevalence and intensity of NFS infection were observed between rookeries. The highest prevalence was registered on Gorbatch rookery (37.9%), the lowest - on Polovina (25.7%). The highest intensity of seal infection was on Lukanin

(41.4 ± 222.3). Our data support the notion about differences in feeding sites of subadult NFS males from different rookeries of St. Paul Island.

Northernmost Stejneger's Beaked Whale (*Mesoplodon stejnegeri*) Stranding, Saint Lawrence Island, Alaska

Gay Sheffield
University of Alaska Fairbanks, gay.sheffield@alaska.edu
Raphaela Stimmelmayr
North Slope Borough (NSB), Raphaela.Stimmelmayr@north-slope.org
Kathy Burek
Alaska Veterinary Pathology Services, avps.kbh@gmail.com
Chris Koonooka
Native Village of Gambell resident, petu_notyou@yahoo.com
Teri Rowles
NOAA, Office of Protected Resources, Teri.Rowles@noaa.gov
Taqulik Hepa
NSB, taqulik.hepa@north-slope.org

During 2013, a total of four Stejneger's beaked whales (*Mesoplodon stejnegeri*) stranded on Alaskan shores during September-November and included the Gulf of Alaska, central Aleutian Islands, and the Bering Strait region. The northernmost documented stranding of a Stejneger's beaked whale occurred near the village of Gambell on Saint Lawrence Island during early October.

A field examination of the adult female whale was conducted on Saint Lawrence Island with subsequent histopathology and diagnostic imaging analyses. No evidence of rope or line wounds, killer whale (*Orcinus orca*) wounds, ship strike, or other obvious trauma was observed. The presence of grossly visible gas bubbles in various vascular locations (i.e., gastrointestinal mesentery, uterus mesentery, heart ventricles) and sub-capsular gas (i.e., kidney, lung) suggest this whale was subjected to a decompression sickness-like disease. Histopathological findings indicated pulmonary hemorrhage and edema being the most likely cause of death. Degenerative myopathy was also present. Preliminary evaluation of the computed tomography (CT) scans indicated multiple air bubbles in the brain, however brain tissue was judged to be autolyzed, therefore post mortem gas bubble production could not be excluded. Further diagnostic imaging analysis is pending.

Collaborative participation and approvals to conduct this response included Native Village of Gambell, Sivuqaq Native Corporation, and local residents. Logistics and protocols involved with a collaborative marine mammal stranding response in the Bering Strait region of Alaska are described.

The Origin of Feces: Does Diet Diversity Matter More Than Prey Quality for Northern Fur Seals?

Mariana Diaz Gomez
University of British Columbia (UBC), m.diazgomez@fisheries.ubc.ca
David Rosen
UBC, rosen@zoology.ubc.ca
Andrew Trites
UBC, a.trites@fisheries.ubc.ca

The steady decrease in population numbers of northern fur seals (*Callorhinus ursinus*) on the Pribilof Islands may be due to reduced quality and diversity of prey available to them in the Bering Sea. However, it is unknown how important diet diversity is compared to prey quality in terms of the abilities of the fur seals to absorb energy and nutrients and whether the interplay between all of these factors could provide insights into the population decline. We therefore investigated how efficiently six captive female fur seals absorbed nutrients and energy when subjected to eight, three-week feeding trials. Diets were composed of four prey species consumed by fur seals in the Bering Sea (pollock (*Gadus chalcogrammus*), herring (*Clupea pallasii*), capelin (*Mallotus villosus*), and commander squid (*Berryteuthis magister*)), fed alone or in combination. We estimated assimilation efficiency (AE) of energy, protein and lipids; as well as net energy gain by quantifying three pathways of digestive energy loss: fecal and urinary energy loss, and heat increment of feeding. This study is the first to measure the heat increment of feeding of fur seals and results show that it varied from 4 - 12% of the gross energy fed. Our results indicated that fur seals assimilated more of the available energy and fat from fattier diets than from learner diets (AE of energy was 95.3 - 97.1% and AE of lipids was 95.3 – 98.6%). However, fur seals assimilated protein with similar efficiency across all diets regardless of diet composition (AE was 95.5 – 96.6%). The highest net energetic gains were from eating the herring diet (80.6%), the lowest was from the capelin diet (53.3%), while the pollock diet was intermediate (76.5%). Additionally, there appeared to be a higher than expected absorption rate for mixed species diets than was predicted from their individual prey components. Overall, our results demonstrate that prey quality is more important than prey diversity in terms of nutritional and energetic gain, but diet diversity does appear to provide an additional advantage. Hence, changes in the quality of prey available to fur seals in the wild will have a significant impact on their ability to attain their daily requirements, which may ultimately impact population fitness.

Evaluation of the Population Dynamics of Steller Sea Lion (*Eumetopias jubatus*) on the Reproductive Rookery by Using Non-monotonic Growth Curves: Comparison of Two Logistic Models

Oksana Savenko
Schmalhausen Institute of Zoology, National Academy of Sciences of Ukraine, o.v.savenko@gmail.com
Vladimir Burkanov
Kamchatka Branch of the Pacific Geographical Institute FEB RAS, vburkanov@gmail.com

Reproductive period in colonies is distinguished by phases of growth, stabilization and decline; their parameters can characterize stability of habitat. Assessment of population dynamics on rookeries of Steller sea lions (*Eumetopias jubatus*) (SSL) previously was performed by using monotone functions – for the growth phase, or separate phases of growth and decline. To describe the entire reproductive period we have tested more complex functions – double logistic model (DLM) and Jolicoeur and Pontier generalized logistic model (JPM). The purpose of our work was to study changes in sex-age composition of SSL at different stages of the reproductive period by using non-monotonic growth curves. In the analysis we used data of daily counts of SSL on the Dolgaya Rock rookery (Lovushki, Kuril Islands) in 2007-2010. Fitting was conducted with the nonlinear mixed-effect models. In the main sex-age groups the empirical data are best described by DLM model. The number of territorial males is equally well described by both models, and the number of other animals JPM model describes better. We found variability in the growth rates of each of the sex-age group, though groups' peak numbers were reached synchronously (the last days of June – beginning of July). Unlike JPM, DRC model allowed us to estimate a plateau period – a week for males and pups, and 2 weeks for females. Models' predictions for the rate of decline in the number of SSL at the end of the breeding period was different: slower in JPM than in DLM, though intergroup differences predicted by one model are also confirmed by the other. Pups and female decrease synchronously and almost with the same as increase rate (by DRC) or slower (by JPM), whereas territorial males sharply decrease after reaching peak, faster than the growth rate (by both models). Both models are suitable for describing population dynamics at the rookery.

Evaluating RNA-Seq as a Tool for Assessing Health Status of Steller Sea Lions (*Eumetopias jubatus*) in an Area of Population Decline

John Harley
University of Alaska Fairbanks (UAF), jharley3@alaska.edu
Lorrie Rea
UAF, ldrea@alaska.edu
Brian Fadely
NOAA, Alaska Fisheries Science Center (AFSC), brian.fadely@noaa.gov
Tom Gelatt
AFSC, tom.gelatt@noaa.gov
Terrance Kavanagh
University of Washington (UW), tjkav@u.washington.edu
James MacDonald
UW, jmacdon@u.washington.edu
Todd O'Hara
UAFs, tmohara@alaska.edu

Steller sea lions (*Eumetopias jubatus*) experienced a sharp decline in population in the 1970 - 1990s from which segments of the population have failed to recover. The situation has been vigorously debated including theories related to prey availability, contaminants, and disease. There have been limited surveys of potential pathogens and no "smoking gun" is evident. High concentrations of total mercury ([THg]) occur in blood and pelage of pups in the western Aleutians Islands, although the physiologic implications are unknown. We report on the potential of next-generation sequencing tools to evaluate gene expression profiles in relation to contaminants, body condition, and post-hoc bacteria surveillance in Steller sea lion pups. We sequenced total-RNA from whole blood samples (preserved in PaxGene collection tubes) of 12 Steller sea lion pups on the LifeTech Ion Proton platform to a depth of 25 million reads. A *de novo* transcriptome was generated using the Trinity aligner using all 12 individuals, and subsequently individual reads were aligned to the newly generated transcriptome using RSEM (RNA-Seq by expectation maximization). After filtering out genes with little evidence of expression, we identified 15,034 genes which we then annotated using standard nucleotide BLAST. After adjusting for multiple comparisons, we identified 61 genes that were expressed differently between individuals with high [THg] (mean 0.14 mg/kg in whole blood) and low [THg] (mean 0.02 mg/kg in whole blood). In addition, we detected transcripts which aligned closely to 23S rRNA from *Mycoplasma haemozaophi*, a species recently described in California sea lions (*Zalophus californianus*). Despite the sub-optimal number of genes identified as significant for pathway enrichment analysis, the potential for RNA-Seq to identify microbial transcripts, as well as the generation of archival transcriptome data, makes it a powerful tool to potentially evaluate the status of populations with respect to contaminants, infectious disease, and other sources of stress or poor condition.

Prevalence of *Coxiella burnetii* and *Brucella* spp. in Tissues From Subsistence Harvested Northern Fur Seals (*Callorhinus ursinus*) of St. Paul Island, Alaska

Colleen Duncan
Colorado State University, colleen.duncan@colostate.edu
Bobette Dickerson
NOAA, Alaska Fisheries Science Center (AFSC), bobette.dickerson@noaa.gov
Kristy Pabilonia
Colorado State University, kristy.pabilonia@colostate.edu
Amy Miller
CytoVet, amymiller_DVM@yahoo.com
Tom Gelatt
AFSC, tom.gelatt@noaa.gov

Background: The northern fur seal (*Callorhinus ursinus*) is an important cultural and nutritional resource for the Aleut community on St. Paul Island Alaska. In recent years, an increasing number of zoonotic pathogens have been identified in the population, but the public health significance of these findings is unknown. To determine the prevalence of *Coxiella burnetii* and *Brucella* spp. in northern fur seal tissues, eight tissue types from 50 subsistence-harvested fur seals were tested for bacterial DNA by real-time polymerase chain reaction.

Findings: Of the 400 samples tested, only a single splenic sample was positive for *Brucella* spp. and the cycle threshold (ct) value was extremely high suggesting a low concentration of DNA within the tissue. *C. burnetii* DNA was not detected.

Conclusions: Findings suggest that the risk of humans contracting brucellosis or Q fever from the consumption of harvested northern fur seals is low.

Busted! First Detection of Steroid Hormones in Pacific Walrus Bones

Patrick Charapata
University of Alaska Fairbanks (UAF), pmcharapata@alaska.edu
Lara Horstmann-Dehn
UAF, lara.horstmann@alaska.edu
Nicole Misarti
UAF, nmisarti@alaska.edu

The Pacific walrus (*Odobenus rosmarus divergens*) is a candidate for the Endangered Species List, because climate warming could affect habitat use and food web structure. With the current change of the Arctic ecosystem, it is unclear how walruses will respond to these possible stressors. In this novel study, steroid hormones (i.e., progesterone, testosterone, estradiol, and cortisol) were extracted from archeological (1,410-2,540 years old) and historical bones (33-81 years old) to determine if hormones could be detected in bones of various ages. Hormone levels were analyzed and validated by liquid chromatography triple quadrupole mass spectrometry (LC-QQQ MS). Progesterone and testosterone were detected, while cortisol and estradiol concentrations were below the detection limit (< 1 ng/g) in all samples. Mean progesterone (10.48 ng/g, n = 6) and testosterone (9.85 ng/g, n = 6) levels were lower in archeological bones (mean age ~1,807 years) compared with historical bone (mean age ~ 60 years), progesterone (42.89 ng/g, n = 10), and testosterone (114.93 ng/g, n = 10) levels. Male testosterone levels (177.40 ng/g, n = 5) were higher than female testosterone (52.46 ng/g, n = 5) levels, while progesterone levels were similar (40.82 ng/g, n = 5).There are two possible explanations for the lower hormone concentrations in the archeological bones. First, steroid hormones are lipophilic and archeological bones have lower lipid levels suggesting the amount of steroids detectable in the sample may be dependent on the amount of lipid present in the bone. Second, all sampled archeological specimens were juveniles, thus containing lower sex steroid concentrations. These preliminary data are the first to address environmental interactions and physiological responses in historic and pre-historic walrus populations.

Blast From the Past: Pacific Walrus Foraging Ecology Across Prehistoric, Historic, and Modern Timeframes

Casey Clark
University of Alaska Fairbanks (UAF), ctclark@alaska.edu
Lara Horstmann-Dehn
UAF, ldehn@alaska.edu
Nicole Misarti
UAF, nmisarti@alaska.edu

The presence of sea-ice and its associated algal biomass has a great impact on productivity and movement of energy in the Arctic marine ecosystem. In recent years, Arctic sea-ice coverage has exhibited substantial declines, and previously unrecorded sea-ice minima have led to concerns regarding the future health of ice-dependent species. The heavy reliance of Pacific walruses (*Odobenus rosmarus divergens*) on sea-ice as a platform for giving birth, molting, and resting between foraging bouts makes this species particularly vulnerable to warming climates and reduced sea-ice coverage. Scientific studies of Pacific walruses span only the last 50 years, thus have little power to predict the effects of future climates on walrus populations. This study uses stable isotope ($\delta^{15}N$ and $\delta^{13}C$) analyses to investigate changes in walrus foraging ecology across three periods (prehistoric, historic, and modern) using samples collected in association with archaeological digs, housed in museum collections, and recovered from animals stranded or killed as part of the Native subsistence harvest. Prehistoric samples encompassed major climatic anomalies including the Roman Warm (2200 – 1900 BP, calibrated years before present), the Medieval Warm (1100 – 800 BP), and the Little Ice Age (450 – 150 BP). Historic and modern samples spanned a series of major regime shifts within the North Pacific and Bering Sea. Preliminary $\delta^{15}N$ values for prehistoric samples (13.65 ± 0.11, mean ± SE) did not differ significantly from $\delta^{15}N$ values of modern samples (13.34 ± 0.07; $p = 0.59$), nor did $\delta^{13}C$ values differ significantly among prehistoric (-18.17 ± 0.22) and modern samples (-17.35 ± 0.45; $p = 0.11$). This indicates the trophic position and foraging ecology of prehistoric walruses was likely similar to that exhibited by walruses today. Analyses are currently being conducted on historic samples. This study provides the first data in a larger project that aims to understand the effects of historic changes in climate on walrus foraging ecology.

Flying Beneath the Clouds at the Edge of the World: Using an Unmanned Aircraft System to Survey the Endangered Steller Sea Lions in the Aleutian Islands

Kathryn Sweeney
NOAA, Alaska Fisheries Science Center (AFSC), kathryn.sweeney@noaa.gov
Van Helker
AFSC, van.helker@noaa.gov
Wayne Perryman
NOAA, Southwest Fisheries and Science Center, wayne.perryman@noaa.gov
Don LeRoi
Aerial Imaging Solutions, dleroi@aerialimagingsolutions.com
Lowell Fritz
AFSC, lowell.fritz@noaa.gov
Thomas Gelatt
AFSC, tom.gelatt@noaa.gov
Robyn Angliss
AFSC, robyn.angliss@noaa.gov

Surveying endangered Steller sea lions (*Eumetopias jubatus*) using manned aircraft presents unique challenges in the remote Aleutian Islands of Alaska. Long distances between the three airfields along the 1,000 mile Island chain, inclement weather (i.e., fog and low ceilings) during the summer breeding and survey season, and dangerous winds at sites adjacent to cliffs combine to severely limit flying opportunities. Aerial photography taken from these flights has proven to be the best method to conduct accurate counts of animals. There is a pressing fishery management concern for up-to-date and accurate trend information for the regions of the Aleutian Islands due to a persistent population decline. This decline abundance has persisted since 2000 for unknown reasons. To address these challenges we used a small unmanned aircraft system (UAS; APH-22 hexacopter) to supplement the NOAA manned aircraft (Twin Otter) surveys in Alaska. During June-July 2014, NMFS biologists working off the USFWS R/V *Tiĝlâx* assessed 34 sites, 12 of which were surveyed with the hexacopter, from Attu Island to the Delarof Islands. This area is served by only a single airport on Shemya Island (Eareckson Air Force Base) for manned aircraft surveys. Simultaneously, the Twin Otter crew surveyed sites east of the Delarof Islands, which is served by 4 airfields. This combined approach resulted in the most complete aerial survey in one field season of adult, juvenile, and newborn Steller sea lions in the Aleutian Islands since the 1970s. Additionally, we were able to sight permanently marked juvenile and adult individuals from high resolution images captured by the hexacopter. NOAA Fisheries plans to continue this multi-platform approach to survey Steller sea lions in Alaska devoting the hexacopter to the Aleutians while relying on manned aircraft for the rest of the range. Furthermore, the hexacopter platform may be utilized for future studies such as, using photogrammetric methods to collect Steller sea lion morphology information, to sight permanently marked individuals, capture mosaics of northern fur seal rookery-space use in the Pribilof Islands, and supplement current methods for estimating fur seal abundance.

Blow as An Alternative Matrix and Non-invasive Tool for Measuring Cortisol in Wild Belugas During Population Health Assessments in Bristol Bay, AK.

Laura Thompson
Mystic Aquarium, a division of Sea Research Foundation Inc (MYSTIC)., lthompson@searesearch.org
Tracy Romano
MYSTIC, tromano@searesearch.org

Glucocorticoids (e.g., cortisol) are often used in wildlife health and conservation efforts as indices of fitness and stressor load; providing information concerning individual or population responses to potential stressors. Typical methodology, however, involves blood sampling which can be invasive, stressful, or unfeasible in free-ranging animals. Recently, alternative matrices for hormone measurements have received a lot of interest, including collection of exhaled breath condensate (blow) from marine mammals. Methodology for collecting blow from belugas (*Delphinapterus leucas*) for cortisol measurement has previously been validated in our lab, and was applied to belugas in Bristol Bay, AK, during live-capture health assessments from 2012-2014. For sample collection, a petri dish covered with precision woven nylon membrane was held inverted over the blowhole for 2 - 4 repeated exhales. Samples were collected at the onset of examination (Pre) as well as just prior to release (Post). In 2014, intermediate plates were also taken throughout the examination. Blow was recovered from membranes by centrifugation and shipped to Mystic Aquarium on dry ice for analysis, or plates were shipped intact on ice packs. Cortisol was measured in samples using a commercially available EIA from Cayman Chemical. Blow samples from a total of 22 whales are included in this study. Pre samples were taken approximately 20-40 minutes from entanglement. There was a slight increase in cortisol between Pre- and Post-samples, though this was not statistically significant. In fact, a decrease in cortisol was detected in several animals. Cortisol appeared to be lowest for Pre- to Post-times < 60 min as compared with > 60 min. However in 2014 alone, cortisol values showed a decreasing trend with increased time. Samples taken throughout examination during 2014 suggest variability in individual responses to handling and sampling, and neither Pre nor Post samples necessarily represent the peak in cortisol response. Ongoing work includes investigating methods to standardize results from variation in dilution. This work demonstrates the usefulness of blow sampling as a tool to measure the cortisol response of belugas and can be applied to sampling stranded belugas and potentially free-ranging belugas such as the endangered population in Cook Inlet.

Determining the Number of Exhales Necessary for the Application of Minimally-invasive Blow Sampling to Molecular Analyses in Wild Belugas (*Delphinapterus leucas*)

Justin Richard
University of Rhode Island (UI), jt_richard@my.uri.edu
Krystle Schultz
UI, krystle_schultz@my.uri.edu
Becky Sartini
UI, blsartini@uri.edu

Blow (exhale) sampling in cetaceans presents a minimally-invasive alternative to biopsy sampling for genetic analyses that may be favored in vulnerable populations such as the Cook Inlet belugas. A sample consisting of a single exhale yields enough DNA for molecular sex determination in aquarium belugas, but this is untested for wild belugas (*Delphinapterus leucas*). Also, the relationship between the number of exhales collected and DNA yield and its subsequent performance in polymerase chain reactions (PCRs) is unknown. We hypothesized that increasing the number of exhales collected would increase the DNA yield proportionally and that higher yields would improve PCR performance. DNA was isolated from 84 samples (45 samples from 4 trained belugas at Mystic Aquarium and 39 samples from 29 temporarily restrained belugas in Bristol Bay, Alaska) using the Qiagen DNEasy kit optimized for blow samples. Samples consisted of 1, 2, or 4 successive exhales, with at least 9 samples per type from each location. DNA concentration was assessed with a spectrophotometer (NanoDrop, ThermoScientific). Measurable DNA was recovered from 82 samples (98%), but the relationship between yield and the number of exhales was not proportional. Yields were similar for all aquarium sample types, while among Bristol Bay samples, four-exhale samples yielded 30x the amount of DNA as single-exhale samples. Successful beluga-specific PCR amplification occurred in 42/45 of the aquarium samples (23/25 single-exhale samples) and 11/20 of the Bristol Bay samples tested (3/10 of the single-exhale samples). The amount of DNA recovered was predictive of PCR performance ($p < 0.05$). The forcefulness of the breath and chance collection of large pieces of cellular debris likely shaped the relationship between the number of exhales and the DNA yield. This technique is immediately applicable to live-stranded belugas. Although DNA amplification was successful in three wild beluga single-exhale samples, at least 2 exhales should be collected to improve PCR success. More advanced methods could be used to further develop the technique for use with free-swimming belugas because a single-exhale is sufficient in many cases. Due to its minimally-invasive nature, blow sampling has the potential to increase genetic sampling in beluga populations, facilitating research and management.

Genetic Variation and Immune Response in Beluga Whales

Tatiana Ferrer
Florida Atlantic University (FAU), tferrer2@fau.edu
Heidi Pagan
FAU, hpagan1@fau.edu
Sarah Rodgers
FAU, sbechdel@fau.edu
Ashley Taylor
FAU, ataylo74@fau.edu
Jorge Monroy
FAU, monroyjh@yahoo.com
Robert Suydam
North Slope Borough, robert.suydam@north-slope.org
Lori Quakenbush
Alaska Department of Fish & Game, lori.quakenbush@alaska.gov
Greg O'Corry-Crowe
FAU, gocorryc@fau.edu

The Major Histocompatibility Complex (MHC) is the system of antigen recognition and presentation that initiates the immune response cascade in vertebrates. Characterizing MHC diversity is a genetic measure of the adaptive aspects of immune function of vertebrate populations, and is therefore of central importance to species conservation. The polymorphism detected within MHC genes is maintained by positive selection but can also be influenced by drift and gene flow. Class II genes defend against extracellular pathogens, suggesting diversity at these loci may reflect the pathogen environment. Using direct sequencing and cloning verification methods, we isolated the entire exon 2 of the Class II DQB locus in beluga whales (*Delphinapterus leucas*) from the Chukchi Sea (n = 20) and the DQA locus in belugas from the Chukchi Sea (Kasegaluk Lagoon n = 17; Kotzebue Sound n = 5), Bristol Bay (n = 13) and Cook Inlet (n=3). This is the first time the entire exon 2 (273bp) for DQB has been sequenced in beluga whales, and at least 4 alleles were detected. Although there are few cetacean studies who have characterized the entire exon 2 for comparisons, this does appear to be a low amount of polymorphism for this locus. In 1995, Murray *et al.* sequenced 172bp for n = 233 beluga whales, and characterized 5 alleles; however, we detected an additional polymorphic site downstream from their fragment, suggesting their allele number is artificially low. To date, DQA has never been sequenced in beluga whales. We analyzed the entire exon 2 (246bp), and, as yet, have found no variation. This is surprising, as we have found substantial polymorphism at this locus in other cetaceans, including bottlenose dolphins, killer whales (*Orcinus orca*), and short finned pilot whales (*Globicephala macrorhynchus*). The monomorphism likely reflects strong selective constraints for the observed allele. However, genetic drift and mutational forces may also be at play. These initial findings may provide some genetic insight as to why some beluga populations are not recovering, but they also highlight the need for a more thorough and comprehensive study within and among beluga whale populations and for further comparative work across higher level taxa.

At-Risk Marine Mammal Populations: Using the NIST Marine Environmental Specimen Bank to Answer Questions

Amanda Moors
National Institute of Standards and Technology (NIST), amanda.moors@noaa.gov
Rebecca Pugh
NIST, rebecca.pugh@noaa.gov
Carrie Goertz
Alaska SeaLife Center, carrieg@alaskasealife.org
Paul Becker
NIST, paul.becker@noaa.gov

In 1989, the National Marine Fisheries Service, Office of Protected Resources (NMFS/OPR), in collaboration with the National Institute of Standards and Technology (NIST) began the National Marine Mammal Tissue Bank (NMMTB) for long-term cryogenic archival of selected marine mammal tissues from stranded animals, fisheries by-catch, and Alaska Native harvests. In 2002, NIST began partnerships with NMFS/OPR and various research institutions to conduct health research on populations of wild bottlenose dolphins. Samples collected from these live animal health assessments are banked as a part of the NMMTB in liquid nitrogen vapor-phase freezers at the Marine Environmental Specimen Bank (Marine ESB) at the Hollings Marine Laboratory in Charleston, SC. Since 2008, NIST partnered with the Alaska SeaLife Center, and researchers from other institutions, to assess the health of and establish baseline data for the beluga whale (*Delphinapterus leucas*) population in and around Bristol Bay, AK, using an approach similar to that used for the bottlenose dolphin health assessments. Beluga whales are of scientific interest because of their vulnerability to climate change, their role as a sentinel species, their importance as a subsistence food item, and the need to understand threats to at-risk populations, such as the Cook Inlet beluga whale. Studying beluga whales can be difficult because the areas they inhabit host a multitude of adverse working conditions. Given these challenges, researchers from different disciplines and institutions are collaborating on studies of belugas in Bristol Bay and those managed at aquaria facilities. NIST intends to expand its efforts in beluga health research through ongoing collaborations with its aquaria partners in the Bristol Bay beluga studies to include archival of blood samples and dietary items collected from belugas maintained at the aquaria for future analysis. The aquaria animals could thus provide a baseline set of samples and associated data that could be used for comparison with wild populations of this species. This research would not only be valuable in addressing health concerns that effect animals in zoological facilities, but may help to answer scientific questions facing wild beluga whale populations as well.

Freshwater Harbor Seals of Iliamna Lake, Alaska; Recent Population Updates

Dave Withrow
NOAA, Alaska Fisheries Science Center (AFSC), dave.withrow@noaa.gov
Jennifer Burns
University of Alaska Anchorage, jmburns@uaa.alaska.edu
Peter Boveng
AFSC, peter.boveng@noaa.gov
Jay VerHoef
AFSC, jay.verhoef@noaa.gov
Greg O'Corry-Crowe
Florida Atlantic University, Gocorryc@fau.edu

Iliamna Lake is home to a unique colony of “freshwater” harbor seals (*Phoca vitulina*) which are likely year-round residents of this large lake located approximately 225 miles southwest of Anchorage. The Alaska Fisheries Science Center’s National Marine Mammal Laboratory, along with the University of Alaska-Anchorage and our partners from the Bristol Bay Native Association and the Newhalen Tribal Council combined resources to census these seals multiple times each year from 2008 to present. Over the years, seals in Iliamna Lake have been seen hauled out on 24 different islands within the lake, occasionally sighted around river mouths and part way up the Newhalen River, but never observed hauled out along the lake’s shoreline. Most of the haulout sites used are located at the east end of the lake, and are relatively, but not entirely, free from predators and disturbance (bears, wolves, man). Four sites (JF16C, JF16EF, JF16H, and JF19B) make up 92% of all sightings. These sites are also where the majority of pups are sighted, as 22%-31% of the seals hauled out at these locations in late July and early August are classified as pups. On August 8, 2014, we recorded 356 seals hauled out, our highest count ever. A recent population analysis estimated the number of seals in the lake to be around 400, with an intrinsic growth rate of 5% per year. This is similar to the average annual harvest as estimated from household surveys. In an analysis of 11 genetic samples which yielded mtDNA haplotype sequences, only a single haplotype was found. Because these samples came from seals harvested by hunters in fall and spring of 5 different years over a 14-year period, the low haplotype diversity is suggestive of low genetic diversity (or high degree of relatedness) within the population. However a larger sample size and greater number of genetic markers are required for definitive conclusions about the degree of diversity within the lake’s seals.

Quantitative Assessment of Species Identification in Aerial Transect Surveys for Ice-associated Seals

Brett McClintock
NOAA, Alaska Fisheries Science Center (AFSC), brett.mcclintock@noaa.gov
Erin Moreland
AFSC, erin.moreland@noaa.gov
Josh London
AFSC, josh.london@noaa.gov
Shawn Dahle
AFSC, shawn.dahle@noaa.gov
Gavin Brady
AFSC, gavin.brady@noaa.gov
Erin Richmond
AFSC, erin.richmond@noaa.gov
Kym Yano
AFSC, kym.yano@noaa.gov
Peter Boveng
AFSC, peter.boveng@noaa.gov

Technological advances have facilitated collection of vast quantities of photographic data from aerial transect surveys of marine mammals. However, when it is difficult to distinguish species from a distance, reliable identification from aerial images can often be challenging. This is the case for ice-associated seals, species for which global climate change has motivated intensive monitoring efforts in recent years. We assess species and age class identification from aerial images of four ice seal species (bearded seals, *Erignathus barbatus*; ribbon seals, *Histriophoca fasciata*; ringed seals, *Phoca hispida*; spotted seals, *Phoca largha*) in the Bering Sea. We also investigate the specific phenomenological and behavioral traits commonly associated with species identification and observer confidence. We generally found species and age class misidentification occurred at relatively low levels, but about 12% of spotted seals were mistaken as ribbon seals. We also found certain traits were strong predictors for observed species, age class, or observer confidence. Our findings add to the growing body of evidence that misidentification is pervasive in passive sampling of animal populations. Even low levels of misidentification have been demonstrated to induce substantial biases in estimators of species distribution and abundance, and it is important that statistical models account for such errors.

Multi-year, Pulse-coded VHF Transmitters to Monitor Foraging Trip Duration of Northern Fur Seals on St. Paul Island, Alaska

J. Ward Testa
NOAA, Alaska Fisheries Science Center (AFSC), ward.testa@noaa.gov
Rolf R. Ream
AFSC, rolf.ream@noaa.gov
Thomas S. Gelatt
AFSC, tom.gelatt@noaa.gov

Maternal foraging trip duration (FTD) for northern fur seals (*Callorhinus ursinus*) is likely to be an indicator of foraging conditions in the area surrounding breeding colonies in the Bering Sea. We report on a series of small deployments testing the utility of long-life (5 years), pulse-coded VHF radio-tags on female fur seals from 2010-2014, including results from multiple seasons for the same individuals. Pulse-coded transmitters with digital signal processing by a data-logging receiver produced exceptionally reliable data with minimal maintenance. The sample size in this study was small but, in general, there was a seasonal progression toward longer duration trips, and similarity between seasons for individual fur seals. Also, there were differences in seasonal patterns that may indicate the responsiveness of FTD as an index to changes in food availability within and between years.

Preliminary Results from Hunter-assisted Walrus Sampling Near Saint Lawrence Island, Alaska 2012–2014

Lori Quakenbush
Alaska Department of Fish & Game (ADFG), lori.quakenbush@alaska.gov
Jonathan Snyder
U.S. Fish and Wildlife Service, jonathan_snyder@fws.gov
Anna Bryan
ADFG, anna.bryan@alaska.gov
Harold Kiyuklook
Resident of Savoonga, Alaska, none3@hotmail.com
Sheena Anningayou
Resident of Gambell, Alaska, none4@hotmail.com
Mark Nelson
ADFG, mark.nelson@alaska.gov

Pacific walruses (*Odobenus rosmarus divergens*) are harvested each spring for subsistence purposes by Alaska Natives near coastal villages in the Bering and Chukchi seas. Collecting information and samples from the harvest is especially important because of the rapid environmental changes taking place in the Arctic and the fact that the challenges of estimating walrus abundance have not been overcome. Walruses live in remote, ice-covered waters and are extremely gregarious, hauling out on ice in huge congregations, which makes counting them extremely difficult using aerial surveys. Without reliable estimates of walrus abundance or population trends, data provided by sampling the harvest allows us to examine parameters that affect population size. Parameters such as body condition, age distribution, sex ratio, pregnancy rate, and diet can be useful in evaluating population health and status. This project also records hunter assessment of walrus health and evaluates contaminant concentrations and disease exposure. A total of 204 walruses were sampled by hunters during 2012–2014; 14 have been analyzed for contaminants and 14 more are pending. Blood (sera) from 151 walruses has been screened for morbillivirus (distemper), brucella, herpes, leptospira, and toxoplasma. Intestinal contents have been tested for toxins produced by harmful algae blooms (HABs). These toxins concentrate in clams, a key walrus prey and are predicted to increase in northern seas as water temperatures increase. Preliminary findings show that contaminants (both organochlorines and trace elements) are similar to or lower than concentrations found in Alaskan ice seals, disease exposure is low except for herpes, which is common and expected. HABs are being detected at higher than expected levels but not at levels of concern for walruses. The sampled harvest was 46.5% female for the three years combined. Most of the females harvested in 2012 and 2013 were 11–15 years old. Most of the males were 16–20 years old in 2012 and 21–25 in 2013. These sample collections rely on the cooperation of subsistence hunters, the Tribal Governments of Gambell and Savoonga, and the Eskimo Walrus Commission working with the Alaska Department of Fish and Game and the U.S. Fish and Wildlife Service.

Retrospective Study of Walrus Foraging and Movement Patterns During a Major Ecosystem Shift

Seth Newsome
University of New Mexico, newsome@unm.edu
Patrick Lemons
U.S. Fish and Wildlife Service (USFWS), patrick_lemons@fws.gov
Daniel Monson
U.S. Geological Survey, Alaska Science Center, dmonson@usgs.gov
Joel Garlich-Miller
USFWS, joel_garlichmiller@fws.gov
James Lovvorn
Southern Illinois University, lovvorn@siu.edu
Lori Quakenbush
Alaska Department of Fish & Game, lori.quakenbush@alaska.gov

Recent work suggests that anthropogenic climate change has caused a shift from arctic to subarctic conditions in the Bering Sea, which has resulted in replacement of ice-dominated benthic ecosystems with pelagic-dominated ecosystems. Some have hypothesized that this northward shift of benthic ecosystems is influencing walrus movement and diet, as well as the ecology of other benthic predators. Few studies have explored this question, however, because addressing it requires the collection of ecological data on movement and diet patterns of benthic consumers from time periods prior to the observed ecosystem shift. Using Pacific walrus (*Odobenus rosmarus divergens*) teeth collected during subsistence harvests on Saint Lawrence Island, we produced a historic 50-year time series of carbon ($d^{13}C$) and nitrogen ($d^{15}N$) isotope values with annual resolution for female and male walruses in the northern Bering Sea. Isotope data collected from 1995–2005 (n = 45) show that $d^{13}C$ and $d^{15}N$ values are negatively correlated, a pattern that mirrors north-to-south baseline gradients in the isotopic composition of their primary prey (bivalves). Isotope data for teeth collected from 1950–1960 (n = 27) are also negatively correlated, but most individuals have higher $d^{13}C$ values than walrus from 1995–2005. Isotope data for teeth collected from 1965–1985 (n = 69) are more variable with no obvious trend. Many individuals from 1965–1985 have higher $d^{15}N$ values relative to walruses from the other time periods, suggesting a dietary expansion to high trophic level prey that included carnivorous gastropods and decapods. We also analyzed vibrissae collected from recently harvested female and male walrus (n = 66) to create a sub-annual isotopic record of diet and movement patterns. Similar to teeth, vibrissae isotope values are negatively correlated and males have significantly higher $d^{13}C$ but lower $d^{15}N$ values than females. Overall, our data suggest that walrus $d^{13}C$ and $d^{15}N$ values are primarily driven by north-to-south baseline isotopic gradients in this region, however, increased variation in $d^{13}C$ and $d^{15}N$ values in tooth collagen collected during the 1965–1985 time period are best explained

by an expansion of dietary breadth correlated with when the population was thought to be at or near carrying capacity.

Stable Isotopes Predict Foraging Habitat of Northern fur Seals (*Callorhinus ursinus*) in Alaska

Tonya Zeppelin
NOAA, Alaska Fisheries Science Center (AFSC), Tonya.Zeppelin@noaa.gov
Devin Johnson
AFSC, Devin.Johnson@noaa.gov
Carey Kuhn
AFSC, Carey.Kuhn@noaa.gov
Iverson Sara
Dalhousie University, sara.iverson@dal.ca
Rolf Ream
AFSC, Rolf.Ream@noaa.gov

We developed a model to predict foraging habitat of adult female northern fur seals (*Callorhinus ursinus*) using carbon ($\delta 13C$) and nitrogen ($\delta 15N$) stable isotope signatures from plasma and red blood cells. A binomial generalized linear mixed model was developed using blood isotope samples from 35 adult female fur seals collected from three breeding colonies in Alaska during July-October 2006. Satellite location and dive data were used to define foraging habitat in terms of the proportion of time spent or dives made in different oceanographic/bathymetric domains. For both plasma and red blood cells, the model accurately predicted habitat use for animals which foraged exclusively off shelf or on shelf. The model did not perform as well in predicting habitat for animals which foraged in both on shelf and off shelf habitat; however, sample sizes for these animals were small. Concurrently collected scat, fatty acid, and dive data confirmed that the foraging differences predicted by isotopes were associated with diet differences. Stable isotope samples and satellite location data collected from 15 females during August-October 2008 validated the effective use of the model across years. Little within year variation in foraging habitat was indicated from the comparison between stable isotope values from plasma (representing 1-2 weeks) and red blood cells (representing the prior few months). This methodology provides an effective means to assess habitat use at the population level, is inexpensive, and can be applied to other marine predators.

First Record of Diving Behavior of Resident-type Killer Whales in the Aleutian Islands and Documentation of a > 2,500 km Southward Movement and Return in Three Weeks

Paul Wade
NOAA, Alaska Fisheries Science Center (AFSC), paul.wade@noaa.gov
John Durban
NOAA, Southwest Fisheries and Science Center, john.durban@noaa.gov
Russ Andrews
Alaska SeaLife Center , RussA@alaskasealife.org
Tom Gelatt
AFSC, Tom.Gelatt@noaa.gov

Two satellite LIMPET tags (Wildlife Computers SPLASH10-292A model) were deployed on the dorsal fins of Resident-type killer whales (*Orcinus orca*) in Aleutian Islands. Both tags were programmed to transmit up to 600 times each day coinciding with coverage from the Argos satellite system. One tag was deployed on an adult male near Shemya Island in the western Aleutians on 22 June 2014; a second tag was deployed on 30 June 2014 on an adult female near the Delarof Islands in the central Aleutians while her group was observed feeding on Atka mackerel (*Pleurogrammus monopterygius*). Both foraged in the coastal regions where they were tagged for a period of 14 and 19 days, respectively, until the male's tag ceased transmitting and the female's tag began duty cycling (1 day on 4 days off). During this foraging, dive data from the tags documented both whales occasionally diving > 500 m (max depth = 551m and 535m for the male and female respectively; max duration = 10.4 mins and 9.5 mins), but most of the dive activity was in the top 200 m. After spending more than 2 weeks foraging in coastal waters the tagged female left the Seguam Pass area of the central Aleutians and moved in a straight track ~1,000 km south of the Aleutians to ~ 42° S. The whale then turned around and headed north along a similar track, returning to the Aleutians at Amchitka Pass then moving east back into the Delarof Islands. The final tag transmission was within 35 km of the tag deployment location; the round-trip from the Aleutians into the North Pacific transition zone covered > 2,500 km and took a little over 3 weeks (total tag duration = 49 days). This rapid round-trip is remarkably similar to the fast migrations to the sub-tropics documented for killer whales tagged in Antarctica, which have been hypothesized to facilitate physiological maintenance, specifically allowing skin regeneration in warmer waters without the high cost of heat loss that would occur in colder waters. We suggest that similar demands may require killer whales that forage in the Aleutian Islands to periodically travel to the warmer waters of the North Pacific transition zone.

Managing Leviathan: The Current Status of Large Whale Populations in the North Pacific

Phillip Clapham
NOAA, Alaska Fisheries Science Center (AFSC), phillip.clapham@noaa.gov
Yulia Ivashchenko
AFSC, yulia.ivashchenko@noaa.gov

In the North Pacific, large whales were extensively hunted by commercial whaling operations beginning in the late 18th century. More than 560,000 animals of nine species were killed between 1900 and 1999, including 195,000 taken (many illegally) by the former U.S.S.R. Here, I review the current status of mysticetes and sperm whales (*Physeter macrocephalus*) in this ocean, together with the management challenges that have largely replaced whaling. The species that remain the most heavily impacted by whaling include both populations of the North Pacific right whale (*Eubalaena japonica*), Okhotsk Sea bowheads (*Balaena mysticetus*), blue whales (*Balaenoptera musculus*), sei whales (*Balaenoptera borealis*), and sperm whales. Blue whales were apparently extirpated from Japan and perhaps the Aleutians, although they are recovering well in the eastern North Pacific. Sperm whales represented the single largest 20th century catch, with 315,000 taken (primarily by Japan and the U.S.S.R.); their current status is unclear. Soviet whaling likely removed the majority of right whales from the eastern North Pacific, where the population is today estimated in only the tens of animals, and where there is an urgent need for surveys in both the Bering Sea and the Gulf of Alaska. Other species have fared relatively well, notably the humpback whale (*Megaptera novaeangliae*) (currently estimated by the large-scale SPLASH study at 21,000 animals) and the California gray whale (*Eschrichtius robustus*). The latter remains the only large whale to be delisted under the U.S. Endangered Species Act, although delisting is expected to be proposed for some humpback whale stocks in light of recent data suggesting strong recovery. Although Bering-Chukchi-Beaufort bowheads are the subject of a well-managed native subsistence hunt in Alaska, this stock is clearly large and growing. Although most whaling has now ceased, other threats remain; these include entanglement in fishing gear, ship strikes, noise pollution and various potential effects of climate change. The latter include possible impacts from increased trans-polar vessel traffic resulting from loss of sea ice in the Arctic, habitat and prey shifts, and the unknown consequences of ocean acidification.

Survival Rates of Steller Sea Lions During Periods of Differing Population Trends in the Kuril Islands

Alexey Altukhov
University of Alaska Fairbanks (UAF), aaltukhov@gmail.com
Russel Andrews
UAF, russa@alaskasealife.org
Thomas Gelatt
NOAA, Alaska Fisheries Science Center (AFSC), Tom.Gelatt@noaa.gov
Vladimir Burkanov
AFSC, vladimir.burkanov@noaa.gov

Throughout much of their range, Steller sea lions (*Eumetopias jubatus*) have begun to recover from the large population decline of the second half of the 20^{th} century. In the Russian part of the Steller sea lion range there are currently several regions with different population trends. Sea lion numbers are increasing in the Kuril Islands and Sea of Okhotsk, while in Eastern Kamchatka the trend has been mostly stable, and in the Commander Islands numbers are decreasing. In the Kuril Islands, the population decline had bottomed out by the early 1990's and was stable throughout most of that decade, but in the 2000's it began to increase at almost 5% annually. Our goal was to determine whether changes in survival rates could explain the different population trajectories between decades. Although pups were first branded in the Kuril Islands in 1989, regular branding didn't begin until 1996, and by the early 2000s annual mark-recapture observations were conducted throughout the Kuril Islands. We evaluated differences in survival in two different periods (1989-2002 and 1998-2011) at three Kuril Islands rookeries: Brat Chirpoev (BI), Raykoke (RI), and Lovushki (LI). We used Cormack-Jolly-Seber models to estimate apparent survival and recapture rates. We estimated survival of females born in 1989 until they reached 13 years, and females born in 1996, 1997 and 1998 through the age of 13. The cumulative survival to age 13 of the 1989 cohort was 0.14 for BI, 0.19 for RI and 0.25 for LI. The cumulative survival of the cohorts from 1996, 1997 and 1998 until age 13 was 0.20, 0.13 and 0.12 for BI, 0.17, 0.11 and 0.13 for RI. There was no branded cohort in 1998 for LI, but survival to age 13 of the 1996 and 1997 cohorts was 0.18 and 0.11. Survival rates in the more recent period were not greater than in the previous decade for all three Kuril Islands rookeries. Despite likely reductions in anthropogenic mortality between these two periods, similar survival rates lead us to hypothesize that the recent population increase in the Kuril Islands was likely driven by increasing birth rates.

Age-specific Birth Rates at Steller Sea Lion Rookeries in the Russian Far East

Alexey Altukhov
University of Alaska Fairbanks (UAF), aaltukhov@gmail.com
Russel Andrews
UAF, russa@alaskasealife.org
Thomas Gelatt
NOAA, Alaska Fisheries Science Center (AFSC), Tom.Gelatt@noaa.gov
Vladimir Burkanov
AFSC, vladimir.burkanov@noaa.gov

As in Alaska, Steller sea lions (*Eumetopias jubatus*) declined in the Russian Far East in the last few decades of the 20th century. Since that time populations increased in the Kuril Islands, were stable in Eastern Kamchatka, but continued to decline in the Commander Islands. We found regional differences in survival rates, but interestingly they did not match predictions from population trends. Therefore, we next sought to determine whether differences in birth rates could explain the divergent population trends. Using mark-recapture, we estimated birth rates at 6 rookeries (Medny (MY), Kozlova Cape (KC), Antsiferov (AI), Lovushki (LI), Raykoke (RI), and Brat Chirpoev (BI)) in Russia, using resightings of marked females with or without pups on rookeries during summer for 2002-2011. We used a Robust Design Multi-state Open with State Uncertainty and Seasonal Effects (RDMSOpenMCSeas) model in MARK. This model utilizes severe probabilities to describe seasonal state changes and includes the probability that state may be assigned incorrectly if a female was seen without a pup. We constructed recapture histories with 10 primary periods since age 4. Each primary period contained 6 secondary occasions, each representing a week, covering 6 weeks since June 1. Probability to give birth at age 4 was the lowest at MY (0.16), similar at AI (0.19), but was higher at other rookeries (0.22-0.29). Birth probability increased through age 6, with no differences between sites. For females > 6 years, the highest birth rate was at BI (0.86-0.95). Birth rates at RI and LI were lower (0.81-0.86). Birth probability was high at AI until age 8, however it decreased between ages 9-11 (0.78-0.80). Birth rates at KC were stable between ages 6-9 (0.77), and increased between 10-12 years (0.81-0.87). Lowest birth rates were at MY for ages 7-12 (0.67-0.78) with the lowest rates at ages 9-10. Late age at first reproduction and low birth rates at Medny Island may be the main reason for the continued population decline in the Commander Islands, but birth rates at Kozlova Cape were also relatively low, especially during the optimum reproductive ages (7 – 10), possibly explaining the lack of recovery in eastern Kamchatka.

Diving Behaviors and Habitat Use of Adult Female Steller Sea Lions (*Eumetopias jubatus*)

Michelle Lander
NOAA, Alaska Fisheries Science Center (AFSC), michelle.lander@noaa.gov
Brian Fadely
AFSC, brian.fadely@noaa.gov
Thomas Gelatt
AFSC, tom.gelatt@noaa.gov
Jeremy Sterling
AFSC, jeremy.sterling@noaa.gov
Susanne McDermott
AFSC, susanne.mcdermott@noaa.gov
Martin Haulena
Vancouver Aquarium, Martin.Haulena@vanaqua.org
Lorrie Rea
University of Alaska Fairbanks, ldrea@alaska.edu
Johanna Vollenweider
AFSC, Johanna.Vollenweider@noaa.gov
Kimberlee Beckmen
Alaska Department of Fish & Game (ADFG), kimberlee.beckmen@alaska.gov
Michael Rehberg
ADFG, michael.rehberg@alaska.gov

Decreased natality resulting from nutritional stress is one hypothesized mechanism for declines of Steller sea lions (SSLs; *Eumetopias jubatus*) in western Alaska, but little is known of the winter foraging habitats or behavior of adult females. To address this critical data need adult female Steller sea lions were chemically immobilized and tagged with Fastloc® GPS satellite transmitters during the fall at Southeast Alaska (SEAK) during 2010 (n = 3), and the central and western Aleutian Islands (AI) from 2011-2014 (n = 8).Overall, satellite telemetry data indicated adult female SSLs exhibited a broad range of behaviors related to targeted prey and associated habitat features. Diel and seasonal trends of diving behaviors were similar among SSLs from SEAK, whereas diving behaviors among SSLs from the AI were more variable, likely reflecting specific prey behaviors encountered in different areas. Movements of SSLs in SEAK reflected the seasonal distribution of predictable forage fish, whereas animals from the AI utilized a variety of designated marine ecosystems, providing new insights into the foraging ecology of adult females from those areas. For example, six animals remained on the Aleutian/Western Bering Sea Shelf, two of which used Petrel Bank, where diving behaviors coupled bottom trawls suggested they were foraging on a combination of prey species associated with bathymetry and tides. Two other animals conducted large looping trips (1-8 days) beyond the continental shelf, and in some cases the Aleutian Trench, into pelagic waters of the western subarctic domain in the North Pacific. One animal specifically targeted productive waters entrained by a large, persistent eddy. Steller sea lions were monitored up to eight months, providing the longest duration of data for adult females, which have been especially useful given the controversial conservation

measures (e.g., fishery closures) currently enforced in some areas of the endangered, western distinct population segment.

Bering Sea - Humans

Smart Fishing in the Bering Sea: Conservation Engineering Outreach

Christine Simpson
Alaska Pacific University (APU), csimpson@alaskapacific.edu
Bradley Harris
APU, bharris@alaskapacific.edu

The purpose of this project was to 1) develop, 2) instruct, 3) evaluate, and 4) revise a 5th-12th grade fisheries conservation engineering outreach program titled “Smart Fishing and the Bering Sea” (SFBS).

Fishery resources are important to Alaska and Alaskans, but present complex conservation challenges including user conflicts and concerns about unsustainable fishing practices. Alaska residents’ environmental literacy will enhance natural resource management decisions regarding fisheries. The intent of the SFBS program is to introduce students to ecological and economical factors that drive conservation engineering in the Bering Sea pollock fishery. I instructed the SFBS program to 93 students from four different public and private institutions in Anchorage, Alaska. My observations and participants’ pre- and post-program concept maps were used to evaluate the effectiveness of the SFBS curriculum. Participants gained content knowledge from this fishery outreach program about the Bering Sea and commercial fishing. Program evaluation analysis and results were used to revise the curriculum and make suggestions to SFBS stakeholders.

Place-based Marine Education: Reinforcing Student Understanding Through a Local Framework and Contextualized Data

Alexandra Doty
University of Washington (UW), dotya@uw.edu
P. Sean McDonald
UW, psean@uw.edu
Janet Armstrong
UW, janeta@u.washington.edu
David Armstrong
UW, davearm@uw.edu
Christopher Long
NOAA, Alaska Fisheries Science Center, chris.long@noaa.gov

Place-based education offers a localized framework that can contextualize learning and engage students directly in pertinent issues. Demonstrating real-world applications of important educational concepts to issues that affect student's lives reinforces the value of such concepts and incentivizes mastery of the subject material. In the present example, we produced education and outreach materials as part of funded research on blue king crab (*Paralithodes platypus*). We developed place-based lesson plans and explored how best to use data collected as part of fisheries research cruises to engage students in local issues. To this end, qualitative interviews were conducted with high school science teachers and a meta-analysis of current literature about place-based education was performed. We developed several lesson plans about blue king crab for Alaskan high schools. These lesson plans focused on the complex life history of blue king crabs, the importance of particular habitat for juveniles, and the impact of climate change on blue king crab populations. Our experience supports existing work indicating that place-based examples are effective tools for solidifying student understanding and facilitating student engagement in the classroom. We suggest that community involvement and local cultural knowledge are invaluable for creating impactful place-based lesson plans. Moreover, we contend that place-based lessons are most effective when created by a community *in situ*, and when guided, but not dominated, by standards and requirements. The lesson plans will be provided as free online resources for educators and the public.

Marine Vessel Traffic and Shoreline Vulnerability in the Aleutian Archipelago

Martin Robards
Wildlife Conservation Society, mrobards@wcs.org
Douglas Burn
Aleutian and Bering Sea Islands Landscape Conservation Cooperative (ABSILCC), douglas_burn@fws.gov
Aaron Poe
ABSILCC, aaron_poe@fws.gov

Although the Aleutian archipelago is one of the most remote landscapes in the U.S., it is nonetheless subject to an intense amount of commercial shipping activity. Each year, several thousand vessels make the voyage along great circle routes between North America and Asia. The purpose of our study was to provide spatial and temporal information about this vessel traffic for use by resource managers and stakeholders. Development of decision support tools to help mitigate risks from international shipping requires a quantitative and spatially explicit understanding of vessel traffic across the entire region. Current efforts using just ground-based data from the Automatic Identification System (AIS) provide high precision data, but only for the immediate areas around the limited number of ground-based receivers. Consequently, large gaps in coverage for vessel traffic exist, particularly in the western Aleutians and south of the Aleutian chain, many of which coincide with areas of value for conservation or fisheries. To fill these gaps, we used three years of satellite-based AIS data, ranging from July 2010 through August 2013 that covers the southern Bering Sea and northern Gulf of Alaska. We implemented novel analytical techniques that allowed us to use over 90% of the over 73 million vessel locations, linked each spatial point with additional data to provide ship information, and then connected points through time to produce line features of individual transits. We summarize those transits, identifying vessel routings by month and vessel type that make up the primary routes north and south of the Aleutians. Key findings include the surprisingly close transits to land on several of the great circle routes in the western Aleutians, the extent of traffic passing close along the northern Gulf of Alaska coast, and the profound seasonality in vessel use of different passes and routings. Our efforts have filled critical gaps in knowledge about vessel traffic in the Aleutian archipelago, helped promote better production of metadata for the scientific use of AIS data, and are now being used to inform shoreline vulnerability analyses based on the trajectories of stricken vessels on key routes.

Real-world Education: Using NOAA Data for High School Curricula in Alaska

Lisa Hiruki-Raring
NOAA, Alaska Fisheries Science Center (AFSC), Lisa.Hiruki-Raring@noaa.gov
Pam Goddard
AFSC, Pamela.Goddard@noaa.gov
Rebecca Reuter
AFSC, Rebecca.Reuter@noaa.gov

NOAA's Alaska Fisheries Science Center (AFSC) has partnered since 2007 with schools and communities in Alaska and Washington on education projects based on NOAA's research and management of marine resources, to increase environmental literacy and raise awareness about NOAA science and careers. In recent years, the AFSC has focused on developing high school curricula using real-world data to help underline the science behind sustainable fisheries and marine resource management, supported by funding from NOAA Fisheries and the North Pacific Research Board. Five examples of projects created are: 1) **Marine Mammal Protection Act (MMPA) Curriculum**, which compares case studies of gray whale (*Eschrichtius robustus*) and northern fur seal (*Callorhinus ursinus*) populations and how the MMPA applies to each. The curriculum can also be adapted to other marine mammal species to give local relevance to the discussions. 2) **Science Behind Sustainable Fisheries**, which outlines research and management of U.S. fisheries, using the Alaska pollock (*Gadus chalcogrammus*) fishery as an example. The curriculum integrates real data into lessons about how science is used to ensure sustainable U.S. seafood. 3) **Marine Life and Oceanography on the Eastern Bering Sea Slope**, which examines the relationship between oceanographic conditions and the deep-water distributions of fish and invertebrates. Two labs provide hands-on opportunities to investigate and integrate real-world data into the concepts learned using Excel and Ocean Data View. 4) **Shedding Light on the Unknown with Marine Mammal Tags**, which examines the relationships between primary productivity, ocean conditions, and the feeding behavior of a northern fur seal. Two labs provide experience with data analysis in Excel and spatial analysis of oceanographic conditions and fur seal movements in Ocean Data View. 5) **Steller Sea Lions, Atka Mackerel, and the Endangered Species Act (ESA),** which focuses on the life history and decline of the western Aleutian Steller sea lions (*Eumetopias jubatus*), their primary prey, Atka mackerel (*Pleurogrammus monopterygius*), and the consequences of the ESA for both species.

Catch Sampling and Estimation in the Federal Groundfish Fisheries off Alaska

Jason Gasper
NOAA Alaska Regional Office (AKRO), jason.gasper@noaa.gov
Jennifer Cahalan
Pacific States Marine Fisheries Commission, jcahalan@psmfc.org
Jennifer Mondragon
AKRO, jennifer.mondragon@noaa.gov

The management of Federal groundfish fisheries off Alaska is governed under Fishery Management Plans (FMPs) that are specific to the Bering Sea and Aleutian Islands and Gulf of Alaska regions. Catch of FMP species is monitored by the Alaska Regional Office Division of Sustainable Fisheries using a mixture of landing and production information that is reported by the commercial fishing industry and at-sea information collected from the extensive at-sea North Pacific Groundfish and Halibut Observer Program overseen by the Alaska Fisheries Science Center's Fisheries Monitoring and Analysis Division. These data sources are integrated into a National Marine Fisheries Service (NMFS) application called the Alaska Catch Accounting System and used to produce estimates of total catch for FMP species in the groundfish and halibut (*Hippoglossus stenolepsis*) fisheries and allow the in-season monitoring of catch against limits as required in the FMPs.

This poster depicts the current method used to quantify catch for in-season management of Alaska groundfish fisheries including the variation associated with the final estimates arising at each level of the sampling and estimation process. Industry-reported data consists of catch and processed product amounts that are electronically recorded and submitted to NMFS. The observer data are collected using a stratified hierarchical sample design where strata are defined through a combination of regulations and an annual deployment process. Within each stratum, a multi-stage sampling design is used to sample the species composition of the catch along with other catch components. Post-stratification procedures are used to combine the observer and industry information to create estimates of total catch.

The continuing challenge is to implement rigorous methods while at the same time meeting the need for near real-time information for quota monitoring and in-season management. Certain statistical methods that might provide very robust estimates may not lend themselves to near real-time use without a large increase in staff resources. These issues are being considered as part of ongoing effort by NMFS to evaluate and improve the catch estimation procedures, resulting in estimators that are more robust while continuing to meet management needs.

Variability in Mean Weight Per Fish: How Much Does It Matter?

Jennifer Cahalan
Pacific States Marine Fisheries Commission, jcahalan@psmfc.org
Jason Gasper
NOAA, Alaska Regional Office, jason.gasper@noaa.gov

The mean weight of individual fish is a critical measurement that can have substantial influence on catch estimates used for fisheries management in Alaska. These catch estimates are used by the NOAA Fisheries, Alaska Region, to regulate catch allocation and to insure overfishing does not occur. In addition, the mean weight per fish is used in the stock assessment process where models are often based on numbers of fish while allowable catches are based on weights of fish. Both natural and sampling variation affect the estimated mean weight per fish. Natural variation in weight per fish results from differences in individual fish size and growth rates while sampling variation results from the sample procedure. While sample variation can often be controlled by increasing sample sizes, estimating the natural variation of weights may be biased if data for a given spatial and/or temporal scales are unavailable and proxy weight data are used. This is of particular concern for situations where onboard observers cannot be deployed such as potential electronic monitoring programs.

Weight data routinely collected by the North Pacific Groundfish and Halibut Observer Program from commercial fishery catches are used to assess the variability associated with a variety of commercially harvested species. We used two sources of data: the average weight per fish computed from aggregate fish weight collected by observers from samples of catch and individual fish weight data taken from within sample to evaluate the effects of using proxy data to supplement estimation. The potential impact to catch estimation procedures of the variability in mean weigh per fish and the use of proxy data are discussed in this paper.

Quantifying Spatial Differences in the Distributions of Observed and Unobserved Fishing

Jordan Watson
University of Alaska Fairbanks, jtwatson2@alaska.edu
Alan Haynie
NOAA, Alaska Fisheries Science Center, alan.haynie@noaa.gov

Many fishery management decisions have long relied on the necessary assumption that unobserved fishing behaviors are similar to observed behaviors. However, this assumption has the potential to misrepresent the impacts of fishing on certain habitats and fish stocks. We used vessel monitoring system (VMS) data from catcher vessels targeting walleye pollock (*Gadus chalcogrammus*) in the Bering Sea and Gulf of Alaska to examine differences in observed and unobserved behaviors (e.g., targeting areas to different degrees at different times). VMS units transmit a vessel's location at regular intervals and generalized additive models (GAMs) were used to predict from these data when unobserved vessels were actively fishing. We used a Metropolis-Hastings algorithm to determine multivariate bandwidth values (i.e., kernel density smoothing parameters) at daily, weekly and seasonal scales. Parameter estimates were applied to a kernel product algorithm to estimate utilization distributions, akin to home ranges, of both observed and unobserved fishing observations at each of these temporal scales. We applied Utilization Distribution Overlap Indices and Bhattacharya's measure of affinity to quantify the similarities and differences among observed and unobserved fishing effort at different areas and times. While this current work indicates daily differences in observed and unobserved behavior, a more rigorous comparison is on-going. This examination of the spatio-temporal variation in fisheries has the potential to improve our understanding of the impacts of environmental and management changes on fishers and fishing communities.

Plastics, Phthalates, and PCB Contamination of Seabirds From the Aleutian Islands

Veronica Padula
University of Alaska Anchorage (UAA), vmp2011@gmail.com
Douglas Causey
UAA, dcausey@alaska.edu

We are investigating the levels of phthalates and polychlorinated biphenyls (PCBs) in various seabird species inhabiting the far western Aleutian Islands. This is the first contaminants work ever done in the most western region of the Aleutian archipelago, thus establishing baseline contaminant levels in an isolated region. This is also the first study quantifying phthalates – the plasticizing chemicals that coat plastic objects – in any seabird species globally. Currently these islands have no point sources of contamination, but they are influenced by ocean currents carrying contaminants and debris from other regions of the Pacific Ocean. We are using species from different trophic levels in our analyses: crested auklets (*Aethia cristatella*) (planktivores), tufted puffins (*Fratercula cirrhata*) (mid-trophic), and pelagic cormorant (*Phalacrocorax pelagicus*) and red-faced cormorant (*Phalacrocorax pelagicus*) (upper trophic). Differences in contaminant levels in tissues from these species may be indicative of biomagnification of phthalates and PCBs through the food chain. We found evidence of significant levels of contaminants within embryos, which indicates that these compounds are metabolically active and labile within the adult bird. Finally, research shows that plastic debris not only carries phthalate pollution to wildlife, but plastics also absorb organic pollutants like PCBs. We will use our data to investigate associations between elevated phthalate levels and elevated PCB levels in tissues from seabirds

Trophic Interactions Between Jellyfish and Fish: Investigating the Ecosystem Impacts of Jellyfish Variability in the Bering Sea

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

An understanding of the ecological roles of jellyfish in the Eastern Bering Sea (EBS) is required for fishery and ecosystem management; however, current literature lacks measurements of the direct and indirect impact of changes in jellyfish abundance on the ecosystem and the fish species it supports. In the hopes of addressing this deficiency, we will estimate the scale and impact of competition between the dominant EBS forage fishes and jellyfish, and examine the roles of jellyfish in the ecosystem as a predator and as an ecosystem structuring agent. We will achieve these goals by: 1) examining the ecological impact of jellyfish variability in the EBS by quantifying the predation potential of jellyfish upon zooplankton and early life-history stages of fish, 2) estimating the potential scale of competition between fish and jellyfish in the EBS by determining their dietary and spatial overlap, 3) defining interannual relationships between fish production and indices of jellyfish biomass, and 4) examining the impact of jellyfish variability across all groups in the food web via scenario and sensitivity analyses of large-scale ecosystem models. The project began in July 2014, with sampling and modeling efforts currently underway. Initial estimates of *Chrysaora melanaster* biomass and abundance during the 2014 season indicate an increase in the north and south compared to 2012. Species composition in both regions remains dominated by *C. melanaster*, but preliminary counts show an increase in the presence of other jellyfish species relative to previous years. To examine diets, individual jellyfish (n = 47) were dip-netted from the surface in August 2014. Samples will be analyzed this winter and collections will continue, with the addition of digestion experiments in 2015. In addition, we are updating an established Eastern Bering Sea ECOPATH model developed at the Alaska Fisheries Science Center to incorporate pelagic community composition observations from recent surveys and observations of jellyfish physiological rates. Preliminary model analyses suggest that, on average over the last decade, the summer population of *C. melanaster* requires 11-fold more energy from the ecosystem than do the forage fishes, while passing on only 4% as much energy to the higher food web.

Biobanking In Alaska: Two Projects of the Marine Environmental Specimen Bank

Rebecca Pugh
National Institute of Standards and Technology (NIST), rebecca.pugh@noaa.gov
Amanda Moors
NIST, amanda.moors@noaa.gov
Stacy Vander Pol
NIST, stacy.vanderpol@noaa.gov
Paul Becker
NIST, paul.becker@noaa.gov

In 2009, *Time* magazine published the Top 10 Ideas Changing the World Right Now and Biobanks appeared on that list at #8. A biorepository is a valuable resource that can help advance the science and research (i.e. diseases, cancer, neurological disorders, genomics, etc.) conducted utilizing specimens from these long-term collections. Biobanking, or the banking of biological specimens as part of environmental studies, is not a new concept in Alaska and has been a formal activity for the National Institute of Standards and Technology (NIST) for over 25 years. Two significant projects of NIST's Marine Environmental Specimen Bank (Marine ESB) were established in part to collect and archive marine animal samples to address questions regarding temporal and geographic trends in environmental contaminants as well as new analytes of interest and improved analytical techniques, and to evaluate the feasibility of long-term storage of environmental samples under various conditions. Over 1,800 specimens of liver, kidney, and blubber (fat) tissue collected from over 700 animals are maintained as a part of the Alaska Marine Mammal Tissue Archival Project (AMMTAP) that began in 1987. The Seabird Tissue Archival and Monitoring Project (STAMP), established in 1999, maintains over 1,700 samples of seabird egg contents (18,000 individual aliquots) from five species of seabirds. Through collaborations with other U.S. government agencies and many local Alaskan communities, samples are collected and processed following standard protocols to 1) provide sufficient material for multiple analyses, 2) minimize the possibility of sample change and/or loss during storage, 3) minimize inadvertent contamination during sample handling and ensure sample integrity, 4) provide for long-term sample stability through cryogenic techniques, and 5) track and maintain a record of sample history that is available to other researchers via published access policies. Specimen and data quality established through use of these standard protocols are important in verifying the integrity of an individual sample and establishing the value of repository collection for specific types of measurements and research. Details about the Marine ESB protocols as well as future long-term goals to explore the use of these samples for infectious disease, gene expression, and metabolomic studies will be discussed.

Multi-species Harvest Control Rules for Fishery Management

Kirstin Holsman
University of Washington, kirstin.holsman@noaa.gov
Leif Sandal
Norwegian School of Economics, leif.sandal@nhh.no
Cecilie Hansen
Institute of Marine Research (IMR), cecilie.hansen@imr.no
Ásta Guðmundsdóttir
Marine Research Institute, asta.gudmundsdottir@gmail.com
Jan Arge Jacobsen
Faroe Marine Research Institute, janarge@hav.fo
Lars Ravn-Jonsen
Syddansk Universitet, lrj@sam.sdu.dk
Mike Sigler
NOAA, Alaska Fisheries Science Center (AFSC), mike.sigler@noaa.gov
Mette Skern-Mauritzen
IMR, mette.mauritzen@imr.no
Jason Link
NOAA, Northeast Fisheries Science Center, jason.link@noaa.gov
Kerim Aydin
AFSC, kerim.aydin@noaa.gov

Harvest control rules are well developed for single species stocks but are more difficult to define in a multi-species context. Recent studies have advanced multi-species control rules for fisheries management, particularly those for multi-species stock assessment models that include trophic interactions. Multi-species approaches are able to capture asynchronous species responses to environmental drivers that may influence harvest recommendations in ways that are difficult to predict with single species approaches, can better account for the system-wide uncertainty that occurs due to environmental and trophic interactions, and could also assist in evaluating tradeoffs between multiple harvest regimes. Yet, unlike single species control rules, multi-species control rules can result in multiple, equivalent harvest recommendations that reflect very divergent biological states. Inclusion of economic valuation and conservation constraints can help further refine control rules and reduce the potential number of equivalent solutions for tradeoff evaluation in a multi-species context. Here we consider harvest control rules for two different multi-species from the eastern Bering Sea and the Barents Sea and compare harvest control rules that incorporate biomass-only reference points to those that also include economic valuation. We further consider the effect of process and/or observation error on emergent multi-species control rules.

Addressing Climate Change Vulnerabilities in the Aleutian and Bering Sea Islands

Aaron Poe
Aleutian and Bering Sea Islands Landscape Conservation Cooperative, Aaron_Poe@fws.gov
Ellen Tyler
Alaska Ocean Observing System (AOOS), Tyler@aoos.org
Jeremy Littell
U.S. Geological Survey, Alaska Science Center, jlittell@usgs.gov
Tom Van Pelt
AOOS, tom@xboundary.org
Nick Bond
University of Washington, nicholas.bond@noaa.gov
John Walsh
University of Alaska Fairbanks, jwalsh@iarc.uaf.edu
Tuula Hollme
Alaska SeaLife Center , tuulah@alaskasealife.org

Climate change is already affecting the Bering Sea and Aleutian Island region. Past and present marine research across a broad spectrum of disciplines is shedding light on what sectors of the ecosystem and the human dimension will be most impacted. In a grassroots approach to extend existing research efforts, leveraging recently completed downscaled climate projections for the Bering Sea and Aleutian Islands region, we convened a team of 30 researchers -- with expertise ranging from anthropology to zooplankton to marine mammals-- to assess climate projections in the context of their expertise. This Aleutian-Bering Climate Vulnerability Assessment (ABCVA) began with researchers working in five teams to evaluate the vulnerabilities of key species and ecosystem services relative to projected changes in climate. Each team identified initial vulnerabilities for their focal species or services, and made recommendations for further research and information needs that would help managers and communities better understand the implications of the changing climate in this region. Those draft recommendations were shared during two focused, public sessions held within two hub communities for the Bering and Aleutian region: Unalaska and St. Paul. Qualitative insights about local concerns and observations relative to climate change were collected during these sessions, to be compared to the recommendations being made by the ABCVA team of researchers. Finally, we used a Structured Decision Making process to prioritize the recommendations of participating scientists, and integrate the insights shared during our community sessions. This work brought together residents, stakeholders, scientists, and natural resource managers to collaboratively identify priorities for addressing current and expected future impacts of climate change. Recommendations from this project will be incorporated into future research efforts of the Aleutian and Bering Sea Islands Landscape Conservation Cooperative (ABSI LCC), the Alaska Ocean Observing System (AOOS), and the Alaska Climate Science Center.

Influence of Gap Winds on Oceanography of the Gulf of Alaska

Carol Ladd
NOAA, Pacific Marine Environmental Laboratory (PMEL), carol.ladd@noaa.gov
Wei Cheng
University of Washington, Wei.Cheng@noaa.gov
Sigrid Salo
PMEL, sigrid.a.salo@noaa.gov

Frequent gap winds, defined here as offshore-directed flow channeled through mountain gaps, have been observed blowing into the Gulf of Alaska (GOA). We examine the influence of these localized, high speed wind events on regional oceanography using QuikSCAT wind data, mooring observations, and ocean circulation modeling. Due to strong gradients in the along-shelf direction, these wind events can result in vertical velocities in the ocean of over 20 m d^{-1} due to Ekman pumping. Strong wind mixing can entrain higher nutrient water into the mixed layer, potentially enhancing primary production. Two regions with frequent gap winds are compared: Cross Sound (eastern GOA) and the Iliamna Lake gap near Kodiak Island (western GOA).

In the Cross Sound region, interannual variability in the frequency of gap wind events is correlated with El Niño. During gap wind events, the spatial scales of high off-shore directed winds reach almost 200 km offshore and 225 km along the shelf break, suggesting that the winds directly influence both the shelf (20 – 65 km wide) and the offshore waters. A model experiment suggests that Ekman pumping during a gap wind event can result in eddy formation. An association between El Niño events and eddy formation has been previously reported and gap wind forcing may be one mechanism explaining this association.

Gap winds from the Iliamna Lake gap have larger spatial extent than in the Cross Sound region, influencing the entire shelf width (> 200 km) northeast of Kodiak Island and extending an additional ~150 km off-shelf. Interannual variability is correlated with the Pacific North America Index and shows a linear trend, increasing by 1.35 days per year. The wind events in this region disrupt flow of the Alaska Coastal Current (ACC), resulting in decreased flow down Shelikof Strait and increased flow on the outer shelf. Disruption of the ACC has implications for freshwater transport into the Bering Sea. Recruitment of arrowtooth flounder (*Atheresthes stomias*) is negatively correlated, and Pacific cod (*Gadus macrocephalus*) positively correlated, with interannual frequency of Iliamna gap wind events, suggesting that oceanographic response to gap winds may influence the survival of larval fishes.

High-Resolution Modeling of Coastal Freshwater Discharge and Glacier Mass Balance in the Gulf of Alaska Watershed

Jordan Beamer
Oregon State University (OSU), beamerj@onid.oregonstate.edu
David Hill
OSU, dfh@engr.oregonstate.edu
Anthony Arendt
University of Alaska Fairbanks, aaarendt@alaska.edu
Glen Liston
Colorado State University, glen.liston@colostate.edu

A comprehensive study of the Gulf of Alaska (GOA) drainage basin hydrology was carried out to improve understanding of the coastal freshwater discharge (FWD) magnitude and spatial distribution, and mass changes from GOA glaciers. FWD along the coastline and surface mass balance (SMB) for all glacier surfaces in the GOA drainage were modeled using a suite of physically based, spatially distributed weather, energy-balance snow/ice melt, and runoff-routing models at a high resolution (1-km horizontal grid; 3-h time step). SnowModel simulations of air temperature, precipitation, snow water equivalent (SWE) depth, surface runoff, and glacier SMB were completed for the entire GOA drainage from 1979-2009. HydroFlow was used to route the SnowModel-derived runoff to the GOA coastline. Meteorological forcing was provided by the North American Regional Reanalysis (NARR) dataset (NARR-Orig). The NARR data was bias-corrected using monthly gridded climate data to more accurately reflect the strong spatial gradients in air temperature and precipitation, while retaining the temporal attributes of NARR (NARR-BC). The modeling system was rigorously validated at each step of the modeling process in several catchments using available weather, snow, streamflow, and glacier datasets. Glacier SMB simulated by SnowModel driven with NARR-BC from 2004-2009 produced seasonal storage changes and long term trends consistent with GRACE satellite-based estimates. GOA annual FWD and glacier SMB for 1980-2009 were 640 ± 56 km^3 yr^{-1} and -159 ± 26 km^3 yr^{-1} for simulations driven with NARR-Orig, and 946 ± 76 km^3 yr^{-1} and -91 ± 38 km^3 yr^{-1} using NARR-BC, respectively. The final product of this study is a 30-year record of daily streamflow at every major coastal pour point (1-km resolution) in the GOA drainage, which includes the runoff signal from glacier melt and volume loss. The combination of high resolution, physically based models, and rigorous validation make this the most detailed effort to date to model GOA runoff.

Recent Trends in the Oceanography of Prince William Sound

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

The Prince William Sound (PWS) region has been infrequently surveyed since the mid-1970s, with the most activity during the years immediately following the *Exxon Valdez* Oil Spill in 1989 and during the ongoing PWS herring survey and Gulfwatch Alaska efforts which began in 2009. It can be expected that the hydrology of the region is changing: basins scale warming has lead to the loss of ice mass in the region at rates as high as anywhere in the world, with an expected concomitant change in the timing and magnitude of freshwater and heat fluxes from the land and atmosphere to the ocean. Although there has not been a single coordinated long term observation effort in the area until recently, an assembled database of hydrographic data is dense enough to permit analysis. Temperature and salinity time series in the region generally show a warming trend at depth, where waters are also becoming more saline, likely due to entrainment of deep water set up by enhanced surface circulation. In the northwestern portion of PWS, there has been a pronounced cooling and freshening trend, likely set up by the large ice inventories there, as well as the comparatively limited circulation. Other long-term trends are also evident, including an 18.6 year signal that has been suggested to correspond to changes in the lunar declination cycle, as well as large scale climate forcings and teleconnections.

Dissolved Iron over the Gulf of Alaska Shelf During Spring and Fall 2013

Ana Aguilar-Islas
University of Alaska Fairbanks (UAF), amaguilarislas@alaska.edu
Marie Segure
UAF, msegure@alaska.edu
Robert Rember
UAF, rrember@iarc.uaf.edu
Dean Stockwell
UAF, dstockwell@alaska.edu

The Gulf of Alaska (GOA) is a region with contrasting ecosystems where the availability of the essential micronutrient iron (Fe) contributes to the observed productivity. The North Pacific Research Board's Gulf of Alaska Integrated Ecosystem Research Project (GOAIERP) investigates connections among the various trophic levels of this important region, and as part of lower trophic level component of this project, the distribution of Fe over the GOA shelf was investigated during 2011 and 2013. Here we present dissolved Fe (DFe) data from samples collected during spring and fall 2013. Sample collection and processing was done following stringent trace metal clean protocols. Samples were filtered on-board and analyzed at the University of Alaska Fairbanks using a fully automated, in-line, pre-concentration system with ICP-MS detection that was designed for ultra-low level trace element analysis of seawater. During spring samples from surface waters of the southeast GOA contained on average 1.16 nM ($\pm$ 0.66 nM) DFe, which ranged from 0.32 nM in offshore waters northwest of Yakutat Bay, to 2.64 nM in inshore waters at the entrance of Cross Sound. Similarly, surface waters of the western GOA sampled during spring had an average of 1.13 nM ($\pm$ 0.62 nM) DFe, and ranged from 0.29 nM in offshore waters of the Seward Line, to 2.86 nM in inshore waters near Prince William Sound. In contrast, during fall sampled surface waters in southeast GOA were an order of magnitude lower, and ranged from 0.07 nM to 0.76 nM. While shelf waters in the western GOA remained elevated during fall, ranging from 0.86 nM to 5.86 nM. The distribution of DFe will be discussed in context with lower trophic level biological parameters, and compared to observations from the 2011 field season.

Long-term Observations of Alaska Coastal Current

Phyllis Stabeno
NOAA, Pacific Marine Environmental Laboratory, phyllis.stabeno@noaa.gov
Wei Cheng
University of Washington (UW), wei.cheng@noaa.gov
Seth Danielson
University of Alaska Fairbanks, sldanielson@alaska.edu
Nancy Kachel
UW, nancy.kachel@noaa.gov
Calvin Mordy
UW, calvin.mordy@noaa.gov

While the Alaska Coastal Current (ACC) is evident along much of the coast of Alaska from Chatham Strait to Samalga Pass, it is not a continuous feature. Disruptions in the flow occur at the exit to Cross Sound, from Icy Point to Yakutat, and at Kayak Island. The ACC, however, is a continuous, well-defined system extending for ~1,700 km along the coast of Alaska from Seward to Samalga Pass in the Aleutian Islands. The magnitudes of transports along the path of the ACC were derived using data collected at >20 mooring sites (a total of > 180 deployments) and from > 400 satellite-tracked drifters. While not continuous, the data spans a 30 year period (1984 – 2014). The transports measured using current measurements on four lines (Seward, Gore Point, Kennedy and Stevenson Entrances, and the exit to Shelikof Strait) were significantly correlated with alongshore winds, although the correlation at the Seward Line was weak. The largest mean transport occurred at Gore Point (1.4×10^6 m^3 s^{-1} in winter and 0.6×10^6 m^3 s^{-1} in summer). Integration of recently collected current-meter data (Gulf of Alaska Integrated Ecosystem Research Program and NOAA/EcoFOCI) with historical data sets provides a map of seasonal (May – mid-September and mid-September – April) transport in the ACC from southeast Alaska to Samalga Pass. The interaction of the ACC with topography results in mixing and prolonged summer production around Icy Point, Kodiak Archipelago, and Shelikof Strait.

Evaluating Particle Abundances and Size Distributions with Chlorophyll a Concentrations in the Northern Coastal Gulf of Alaska

Jessica Turner
University of Alaska Fairbanks (UAF), jessie.turner@alaska.edu
Andrew McDonnell
UAF, amcdonnell@alaska.edu

The northern coastal Gulf of Alaska (GOA) is part of a long-term observational program to collect basic physical, chemical, and biological data each spring and fall. However, this region lacks a recent analysis of the behavior of particulate organic matter. This study seeks to analyze particle abundances and size distributions over part of the northern GOA shelf. Profiles were collected in May and September 2014 along the Seward Line in the northern coastal GOA, using the Underwater Vision Profiler (UVP) to take *in situ* optical images of large particles (>100 µm) and the Laser *In Situ* Scattering and Transmissometry device (LISST-deep) to account for abundances and size distributions of smaller particles (2.5-500 µm). Chlorophyll *a* concentrations were obtained with an *in situ* fluorometer on the CTD rosette. Together, data from these instruments provide a high-resolution view of particle abundances and size distributions during two seasons on the Seward Line. This preliminary analysis of spatial and temporal variability in particulate organic matter is a first step toward evaluating the relationships between particle abundances and chlorophyll *a* concentrations. In May 2014, overall particle abundances decreased with distance from shore, with small size classes (< 300 µm) dominating. These trends in particle abundance did not resemble patterns of chlorophyll *a* concentration. In September 2014, more stations, deeper casts, and the addition of smaller size class data from the LISST-deep revealed different trends. Future data collection in May and September 2015 will allow for further investigation of the relationships between the timing and magnitude of primary production and sinking particle flux.

From the Glacier to the Gulf: Land Ice Melt Influences on Carbon Uptake and CaCO3 Corrosivity in a Sensitive Marine Ecosystem

Wiley Evans
NOAA, Pacific Marine Environmental Laboratory (PMEL), wiley.evans@noaa.gov
Jeremy Mathis
PMEL, jeremy.mathis@noaa.gov
Chris Meinig
PMEL, christian.meinig@noaa.gov
Noah Lawrence-Slavas
PMEL, noah.lawrence-slavas@noaa.gov
Scott Stalin
PMEL, scott.e.stalin@noaa.gov
Nicholas Delich
PMEL, nicholas.delich@noaa.gov
Geoff Lebon
PMEL, geoffrey.t.lebon@noaa.gov
Stacy Maenner
PMEL, stacy.maenner@noaa.gov
Jessica Cross
PMEL, jessica.cross@noaa.gov
Natalie Monacci
University of Alaska Fairbanks, nmonacci@alaska.edu

Melt from marine-terminating glaciers has been shown to be highly corrosive to calcium carbonate ($CaCO_3$) biominerals in coastal ocean settings including Prince William Sound (PWS). In addition to this trait, glacial melt plumes have also been described as strong sinks for atmospheric CO_2; setting up the potential for a positive feedback whereby $CaCO_3$ corrosivity is enhanced through air-sea CO_2 exchange. Up to now these observations have been based on sparse sampling conducted from bi-annual cruises focused on the Seward Line and from select stations within PWS. An open question is to what extent do glacial melt plumes impact the broader productive ecosystems of PWS and the adjacent northern Gulf of Alaska (GOA). To address this question, we initiated a multi-platform monitoring project to track coastal ocean corrosivity in PWS and the adjoining continental shelf from May through September of 2014. In conjunction with the bi-annual cruises and a previously established high-latitude mooring, we deployed 2 Carbon Wave Gliders and 1 Slocum Glider, as well as instrumented a glacier tour vessel with sensors to track $CaCO_3$ corrosivity. The Carbon Wave Gliders track corrosivity via direct measurements of the marine carbonate system, whereas data from the Slocum Glider was forced through regionally specific multiple linear regression algorithms to track corrosivity indirectly throughout the upper 200 m of the water column. Cumulatively, the 3 gliders transited ~10,000 km of horizontal distance over their ~135 day deployment collecting over 500,000 measurements, with the Slocum glider executing more than 5,000 dives during the longest high-latitude ocean carbon glider mission to date. The dataset obtained by these platforms illustrates: 1) the ability to

highly resolve carbonate system variability autonomously at unprecedented time and space scales in a high-latitude setting, 2) the local to regional scale effect of glacial melt on the carbonate system from a glacier terminus to PWS to the broader continental shelf, and 3) the interacting processes shaping atmospheric CO_2 uptake and $CaCO_3$ corrosivity in the northern GOA. Results from this study also serve as an analogue for other coastal settings that are recipients of land ice melt.

Conclusions From a Four-year Research Study; Ocean Acidification in Prince William Sound, Alaska

Alta Dean
Colony High School, 77seals@gmail.com

Conclusions from a Four-year Research Study; Ocean Acidification in Prince William Sound, Alaska

Alta Dean

Colony High School, Palmer, Alaska; USA

Abstract: Ocean acidification is the ongoing decrease in the pH of the Earth's oceans, caused by an increase in carbon dioxide (CO_2) from the atmosphere. The more CO_2 produced, the more oceans absorb. If one marine animal's niche is disturbed, it disrupts the remaining balance of nature and can be devastating. Prince William Sound (PWS) is important not only to Alaskans for its commercial and subsistence fisheries, but to the world as a pristine ecosystem and home to many endangered marine species.

The purpose of this experiment was to test the waters of PWS over the course of four years to see if there was a decrease in pH, which will affect areas including shell growth, coral development, and salmon populations.

Experimental Procedures:

1. Obtain equipment

2. Arrive at the test site(s)

3. Test area- follow experimental procedures list

4. Repeat procedures at every test site

5. Record data

6. Compare new data to baseline data and look for any changes.

I gathered a varied range of data at every test site, including: depth, barometric pressure, ocean pH, salinity, water hardness, longitude, latitude, specific gravity, tidal conditions, air temperature, water temperature and the time. I compared the data I gathered and have formed preliminary conclusions. Over the course of four years, I have tested fifty-two water samples from nineteen locations throughout Prince William Sound.

This was the final year of testing and preliminary results can be drawn. There were five specific areas that I sampled that had a decrease in pH over the course of four years. The test locations in southern PWS, closest to the Gulf of Alaska, do show a decrease in pH. Unfortunately, my studies show ocean acidification is occurring in this important body of water.

Observations of Waves off Yakutat's Cannon Beach

Jeremy Kasper
University of Alaska Fairbanks (UAF), jlkasper@alaska.edu
Timothy Tschetter
UAF, tjtschetter@alaska.edu

A >1 year record of wave statistics (wave direction, height and period) from an acoustic Doppler current profiler deployed in 40 m of water off of Yakutat's Cannon Beach shows a wave climate dominated by storm induced waves with maximum wave heights that exceed 12 m occurring in late November of 2013. Wave direction in this shallow location aligns with the local coastline. In addition, the SWAN model was used to propagate the observed wave field into shallower water in order to estimate the wave statistics in 5-10 m of water where direct measurements of waves represents a significant challenge. These observations of waves and currents represent the first in-situ measurements from a shallow location along the Gulf Coast in the vicinity of Yakutat. The observations were conducted as part of a resource assessment to determine if harnessing wave energy was a viable means of powering the city of Yakutat. While the low baseline wave heights interspersed with large storm events in the record suggest wave power is not an ideal energy source, other factors including Yakutat's low baseline power requirements, the ability to access the site between storms for maintenance visits and short distance between the measurement site and the existing power grid argues in favor the community adapting wave energy.

The Long Game: Oceanographic Variability and Limits to Climate Change Detection in Glacier Bay, Alaska

Lewis Sharman
Glacier Bay National Park & Preserve, lewis_sharman@nps.gov

2015 marks the 23rd consecutive year of oceanographic monitoring of Glacier Bay, a tidewater glacial fjord in southeastern Alaska. The monitoring design combines twice-yearly occupation of 22 permanent stations for monitoring for inter-annual changes and trends, with monthly occupation of eight "core stations" to detect seasonal signals. Surface-to-bottom vertical profiles are obtained for temperature, salinity, density, light penetration, turbidity, dissolved oxygen concentration, and a proxy for phytoplankton abundance. Not surprisingly, there is a strong seasonal pattern of a generally homogeneous, well-mixed water column in winter, and a strongly stratified summertime water column that allows for relatively high levels of primary productivity in surface waters. The extended length of this "spring bloom" in Glacier Bay is notable and is believed to be sustained by regular injection of nutrients to the photic zone from depth via the interaction of tidal currents and bottom topography. The data show high inter-annual variability marked by occasional statistical anomalies (compared to the historical mean of the dataset) for several parameters. Such variability is expected for high-latitude temperate fjords of this type, compounded by Glacier Bay's ongoing de-glaciation and associated dynamism as the system seeks biophysical equilibrium. Data to date do not indicate any manifestation of global climate change with high confidence. Because of the expense of data collection (increasing the sample size), oceanographic monitoring designs frequently have relatively low power to detect small changes except over long timeframes. Long-term datasets are essential for this purpose.

Interannual Variability in Lower Trophic Levels on the Alaskan Shelf

Sonia Batten
Sir Alister Hardy Foundation for Ocean Science, soba@sahfos.ac.uk
Dionysios Raitsos
Plymouth Marine Laboratory, dra@pml.ac.uk
Russ Hopcroft
University of Alaska Fairbanks (UAF), rrhopcroft@alaska.edu
Ken Coyle
UAF, coyle@ims.uaf.edu

The south Alaskan shelf region that encompasses the large inlets of Cook Inlet (CI) and Prince William Sound (PWS) and the outer shelf of the northern Gulf of Alaska is a productive, dynamic, subarctic shelf system supporting numerous valued marine resources such as commercially-harvestable fish (e.g., herring, salmon, groundfish), large marine mammals (e.g., beluga whales, humpback whales), and seabirds. Lower trophic level productivity underpins this ecosystem but our understanding of plankton variability in this region is still somewhat limited. This paper reports results from the first 13 years of the Continuous Plankton Recorder (CPR) program that has sampled the lower trophic levels (restricted to larger, hard-shelled phytoplankton and robust zooplankton taxa) with complementary data from the Seward Line. CPR sampling took place along a transect from the open ocean across the shelf (into CI from 2004 to 2012 and to the entrance to PWS from 2000 to 2003) to provide plankton abundance data, spring through autumn of each year. We have found that warm years had generally higher abundances of the larger phytoplankton cells retained by the CPR, particularly of diatoms. Diatom spring phenology (timing) revealed an influence by water column conditions such as salinity, which is important in setting up water column stability. There was also a strong correlation with the North Pacific Gyre Oscillation (NPGO) index, which is known to explain salinity variability further south in the California Current system. Total mesozooplankton biomass was shown to be strongly positively correlated with diatom abundance, and less strongly but still positively, was the abundance of major zooplankton groups. Zooplankton community composition was also influenced by temperature with changes not as dramatic as a replacement of many species by others, but rather a change in relative abundances with temporary occurrences of some rare species. These CPR data thus support the hypothesis that the physical environment of the Gulf of Alaska shelf (in this case SST and salinity) influences the phytoplankton (diatom abundance and phenology), which in turn controls the quantity of mesozooplankton. We can therefore speculate that higher trophic levels such as fish will be influenced.

Spatial and Temporal Variability of the Suspended Particulate Fe Load Over the Gulf of Alaska Shelf

Megan Roberts
University of Alaska Fairbanks (UAF), mvroberts@alaska.edu
Marie Seguret
UAF, mseguret@alaska.edu
Ana Aguilar-Islas
UAF, amaguilarislas@alaska.edu

The Gulf of Alaska (GOA) is a region with contrasting ecosystems where the availability of the essential micronutrient iron (Fe) contributes to the observed productivity. The North Pacific Research Board's Gulf of Alaska Integrated Ecosystem Research Project (GOAIERP) investigates interconnections among the various trophic levels of this important region, and as part of the GOAIERP lower trophic level component, the distribution of Fe over the GOA shelf was investigated during 2011 and 2013. Here we present particulate Fe data from samples collected over the eastern and western GOA during spring 2013, and compare these results to those obtained in the spring of 2011. The leachable (reactive) fraction of Fe in suspended particles was determined using a 25% acetic acid leach, and the refractory (non-reactive) fraction was obtained by sequential digestion of the remaining particles with concentrated acids (HCl, HNO_3 and HF). Analyses of leaches and digests were conducted at the University of Alaska Fairbanks by an inductively coupled plasma mass spectrometry with the use of high-purity standards, and gallium as the internal standard. In general suspended particles over the broad western GOA shelf contained higher concentrations Fe (~100 nM on average) as compared to suspended particles over the narrower eastern GOA shelf (~ 15 nM on average), with the exception of a station near the Copper River plume, where total suspended particulate Fe along the water column ranged from ~ 480 nM to ~ 860 nM. However, throughout the study region the suspended particulate Fe was preferentially partitioned into the refractory fraction (81%-89%) over the entire water column. These observations, together with the molar Fe:Al ratio (0.30) of the suspended particles indicates a particulate load dominated by glacial inputs. This is in contrast to data obtained during spring 2011 when the suspended particulate load was greatly reduced due to a delayed spring freshet. Distributions of Al, Mn, and Cu during these two years will also be discussed.

Determinants of Seaweed Biogeography Along the North Pacific Rim, With Emphasis on the Northern Gulf of Alaska

Sandra Lindstrom
University of British Columbia, Sandra.Lindstrom@botany.ubc.ca

A number of authors have proposed various schemes depicting biogeographic provinces along the west coast of North America. Since the boundaries of these provinces vary, depending on the author, it is hardly surprising that molecular sequencing of present-day collections provides support for only some of the boundaries but also suggests new ones. Molecular data from seaweeds collected along the Pacific rim from California to Japan indicate that biogeographic breaks occur near Cape Mendocino, California, the eastern end of the Strait of Juan de Fuca, British Columbia, the northwestern Gulf of Alaska, and in the Aleutian Islands. Moreover, unique genotypes are found along the Monterey Peninsula, and some of these appear to represent distinct species. This talk will concentrate on the northwestern Gulf of Alaska, where many southern species reach their northern limit and where western species reach their eastern limit. Examples include species of green algae (Chlorophyta, e.g., *Acrosiphonia*), brown algae (Phaeophyceae, e.g., *Macrocystis*), and red algae (Rhodophyta, including *Mastocarpus*, *Mazzaella*, *Palmaria*, and *Halosaccion* among others). Moreover, several endemic species of seaweeds (including species of *Halosaccion* and *Laminaria*) have been identified in this area. Oceanographic and other conditions, including glacial and post-glacial history, that may be responsible for these distribution patterns will be discussed.

Surveying Euphausiid Abundance to Understand the Central Gulf of Alaska Ecosystem

Kirsten Simonsen
NOAA, Alaska Fisheries Science Center (AFSC), kirsten.simonsen@noaa.gov
Patrick Ressler
AFSC, patrick.ressler@noaa.gov
Christopher Rooper
AFSC, chris.rooper@noaa.gov
Stephani Zador
AFSC, stephani.zador@noaa.gov
Martin Dorn
AFSC, martin.dorn@noaa.gov

Euphausiids (or 'krill') are a key zooplankton taxon in the Gulf of Alaska, as in other ecosystems around the world. They form an important ecological link between primary production and higher trophic levels as prey for marine mammals, seabirds, and fish. We created an index of euphausiid (principally *Thysanoessa* spp.) abundance in the central Gulf of Alaska using data from four summertime acoustic-trawl surveys of walleye pollock (*Gadus chalcogrammus*) conducted between 2003 and 2013. Acoustic backscatter at several frequencies (18, 38, 120, and 200 kHz) and targeted trawling were used to detect and classify euphausiid aggregations. Euphausiid backscatter was positively correlated with euphausiid density from targeted net samples ($r^2 = 0.35$) and in-trawl camera footage. Euphausiids were patchily distributed throughout the study area, with relatively higher densities in coastal bays and troughs around Kodiak Island than on the remainder of the shelf. Highest euphausiid abundance was observed in 2011 as compared to other years in the time series. Previous work in the eastern Bering Sea has shown that euphausiid abundance was better predicted by water temperature than by the abundance of walleye pollock, a major predator. To determine whether similar relationships exist in the Gulf of Alaska, we modeled euphausiid abundance from consistently sampled survey areas using several possible covariates, including temperature and predator abundance. We will compare and contrast the relationship between euphausiids and their environment in the Gulf of Alaska and Bering Sea, as well as discuss future directions of the project.

The Role of Bathymetry in the Cross-Shelf Transport of Nutrients and Ichthyoplankton in the Northern Gulf of Alaska

Calvin Mordy
University of Washington (UW), mordy@uw.edu
Phyllis Stabeno
NOAA, Pacific Marine Environmental Laboratory (PMEL), phyllis.stabeno@noaa.gov
Nancy Kachel
UW, nkachel@uw.edu
David Kachel
PMEL, david.kachel@noaa.gov
Carol Ladd
PMEL, carol.ladd@noaa.gov
Mark Zimmermann
NOAA, Alaska Fisheries Science Center, mark.zimmermann@noaa.gov
Miriam Doyle
UW, Miriam.Doyle@noaa.gov

In the northern Gulf of Alaska (NGOA), the relatively broad shelf between the Kenai Peninsula and the Semidi Islands is incised with numerous troughs and canyons. These sea valleys serve as conduits for cross-shelf advection nutrients, and result in extensive phytoplankton blooms through the summer. They also serve as a conduit for ichthyoplankton, as they migrate between spawning grounds near the slope and the shallow nursery grounds adjacent to Kodiak Island. We used data from hydrographic surveys, moorings, and satellite imagery to examine four of the major bathymetric features in the NGOA: Amatuli Trough, Chiniak Trough, Barnabas Trough, and Shelikof Strait. In Amatuli Trough, there was little mixing within the trough, but flow up the canyon brought saltier, nutrient rich water across the shelf towards Kennedy and Stevenson Entrances where deep mixing was prevalent and nutrients were continuously introduced into the euphotic zone. In Chiniak Trough, deep mixing occurred within the trough with fresher water and fewer nutrients evident at depth. But in Barnabas Trough, there was little evidence that water entering the trough were mixed towards the surface. Shelikof Strait had estuarine flow, with an average transport ~ 0.4×10^6 m^3 s^{-1} flowing from the shelf break northeastward up Shelikof Sea Valley and into Shelikof Strait. This flow introduces nutrients, zoo- and ichthyoplankton onto the shelf. Ichthyoplankton were most prevalent in Amatuli Trough and Shelikof Strait.

Gulf of Alaska Integrated Ecosystem Research Program: Ichthyoplankton Assemblages in the Eastern and Western Gulf of Alaska During Spring and Summer of 2011 and 2013

Deborah Blood
NOAA, Alaska Fisheries Science Center (AFSC), Debbie.Blood@noaa.gov
Lisa De Forest
AFSC, Lisa.DeForest@noaa.gov
Ann Matarese
AFSC, Ann.Matarese@noaa.gov
Miriam Doyle
University of Washington, Miriam.Doyle@noaa.gov

The Gulf of Alaska Integrated Ecosystem Research Program (GOAIERP) is a four year (2011–2014) multi-disciplinary study examining interactions between physical and biological oceanography to understand how the environment influences the survival of early life history stages (egg to young-of-the-year) and recruitment of five commercially and ecologically important groundfishes: walleye pollock (*Gadus chalcogrammus*), Pacific cod (*Gadus macrocephalus*), arrowtooth flounder (*Atheresthes stomias*), sablefish (*Anoplopoma fimbria*) and Pacific Ocean perch (*Sebastes alutus*; larvae are presently indistinguishable from other species of rockfish and are therefore reported as *Sebastes* spp.). Biological and oceanographic surveys in the eastern and western Gulf of Alaska (GOA) were conducted during spring and summer of 2011 and 2013. Based on 36 years of historical collections, ichthyoplankton communities are well described for the western GOA, but very limited information is available for the eastern GOA. We present a synthesis of ichthyoplankton data collected during the 2011 and 2013 surveys. The results describe seasonal, regional (eastern vs. western GOA) and interannual variation in occurrence, distribution, abundance and larval sizes of the focal species, as well as species diversity in the broader ichthyoplankton assemblages. Results are interpreted with respect to discerning patterns in spawning times and locations, early ontogeny habitat, and larval pelagic durations and drift pathways to settlement areas. These patterns provide insight into the links between early life history stages of the focal species and the physical and biological environment in the GOA, and how environmental forcing may influence early life history aspects of recruitment.

Pinto Abalone: Overview of the Endangered Species Act Listing Evaluation

Sadie Wright
NOAA, Protected Resources Division, sadie.wright@noaa.gov

The pinto abalone (*Haliotis kamtschatkana*) was added to the National Marine Fisheries Service's (NMFS') "Species of Concern" list in 2004 due to concerns regarding status and threats. In July and August, 2013, NMFS received two petitions to list the pinto abalone as threatened or endangered under the Endangered Species Act (ESA), and to designate critical habitat for the species. The petitioners identified a number of potential threats to the species, including overfishing, poaching, sea otter (*Enhydra lutris*) predation, and environmental change. On November 18, 2013, NMFS published 90-day findings concluding that the petitions presented substantial scientific or commercial information indicating that the petitioned action may be warranted. NMFS conducted a Status Review of the species throughout its range (Southeast Alaska to Baja California, Mexico) to determine if the best available information supported a threatened or endangered listing. The best available data indicate that pinto abalone abundance declined significantly in large parts of its range due to overfishing, and has continued to decline despite the closure of fisheries throughout most of its range. Limited surveys and opportunistic sightings indicate that pinto abalone populations are small, patchily distributed, and fluctuate episodically, with evidence of recent recruitment in a small number of locations. The Status Review includes an evaluation of threats to the species, population demographics, and regulatory protections in place to conserve and manage the species. The Status Review informs the decision whether to list the pinto abalone under the ESA.

Zooplankton Temporal and Spatial Variability in the Gulf of Alaska: Consequences to Resource Availability

Russell Hopcroft
University of Alaska Fairbanks (UAF), rrhopcroft@alaska.edu
Ken Coyle
UAF, kocoyle@alaska.edu

The Gulf of Alaska program allowed extensive sampling of the Gulf of Alaska shelf in 2011 and 2013. Using the Seward Line as reference, during 2011 zooplankton assemblages were anomalously depressed from southeast Alaska to Kodiak due to a strong salp bloom, while 2013 appears relatively typical. We examine the specifics of the cross-shelf and along-shelf patterns in the zooplankton community for the narrow shelf in Southeast and the broad shelf in the northern Gulf of Alaska. The consequences of these differences in the size-spectra of prey available to larval-fish is considered, as well as the potential productivity differences between regions.

Monitoring Phytoplankton in Kachemak Bay, Alaska

Dominic Hondolero
NOAA, National Ocean Service (NOS), Dominic.Hondolero@noaa.gov
Kristine Holderied
NOAA, NOS, Kris.Holderied@noaa.gov

Establishing baseline monitoring information on ecological systems is essential for determining current health of the ecosystems as well as providing the ability to detect changes to ecosystems. NOAA's Kasitsna Bay Laboratory (KBL), in partnership with the NOAA Phytoplankton Monitoring Network and the Kachemak Bay National Estuarine Research Reserve, has been monitoring phytoplankton populations in Kachemak Bay for 3 years. The spring phytoplankton blooms begins in early April and is dominated by diatoms of the genus *Chaetoceros*. This bloom continues until nutrient levels begin to drop in late July and a second bloom generally occurs in August and September. During the peak of the spring bloom concentrations of over 1,000,000 cells/liter have been observed. By percentage, the composition of phytoplankton species at different sites throughout the bay remained similar across seasons. Spring and summer were dominated by *Chaetoceros* spp., which decline in late summer and fall, disappearing in winter when dinoflagellate species became dominant. In the late summer of 2012 a bloom of *Pseudonitzschia* sp. was observed throughout Lower Cook Inlet. During the summer of 2013 there were two additional bloom events that discolored water over large areas: a red water event in June which was caused by the ciliate *Mesodinium rubrum* and was localized to a few bays on the southern shore of Kachemak Bay and a brown water event in late September, early October which was caused by the dinoflagellate *Karenia mikimotoi*. The brown algae bloom was observed more extensively throughout Kachemak Bay. During the summer of 2014, with the exception of the normal spring and late summer blooms, no unusual bloom events were observed. Our Kasitsna Bay Laboratory monitoring program is providing information on seasonal plankton patterns and bloom events to resource managers and the public. Future work will incorporate this baseline information and further investigate the roles that vertical distribution, nutrient input, and nutrient limitation play in the regulation of Kachemak Bay phytoplankton communities.

Dietary Lipids Improve the Nutrition and Condition of Red King Crab Larvae (*Paralithodes camtschaticus*)

Asia Beder
University of Alaska Fairbanks (UAF), ambeder@alaska.edu
Ginny Eckert
UAF, gleckert@alaska.edu
Louise Copeman
Oregon State University, louise.copeman@noaa.gov

Diets supplemented with essential fatty acids improve red king crab (*Paralithodes camtschaticus*) larval nutrition and condition. Larvae were fed *Artemia* nauplii enriched with lipid emulsions varying in the following essential fatty acids: 1) high docosahexaenoic acid (DHA), 2) high DHA and eicosapentaenoic acid (EPA), 3) high DHA and arachidonic acid (AA), and 4) a control lipid (equal in total lipid but low essential fatty acids). Larval condition, assessed by viewing size and number of lipid droplets, was not significantly different among the four diet treatments during the zoeal stages. However, during the glaucothoe stage, larvae that were fed diets enriched with high DHA and EPA and high DHA and AA had more and larger lipid droplets than larvae that received either the DHA or control diets. Biochemical analyses showed that proportions of essential fatty acids were significantly different in crabs from all dietary treatments during both the fourth zoeal and glaucothoe stages. During the crucial glaucothoe stage the total fatty acids per wet weight (mg/g) was significantly lower in crabs fed the control diet (low essential fatty acids). Further, during a stress test, that measured response time after exposure to freshwater, glaucothoe previously fed the control lipid diet recovered significantly slower than individuals previously fed high essential fatty acid diets, suggesting that essential fatty acids can improve performance during stress. These results will improve larval nutrition and assist with assessing the feasibility of rehabilitating king crab stocks that crashed in the early 1980's throughout Alaska.

Importance of Antibody-producing Cells as a Marker for Successful Spawning in Sockeye Salmon.

Patty Zwollo
College of William and Mary, pxzwol@wm.edu

During the spawning phase, salmon undergo drastic, hormonally driven changes in their physiology, including elevated levels of cortisol, which are known to suppress the immune system. Specific antibodies are a major source of protective immunity in salmon, but spawning fish have a reduced capacity to generate new antibodies. However, we recently discovered the existence of so-called “long-lived antibody-producing plasma cells”, which are generated in juvenile fish, and then stored in the anterior kidney for the remainder of their lifetime. As adult fish need to survive their long journey back to the spawning grounds, we hypothesized that these long-lived antibody-producing cells are essential for pre-spawning survival. Hence, the abundance of such cells might provide a good marker not just for pre-spawning survival, but also for the production of viable offspring. For this study, the presence of long-lived antibody-producing cells was measured in immune tissues from migrating sockeye salmon, using real-time qPCR and flow cytometry. Immune tissue samples were collected from salmon from the Kenai River drainage, Main Bay, and Prince William Sound. Our results reveal that migrating fish retain high levels of the antibody-producing cells in their anterior kidney throughout the spawning journey. Antibody was also detected in the eggs of salmon at their spawning site and prior to spawning. Furthermore, we show that antibody-producing cells remain abundant in post-spawning sockeye salmon, even when other immune cells are lost. This suggests that in order for a sockeye salmon to be successful, it needs to retain its long-lived antibody-producing cells throughout the spawning journey and post-spawning.

Distribution, Diet, and Energetic Condition of Age-0 Walleye Pollock (*Gadus chalcogrammus*) and Pacific Cod (*Gadus macrocephalus*) Inhabiting the Gulf of Alaska

Jamal Moss
NOAA, Alaska Fisheries Science Center, jamal.moss@noaa.gov
Marilyn Zaleski
AFSC, marilyn.zaleski@noaa.gov
Ron Heintz
AFSC, ron.heintz@noaa.gov

Walleye pollock (*Gadus chalcogrammus*) and Pacific cod (*Gadus macrocephalus*) are commercially and ecologically important species in Alaska waters. Little is known about their ecology after transitioning from larvae to free swimming fish until settlement to nursery habitats in the eastern and central Gulf of Alaska (GOA). Differences in the distribution, diet, body size, and energetic status between the eastern and central GOA were investigated during summer months to better understand regional and interspecific differences in life history and ecology. Walleye pollock preyed heavily upon large copepods (> 2 mm) whereas Pacific cod preyed heavily upon small copepods (< 2 mm), however, no statistically significant differences in the regional or interspecific composition of prey in walleye pollock and Pacific cod diets were detected. Energy density and total energy of Pacific cod was greater than that of walleye pollock, however, the allometry between total somatic energy and length was similar for both species. Walleye pollock inhabiting continental slope waters had higher energy stores relative to those inhabiting the continental shelf and basin, indicating an energetic advantage for individuals remaining off the shelf during summer months. Previous studies have documented the importance of energy stores for surviving winter and future studies should focus on understanding the mechanisms influencing energy storage and somatic growth in the GOA.

-- No Title Given--

David Welch
Kintama Research Services (KRS), david.welch@kintama.com
Aswea Porter
KRS, aswea.porter@kintama.com
Paul Winchell
KRS, paul.winchell@kintama.com

Background: Worsening recruitment of Alaskan Chinook salmon (*Oncorhynchus tshawytscha*) over the past decade has created major conservation problems state-wide. In Cook Inlet, lucrative sockeye salmon (*O. nerka*) fisheries are severely limited because of Chinook salmon bycatch, restricting economic opportunity and creating political conflict between user groups. Although Chinook salmon are thought to migrate at deeper depths than other salmon during the marine phase, an inability to quantify the depth difference has prevented regulatory changes to protect Chinook salmon while allowing sockeye salmon fisheries to operate.

Results: Using a purpose-built acoustic telemetry array, we found that Chinook salmon repeatedly "patrolled" back and forth in the nearshore fishing area for multiple weeks before river entry (a previously unrecognized behaviour) while sockeye rapidly crossed the area to enter the river. Both species substantially increased migrations speeds at river entry. Clear differences in the median depth of marine migration of Chinook salmon (4.8 m) and sockeye salmon (1.8 m) were evident, allowing us to quantify the potential trade-off between reducing sockeye salmon harvest and increasing Chinook salmon protection from using shallower gillnets in the commercial fishery. Based on the 16,608 depth measurements collected for Chinook salmon and 3,389 measurements for sockeye salmon, reducing the vertical depth of surface-hung gillnets to one-half of current maximum depth would potentially reduce the Chinook salmon interception rate by nearly two-thirds, while reducing sockeye salmon harvests by one-quarter. Alternatively, if commercial fishermen were fully compensated for the reduced area of netting by allowing exactly compensatory increases in net length, sockeye salmon catches could potentially increase to 200-300% of current levels, but Chinook salmon interceptions would remain similar to current levels despite reductions in net depth. Identifying an intermediate strategy between these two extremes could provide a "win-win" solution rather than the current zero-sum game between deeply opposed stake-holders.

Conclusions: Biotelemetry allowed rapid collection of very large numbers of depth measurements despite relatively few adults being tagged. The collected data have already been used to implement some of the first regulatory changes in the fishery in more than a decade and have identified a potential avenue for future political accommodation between fiercely opposed user groups.

Length Changes in Auke Creek Salmon

Joshua Russell
University of Alaska Southeast (UASE), joshuarussell0407@gmail.com
John Joyce
NOAA, Alaska Fisheries Science Center (AFSC), john.joyce@noaa.gov
Scott Vulstek
AFSC, scott.vulstek@noaa.gov
Ryan Kovach
U.S. Geological Survey, rkovach@usgs.gov
David Tallmon
UASE, david.tallmon@uas.alaska.edu

In recent years, a trend of decreasing body length has been observed in some southeast Alaska salmonid populations. This study was undertaken to determine whether this pattern holds for Auke Creek salmon and, if so, what factors are contributing to this phenomenon. We analyzed 32 years of coho salmon (*Oncorhynchus kisutch*) length data from Auke Creek Weir in Juneau, Alaska. We found a decrease in coho salmon length over time. The male coho salmon have decreased in mean length by 11.22 mm over 32 years ($R^2 = 0.21$, $p = 0.0045$, $n = 3{,}285$). The female coho salmon have decreased in mean length by 17.00 mm over 32 years ($R^2 = 0.18$, $p = 0.0078$, $n = 3{,}263$). There is also a great deal of fluctuation in length across the time series. Further analyses will examine factors that seem to influence this variation. Next, we will use a time-series of sockeye salmon (*O. nerka*) and pink salmon (*O. gorbuscha*) length data and incorporate Auke Creek coded wire tag recoveries from southeast Alaska commercial fisheries to expand our analyses and examine factors contributing to changes in salmon length.

Salmon Blitz: Engaging Citizen Scientists in Documenting Salmon Habitat in the Copper River Watershed

Kate Morse
Copper River Watershed Project, kate@copperriver.org
Rich Brenner
Alaska Department of Fish & Game, richard.brenner@alaska.gov

An understanding of Pacific salmon habitat use at all life stages is necessary to protect and sustain Alaska's wild salmon populations into the future. Alaska Department of Fish & Game's (ADFG) *Anadromous Waters Catalog* (AWC) is used to document all known rearing and spawning habitat of anadromous fish. However, due to the vast number of streams in Alaska and limited resources, not all salmon streams are currently listed or have detailed information about their use (e.g., rearing and/or spawning). The Copper River Watershed Project has worked with ADFG and other partners throughout the watershed to develop and implement Salmon Blitz, a citizen science program designed to engage community volunteers in field surveys to collect data needed to nominate additional habitats to the AWC, and provide more spatial and temporal detail for habitats currently listed in the catalog. This project provides important data to inform management of salmon as well as hands-on learning opportunities for participants. By connecting people with their surroundings and deepening their understanding of the resources on which they depend, we hope to instill a greater sense of engagement and responsibility for the long-term health of the region's salmon. During the first field season over 100 volunteers helped asses a total of 15 sites, resulting in 13 nominations that included 7.7 new stream kilometers, and 3.3 km of upstream extent added. New species were nominated for 5.9 km of cataloged streams and life stage designation was added for 6.7 km of cataloged streams.

Status of Bivalve Populations and Sediments on Heterogeneous Beaches in Prince William Sound

Dennis Lees
Littoral Ecological & Environmental Services, dennislees@cox.net

NOAA treatment effects studies from 1989 through 1996 suggested that bivalve assemblages on heterogeneous beaches in Prince William Sound (PWS) were severely injured by EVOS beach washing. In 2002, densities of all sizes of hard-shell clams at washed sites remained 66% lower than at unwashed sites. We hypothesized that disturbance of clast organization accounted for lagging recovery.

In 2010, we re-assessed progress in bivalve recovery. Clam density at unwashed sites was no longer significantly higher than at washed sites. All sizes of littleneck clams (*Leukoma staminea*), living at the extreme northern end of their range, had declined by 95% , with most other dominant species declining by 14 to 68%. Consequently, bivalve recovery could no longer be tracked.

Since these observations echoed claims by other investigators of dramatic regional declines in bivalve abundance, we assessed long-term changes in clams from Kachemak Bay to Glacier Bay. Significant declines were observed in all regions over a 20-year period.

To investigate why, we looked at regional changes in seawater temperature, phytoplankton stocks, and pH, all of which could reduce survival of the more sensitive stages, larvae and post-larvae. Seawater temperatures had declined significantly throughout the region since 2005 and, in ten years between 1995 through 2010, were below reported threshold temperatures for littleneck spring spawning. Long-term research has shown that phytoplankton biomass in GOA had declined significantly since 2000. Thus, the combination of lower seawater temperatures and reduced phytoplankton biomass in spring could lead to considerable reductions in larval recruitment. Combined with normal attrition in adults, these reductions may partially explain observed regional declines of clam populations.

While pH has declined substantially since 1960, ocean acidification does not appear to be playing a role in bivalve declines at this point.

Development of a metric to measure organization of the coarse sediments was an important product of these studies. This metric showed that washed sites remained significantly less organized than unwashed sites 21 years after the cleanup.

Assessment of vertical stratification of sediments showed that beach washing removed significant quantities of silt/clay down to a depth of at least 20 cm.

Temperature and Salinity Effects on the Larvae that Create Zombie Crabs

Leah Sloan
University of Alaska Fairbanks (UAF), lmsloan@alaska.edu
Sarah Hardy
UAF, smhardy@alaska.edu

The parasitic barnacle (*Briarosaccus callosus*) can infect all commercially-harvested Alaskan king crab species. After infection, the parasite does not kill its crab host, but reduces it to no more than a body that is controlled by the parasite, in other words a "zombie crab." Infected crabs can no longer reproduce; instead they raise and care for the parasite eggs and larvae. Prevalence and distribution of *B. callosus* is poorly understood. Most records indicate a low level prevalence (< 1% of crabs infected) throughout Alaskan king crab populations. However, outbreaks occurred in the 1980s in some areas of southeast Alaska where over 75% of king crabs were infected. *Briarosaccus callosus* outbreaks at this level will greatly reduce reproductive output in king crab populations and likely lead to population declines. Causes of variability in *B. callosus* prevalence have not been identified, but salinity and temperature are important factors influencing survival in other species of parasitic barnacles. Due to climate change, water temperatures and salinities are expected to change in the Arctic and sub-Arctic, suggesting that *B. callosus* prevalence could also change. In this study, we examined the effects of temperature and salinity on *B. callosus* larval survival by raising larvae at a range of temperatures (0 – 16 ^{o}C) and salinities (19 – 40). Larval survival was highest at temperatures between 4 and 8 ^{o}C and at salinities between 28 and 34; survival declined rapidly outside these temperature and salinity ranges. This study indicates that future changes in temperature and salinity are unlikely to increase the prevalence of *B. callosus,* since current temperatures and salinities typically fall within the range of highest larval survival. There is the potential that future temperature increases and salinity decreases, especially in enclosed bays and fjords, will decrease survival of *B. callosus* larvae. However, this will depend on the behavior of *B. callosus* larvae and where they reside in the water column, for surface changes in temperature and salinity will be more dramatic than at depth.

Expanded Hydroacoustic Surveys of Adult Herring in Prince William Sound, 2013-2014

Richard Thorne
Prince William Sound Science Center (PWSSC), rthorne5800@gmail.com
Michele Buckhorn
PWSSC, mbuckhorn@pwssc.org

The Prince William Sound Science Center has conducted hydroacoustic surveys of the adult herring biomass in Prince William Sound each year since 1993. During the past two years the emphasis of the surveys has changed to an investigation of uncertainties in the survey design, specifically the possibility of significant herring (*Clupea pallasii*) abundance outside of the traditional survey area (primarily Port Gravina and Port Fidalgo over the past decade). The effort in 2013 included an expansion of the survey area, while the 2014 effort also expanded the survey time period from late March to late April. Very few adult herring were found outside the primary area in 2013, but an estimated 1-3 thousand metric tons of adult herring were found in the vicinity of Montague Island in late April. The herring during this later period were distributed in small dense schools near shore, and were the focus of intense foraging by humpback whales (*Megaptera novaeangliae*).

Development of the First Stock Assessment for Skates in Alaska, Using Stock Synthesis

Thomas Farrugia
University of Alaska Fairbanks (UAF), tjfarrugia@alaska.edu
Andrew Seitz
UAF, acseitz@alaska.edu

Skates are in growing demand worldwide, specifically in European and Asian markets. Big (*Beringraja binoculata*) and longnose (*Raja rhina*) skates are the most commonly landed skates in Alaska and currently, these species are harvested as non-target catch, partly because of a lack of information and formal stock assessments. Because skates are long-lived, slow-growing and late-maturing, they are vulnerable to overfishing, and management is unlikely to allow more skate landings until skate populations are shown to be capable of sustaining increased harvest pressures. Recently, more species-specific information on skates has made it possible to develop full stock assessments.

Through cooperation with the National Marine Fisheries Service (NMFS), we developed a preliminary stock assessment for big skates in Alaska, using Stock Synthesis (SS3), a powerful software package flexible enough to handle data-poor assessments. The current version is a single-sex model that divides the fishery into longline and trawl gears, and incorporates two survey data sets. The model shows that the big skate population in the Gulf of Alaska has declined since 2004 when retention of skates became more prevalent, and suggests that skate landings cannot be substantially increased without jeopardizing the sustainability of the stock. We now need to refine the big skate model, and create a parallel model for longnose skates in the Gulf of Alaska. These models will be shared with NMFS, and used to evaluate the feasibility of expanding harvest opportunities and prosecuting directed fisheries for skates.

Variation in Pacific Halibut Size-at-Age and the Harvest Policy Implications

Steven Martell
International Pacific Halibut Commission (IPHC), stevem@iphc.int
Jane Sullivan
University of Alaska Fairbanks (UAF), jysullivan@alaska.edu
Kirsten Holmsman
NOAA, Alaska Fisheries Science Center (AFSC), kirstin.holsman@noaa.gov
Gordon Kruse
UAF, gordon.kruse@alaska.edu
Bruce Leaman
IPHC, bruce@iphc.int
Kerim Aydin
AFSC, kerim.aydin@noaa.gov

Since 1888, the Pacific halibut (*Hippoglossus stenolepsis*) fishery has landed nearly 6 billion pounds net weight, or on average 47 million pounds per year. During this 126-year period there have been dramatic changes in halibut size-at-age. For example, in the early 1990's the average weight of an 18-year old female halibut was roughly 100 pounds net weight. Twenty years later the average weight has declined to less than 40 pounds net weight. There are a number of hypotheses regarding changes in size-at-age for Pacific halibut including, density-dependent growth, intra-specific competition, climatology and temperature effects, cumulative effects of size-selective fishing, bycatch, and potential biases in aging methods. The current harvest policy for Pacific halibut apportions estimates of coast-wide biomass into 8 regulatory areas and a fixed fraction of the biomass is harvested within each area. This paper examines the spatial and temporal variation in Pacific halibut size-at-age among regulatory areas and the harvest policy implications associated with spatial variation and continued changes in size-at-age. In addition we also explore temperature effects on the growth of Pacific halibut and sensitivity of bioenergetics to temperature gradients and different prey fields.

Juvenile Herring Index From Aerial Surveys Reflects Recruitment to Spawning Stock in Prince William Sound, Alaska

W. Scott Pegau
Oil Spill Recovery Institute, wspegau@pwssc.org
Mayumi Arimitsu
U.S. Geological Survey, Alaska Science Center, marimitsu@usgs.gov
Mike Collns
Pilot, flyingandfishing@hotmail.com

Recruitment failure is hypothesized to be a leading cause for the lack of recovery of Pacific herring (*Clupea pallasii*) in Prince William Sound (PWS) since the *Exxon Valdez* Oil Spill in 1989. Recruitment to the spawning stock occurs at age-3, and an index of juvenile herring abundance in the Sound is essential for informing the age-structured stock assessment. Aerial surveys of near-surface schooling herring and other forage fish have been conducted as a means to provide a cost-effective index of abundance in PWS. Previous aerial surveys began in the late 1990s, and more recent efforts occurred in 2010-2014. Aerial observations were made with the aid of an experienced commercial spotter pilot during June and July from a fixed-wing aircraft flying at altitudes of 300-400 m, and speeds of 200 km h^{-1}. Surveys conducted in June provide an index of the number of juvenile (primarily age-1) herring schools in PWS. Starting in 2014, the July aerial survey was combined with a vessel to provide improved validation of the species and age-class of schools, and acoustic measures of biomass. During June surveys we observed between 120 and 2100 age-1 herring schools. There appears to be a relationship between the age-1 index based on the number of schools to the recruitment of age-3 herring spawning biomass. Based on the unusually high age-1 index in 2013 we predict higher than average recruitment to the 2015 spawning stock. Here we will also provide an overview of the 2014 July aerial survey design. This work demonstrates the utility of aerial surveys for providing useful indices of herring and other forage fish abundance over time.

Seasonal Movements of Pacific Herring Tagged with Acoustic Transmitters in Prince William Sound, Alaska

Mary Anne Bishop,
Prince William Sound Science Center, mbishop@pwssc.org
John Eiler
NOAA, Alaska Fisheries Science Center, john.eiler@noaa.gov

Seasonal movements were determined for Pacific herring (*Clupea pallasii*) in Prince William Sound, Alaska, using acoustic telemetry. Herring jigs were used to capture the fish on spawning grounds in Port Gravina during April 2013. We surgically tagged 69 herring with acoustic transmitters. Both tagged and untagged fish were held for several hours for observation, and released together in the vicinity of other herring schools near the capture site. The post-tagging movements of the fish were monitored with an array of acoustic receivers located near the mouth of Port Gravina. Similarly, acoustic arrays operated by the Ocean Tracking Network at the principal entrances to Prince William Sound were used to track herring movements into the Gulf of Alaska. Over 80% of the tagged herring were detected after release by the Port Gravina array, with several fish recorded on multiple days. Forty-three (62%) tagged herring were subsequently detected by receivers at the entrances to the Gulf of Alaska. The movements from Port Gravina to these passageways were often rapid, with 11 (25%) of the 43 herring recorded within 2-4 days at the two major entrances, Hinchinbrook and Montague Strait (~ 50 and 115 km from Port Gravina, respectively). The fish were detected at the entrance sites from 10 April to 2 January, with seasonal peaks evident during the spring at both Hinchinbrook Entrance and Montague Strait. We also recorded a pulse of tagged fish at Montague Strait during September, however, this pattern was not observed at Hinchinbrook Entrance. Other populations of Pacific herring are known to exhibit seasonal migrations between spawning, feeding, and wintering areas. Seasonal movement patterns and post-spawning dispersal are important knowledge gaps in Prince William Sound, but herring are ostensibly sensitive to handling and tagging making these data difficult to collect. The results of this study suggest that large-scale telemetry studies on herring are feasible. In addition, the Ocean Tracking Network acoustic arrays provide an exceptional opportunity to document migratory herring patterns in Prince William Sound and determine connectivity between this area and the Gulf of Alaska.

Seasonal Patterns in Nutrient Utilization and Storage by the California Sea Cucumber (*Parastichopus californicus*) From Southeastern Alaska

Sarah M. Hardy
University of Alaska Fairbanks (UAF), smhardy@alaska.edu
Alexandra C. M. Oliveira
UAF, acoliveira@alaska.edu
Charlotte Regula-Whitefield
UAF, cmregulawhitefield@alaska.edu

Parastichopus californicus is a profitable Alaskan fishery; however, commercial divers are concerned about recent population declines. Causes are unknown, but diet shifts have been hypothesized to play a role. Previous aquaculture studies have demonstrated that limitations in food derived fatty acids (FA) can cause reduced growth rates and egg production. Many essential lipids and FA cannot be synthesized by marine animals, and must be acquired through consumption of primary producers and stored in tissues for later use. Here, field collections assessed if diet, total lipid and specific FA content of body tissues varied with seasonal cycles of growth and reproduction. Specimens were collected near Ketchikan, AK, between April 2012 and August 2013. Dissected female gut contents were removed and freeze-dried to examine seasonal variations in diet. Freeze-dried gut samples were weighed, contents identified to lowest taxonomic level, and then re-weighed by group. Shell debris and terrestrial matter were most abundant in guts. The incorporation of terrestrial matter into tissues was examined during FA analysis, and may indicate important ecological links between terrestrial and marine systems. Additionally, all gut samples contained centric diatoms in high abundance. Tissues were also separated by type (muscle, skin, viscera, and gonad), freeze-dried, and then subjected to lipid extraction using an accelerated solvent extraction system (ASE200, Dionex Corp.) with dicholormethane. Skin lipids were highest following spawning, when gonad lipids were lowest, suggesting skin may be used for lipid storage. Muscle and viscera lipids were low year-round, and are thus not likely storage tissues. FA in the lipid extracts were quantified using gas chromatography coupled to a flame ionization detector. Preliminary FA analysis demonstrates clear seasonal trends in abundance of FA such as EPA and DHA within gonad tissue. Other tissue types do not appear to be as seasonally variable in specific FAs. Overall, patterns in total lipid content reflected energy storage and allocation. In addition, seasonal changes in the relative abundance of FAs in each tissue identified specific FAs that may be important nutrients. These data should help shed light on effect of variations in natural food supplies on reproduction and recruitment in wild stocks.

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

Carrie Worton
Alaska Department of Fish & Game (ADFG), carrie.worton@alaska.gov
David Barnard
ADFG, david.barnard@alaska.gov
Gregg Rosenkranz
ADFG, gregg.rosenkranz@alaska.gov
Christian de Moustier
10dBx LLC, cpm@ieee.org
Philip Tschersich
ADFG, philip.tschersich@alaska.gov

This project used the wide-angle seafloor sonar profiler (WASSP) multibeam system and a towed benthic imaging system (CamSled) to deliver full-coverage maps of bathymetry and seafloor acoustic backscatter and to provide both classified substrates and biological observations for Tanner crab habitat for two important areas northeast of Kodiak Island in the Gulf of Alaska (GOA). The WASSP multibeam system worked as expected delineating substrate types and bottom features consistently, while the CamSled delivered high-resolution images of the bottom for ground truthing. Classification tree analysis was used to predict substrate type from acoustic data. Depth was the main parameter for delineating substrate types, although, hardness, slope, rugosity, and aspect also contributed to the final classifications. Mud-mud and mud-sand were the preferred substrate types for Tanner crab (*Chionoecetes bairdi*) in Marmot Bay, while they were found exclusively in mud-mud substrates in Chiniak Bay. As a result, Tanner crab habitat was estimated at 85% of the survey area for Marmot Bay and 56% of the survey area for Chiniak Bay. Mud sediments and epifauna play an important role in Tanner crab presence. Current velocity most likely influence Tanner crab, but to what level is unknown. For a benthic species like Tanner crab, understanding the relationships between habitat and abundance is essential for extrapolating population density estimates to larger scales. This information will be used to increase understanding of the spatial distribution of Tanner crab and their habitat and will aid in interpretation of stock assessment data.

Can Temperature-dependent Egg Development Affect Connectivity Between Spawning Areas and Nursery Grounds for Arrowtooth Flounder (*Atheresthes stomias*) in the Gulf of Alaska?

William Stockhausen
NOAA, Alaska Fisheries Science Center (AFSC), william.stockhausen@noaa.gov
Deborah Blood
AFSC, debbie.blood@noaa.gov
Kenneth Coyle
University of Alaska Fairbanks, kocoyle@alaska.edu

Understanding recruitment is central to rational fishery and ecosystem planning. Recruitment is thought to be controlled by physical (e.g., climate, transport) and biological processes (e.g., growth, predation) acting on the early life stages of marine fishes. As part of the Gulf of Alaska Integrated Ecosystem Research Project (GOAIERP) Modeling Component, we hypothesize that fish recruitment is principally determined by processes acting on early life stages between offshore spawning sites and the end of the young-of-the-year stage, the "gauntlet". Among these processes, temperature-dependent egg development and/or larval growth rates may be important sources of variability.

We developed an individual-based, temperature-dependent egg development model for arrowtooth flounder (*Atheresthes stomias*) based on previous work by Blood et al. (2007). We embedded this in the Dispersal Model for Early Life Stages (DisMELS, an individual-based biophysical model), which we used to simulate dispersion of the early life stages of individual arrowtooth flounder in the GOA from spawning areas along the continental slope to inshore nursery grounds. A high resolution ROMS model for the GOA provided the simulated time-varying environment for model runs. DisMELS tracked the development and dispersion of simulated individuals through a series of egg and larval stages, based on the *in situ* environment (3D currents, temperature) experienced by each individual as well as ontogenetic changes in behavioral and physiological characteristics.

We examined the potential importance of interannual and spatial variation in temperature experienced by arrowtooth flounder eggs on connectivity between the spawning areas and nursery grounds using four scenarios, 3 constant temperature scenarios (1 ^{o}C, 4.25 ^{o}C, 7.5 ^{o}C), and an *in situ* temperature scenario. In the constant temperature scenarios, all eggs experienced identical temperature regimes during development. For the *in situ* scenario, individual eggs developed according to the local (ROMS model) temperature, which varied temporally and spatially.

Higher temperatures (faster egg development rates) led to higher fractions of individuals recruiting to nursery grounds from individual spawning areas. With faster egg development rates, individuals were able to reach the life stage capable of settling in the

nursery grounds in a shorter amount of time and were less likely to be transported westward out of the system by the Alaskan Stream.

Seasonal Habitat Use and Productivity of Commercially Important Rockfish in the Gulf of Alaska

Christina Conrath
NOAA, Alaska Fisheries Science Center (AFSC), Christina.Conrath@noaa.gov
Brian Knoth
AFSC, Brian.Knoth@noaa.gov
Christopher Rooper
AFSC, Chris.Rooper@noaa.gov

The 1996 reauthorization of the Magnuson-Stevens Fishery Conservation and Management Act mandates the identification of Essential Fish Habitat (EFH) for each life stage of federally managed fish species. Our understanding of EFH for many rockfish species in the Gulf of Alaska (GOA) is rudimentary, especially their seasonal habitat requirements and the relative importance of specific habitat types. It is generally accepted that rockfish in the GOA have patchy distributions and frequently occur in rocky, hard, or high relief substrate. Many commercially important rockfish species are also associated with coral and sponge habitats in Alaska waters. The added complexity provided by coral and sponge habitats may offer juvenile and adult rockfish increased protection from predators and/or enhanced food resources similar to other structurally complex habitats. We are conducting a project examining the seasonality of rockfish distribution, abundance, and productivity across three habitat types: low relief, high relief rocky/boulder, and high relief coral/sponge. Research cruises are being conducted during the summer, winter, and spring at two study sites in the central GOA, focusing on three commercially important rockfish species (Pacific ocean perch (*Sebastes alutus*), northern rockfish (*S. polyspinis*), and dusky rockfish (*S. variabilis*)). In each sampling period, we are using an underwater stereo drop camera system to examine rockfish habitat associations, community structure, size structure and density within each habitat type and a bottom trawl and bongo net to collect fish and zooplankton. We are collecting specimens to examine differences in prey availability, diet diversity, and reproductive potential among the habitats. Habitat quality is indirectly being assessed by examining rockfish energy content, body condition, and growth potential. Preliminary catch-per-unit-effort (CPUE) estimates of rockfish density from the SDC video drops indicate significant differences in rockfish density among habitats, with highest densities in the boulder and coral habitats. Preliminary estimates of rockfish condition suggest differences among species, but similar condition across habitats. This research will enable us to better understand the relative importance of particular habitats to rockfish productivity throughout the year and provide data critical for understanding EFH for these species.

Size-at-Age and Diet Composition of Pacific halibut (*Hippoglossus stenolepis*) in Cook Inlet, Alaska

Sarah Webster
Alaska Pacific University (APU), swebster@alaskapacific.edu
Brad Harris
APU, bharris@alaskapacific.edu
Jeffery Welker
University of Alaska Anchorage, jmwelker@uaa.alaska.edu

Declining Pacific halibut (*Hippoglossus stenolepis*) size-at-age in southcentral Alaska remains unexplained and the mechanisms driving slower growth have not been assessed. The decrease in size-at-age may be diet-driven so during the summers of 2012-2013 we implemented a “*pre-dumpster, post-mortem*” port-sampling method in the port of Homer, AK, to record sex, length, location, and stomach contents, and to collect muscle tissue and otoliths from the carcasses of halibut landed in the sport fishery. Our objectives were to: 1) compare halibut size-at-age in Lower Cook Inlet with International Pacific Halibut Commission’s survey samples; 2) describe the stable isotope (d^{13}C and d^{15}N) ratios of halibut prey; 3) evaluate halibut diet composition using gut contents and stable isotopes; 4) determine if diet composition varied with size, age, sex and location; and 5) determine if diet was correlated with size-at-age. Sampling was size-based and targeted at least 30 individuals from each 10-cm size group for males and females. Fish were aged using otoliths. The presence-absence of prey items in fish stomachs was assessed and assimilated dietary proportions established using stable isotope mixture models implemented in a Bayesian framework. The 703 (222 male, 481 female) halibut we sampled were larger on average than fish sampled by the IPHC Area 3A survey. Nearly 25% of stomachs sampled were empty, 40% contained fishes, 37% crabs, 9% cephalopods, and 9% identifiable bait. Halibut muscle tissue (568 samples) had a wide range of stable isotope values (δ13C = -18.73‰ to -14.75‰, δ15N = 13.43‰ to 19.62‰) and (after fractionation adjustment) overlapped the values of prominent prey. Prominent prey (fish, crabs, cephalopods, zooplankton) had unique isotopic signatures of d^{13}C and d^{15}N (MANOVA, $F(3, 179) = 34.76$, $p < 0.001$). Based on stable isotope ratios in halibut muscle, diet varied significantly by size, age, location and sampling date for both males and females and for sex (MANOVAs, $p < 0.01$). Further, among 80 – 89 cm females, age was negatively correlated with both mean δ13C ($r^2 = 0.68$) and δ15N ($r^2 = 0.91$); on average, faster growing fish were more enriched in d^{13}C ($p < 0.001$) and d^{15}N ($p < 0.001$). This supports the hypothesis that diet may be driving size-at-age.

Effect of Spawning Timing and Location on Transport of Walleye Pollock in the Gulf of Alaska: An Individual-based Model Study

Carolina Parada
Geophysics department, University of Concepcion (Udec), Chile., carolina.parada@dgeo.udec.cl
Miriam Doyle
Joint Institute for the Study of the Atmosphere and Ocean, University of Washington, Seattle, WA., miriam.doyle@noaa.gov
Sarah Hinckley
Alaska Fisheries Science Center, FOCI, NOAA, Seattle, WA., sarah.hinckley@noaa.gov

Walleye pollock (*Gadus chalcogrammus*), an important fishery in the Gulf of Alaska (GOA), is characterized by spatially disaggregated spawning and nursery habitats. Historically, a large part of the egg production has been associated with Shelikof Strait and advected southwest along the Alaska Peninsula where by summer and through early fall juveniles arrive at the Shumagin Islands nursery area. An individual based model (IBM) of young walleye pollock coupled with a Nutrient/Phytoplankton/Zooplankton model and a Regional Ocean Modeling System physical model was used to explore the transport of young pollock in the GOA. The model was forced with spatial and temporal (seasonal variability) climatological initial conditions synthesized from 31 years of egg distribution data in the GOA from Alaska Fisheries Science Center ichthyoplankton samples (Ecosystem and Fisheries Oceanography Program; EcoFOCI databases). The release times were March to June, every 2 weeks, for all years from 1996 to 2011. The release depth was set at 200-250 m, except where bottom depth was < 200 m. Total number of particles released for 8 seasons x 16 years × 10,000 particles was 1,2800,000. The model simulations aim to i) study transport patterns in the western GOA including the identification of spatial and temporal spawning-nursery area connectivity based on realistic initial condition of egg release, ii) extract IBM pre-recruitment indices, and iii) compare these indices with recruitment. Preliminary analysis of the connectivity matrices generated for all model simulations has led to the identification of seasonal and interannual variability in early ontogeny drift pathways, based on variable spawning areas (sources) and resultant nursery grounds (sinks). Empirical Orthogonal Functions analysis was used to explore variance in the pre-recruit indices generated by the various IBM simulations, and identification of significant source and sink pairs was accomplished with the Dirichlet test. This study is being developed under the framework of Gulf of Alaska Integrated Ecosystem Research Program.

Ichthyophonus Versus Proteins: Should We be Eating These Fish?

Alisa Aist
Polaris K-12 School, ak4ara@gmail.com

This experiment looks into differences in protein content in Ichthyophonus positive and negative Pacific halibut (*Hippoglossus stenolepis*) from the Lower Cook Inlet area. The halibut these samples were taken from were caught by fishermen to consume, which makes this study important from a public health perspective. Almost 76.7% of halibut in Prince William Sound have Ichthyophonus. Unpublished data indicate the infection rate in the Lower Cook Inlet is around 30%. While research has confirmed that Ichthyophonus does not harm people, there has been insufficient research into the quality and quantity of protein in halibut with Ichthyophonus. A comprehensive comparative protein analysis of liver and spleen samples from 18 halibut, 9 positive and 9 negative for Ichthyophonus, was used to detect potential protein changes. Liver and spleen samples were chosen as indicators for further research into the protein content of other organs and muscles. Protein fingerprints from each sample were obtained using standard protein extraction procedures and SDS-PAGE Gel Electrophoresis. The result was 4 useable protein fingerprints each run with an Actin-Myosin Standard. Although resolution of the gels could have been clearer with refinement of protocol, some bands were visible following staining. There was minimal difference in the protein content from the positive or negative halibut samples. Further research using muscle tissue from the halibut would enable a closer look at the nutritional value of these fish that are being sold. This data would be valuable when evaluating the potential impact on human consumption as well as the health of the halibut population.

Gulf of Alaska - Fishes and Fish Habitats

Mechanisms Influencing Growth and Size-at-Age of Pacific Halibut

Jane Sullivan
University of Alaska Fairbanks (UAF), jysullivan@alaska.edu
Gordon Kruse
UAF, ghkruse@alaska.edu
Steven Martell
International Pacific Halibut Commission, stevem@iphc.int

Pacific halibut (*Hippoglossus stenolepis*) are a culturally significant and commercially valuable species throughout their wide distribution in the North Pacific Ocean. They have been actively managed by the International Pacific Halibut Commission (IPHC) since the 1923. Since the early 1990s, the IPHC documented steep declines in halibut size-at-age (SAA) coastwide. Trends are complicated by long-term temporal and spatial variability in SAA. Though halibut SAA has dramatically decreased since the early 1990s, current SAA levels are similar to those observed in the 1920s. Furthermore, declines in SAA are primarily driven by observations in two IPHC regulatory areas in the central and western Gulf of Alaska, namely areas 3A and 3B; SAA has remained relatively constant or increased in other regulatory areas. Hypothesized mechanisms influencing SAA include environmental variability, changing ecological conditions, intra-specific competition (density-dependent growth), inter-specific competition, changes in bioenergetics, and size-selective fishing effects including genetic selection. We address specific hypotheses by fitting the von Bertanlanffy growth curve using mixed effects models, where biologically significant growth parameters are allowed to vary as a function of covariates. Specific potential environmental covariates include the Pacific Decadal Oscillation (PDO), which is an index of regional sea surface temperatures, and ocean bottom temperatures recorded at an oceanographic station (GAK1) near Seward, Alaska. Additionally, we include annual biomass estimates of arrowtooth flounder *(Atheresthes stomias)* and Pacific halibut to investigate the potential role of inter- and intra-specific competition, respectively, on halibut SAA.

What to do When Spiny Dogfish Lie About Their Age?

Cindy Tribuzio
NOAA, Alaska Fisheries Science Center (AFSC), cindy.tribuzio@noaa.gov
Beth Matta
AFSC, beth.matta@noaa.gov
Chris Gburski
AFSC, chris.gburski@noaa.gov
Walter Bubley
South Carolina Department of Natural Resources, walter.bubley@gmail.com
Gordon Kruse
University of Alaska Fairbanks, gordon.kruse@alaska.edu
William Bechtol
Bechtol Research, bechtolresearch@hughes.net
Cal Blood
Private Contractor, clb640b@hotmail.com

Spiny dogfish (*Squalus suckleyi*) have been aged using annuli counts on dorsal fin spines since the 1930s. However, this historical method results in low precision of age estimates, particularly for older fish exhibiting spine erosion, prompting a search for improved methods of ageing. Spiny dogfish were aged by historical methods using dorsal fin spines and by a proposed new method involving vertebral thin sections. Centrum edge analysis confirmed an annual banding pattern on vertebrae. Ages were determined by multiple readers using both fin spines and vertebrae thin sections obtained from the same specimens. We estimated inter-reader precision and variance associated with each structure. The two structures yielded similar ages for younger animals, while for older animals age agreement depended on the quality of the thin sections. Similar to other ageing structures, individual variability can impact thin section quality, particularly in larger older animals. We were unable to fully validate vertebral thin section ages of larger, older animals because of variability in thin section quality and limited sample size. Each method has advantages and disadvantages. The dorsal fin spine method was validated previously by both oxytetracycline and bomb radio carbon dating, but between-reader agreement is poor. Moreover, worn or broken dorsal fin spines, common in older animals, require another step, where lost annuli are estimated through regression methods, which introduce an additional source of error into age estimation. In comparison, the vertebral thin section method substantially improved between-reader agreement and does not require the additional regression step, but processing of vertebrae is time consuming, the quality of the thin section impacts the age estimates, and validation of ages for larger animals has not yet been realized. In summary, the vertebrae thin section method is promising, but more work is required to examine individual variability in thin sections (i.e., quality) and ages need to be compared among the two methods from a larger sample size of large, old fish that have been age validated by bomb radio carbon dating. Data from this research is being used to create new growth models for spiny dogfish, which is also presented at this conference.

Delayed Discard Mortality Studies for the Giant Pacific Octopus, *Enteroctopus dofleini*, in Alaska Waters

Christina Conrath
NOAA, Alaska Fisheries Science Center (AFSC), Christina.Conrath@noaa.gov
Nicholas Sisson
AFSC, Nick.Sisson@noaa.gov

The giant Pacific octopus (*Enteroctopus dofleini*) is the most abundant octopus species found on the continental shelf of Alaska and it dominates the commercial catch of octopus within Alaska waters. There is no fishery directly targeting octopus, but they are taken as bycatch in trawl, longline, and pot fisheries throughout Alaska, with the majority of catch coming from the Pacific cod (*Gadus macrocephalus*) pot fishery. Recent changes to management of octopus within this region necessitate a more complete understanding of the fate of octopus captured and eventually released during fishing operations. Previous research conducted by on-board fisheries observers and from short-term delayed mortality studies, indicated a low level of fishery induced mortality (< 10%). Until now, there were no experimental data on delayed mortality beyond a few days after release. A study of long-term, delayed discard mortality was initiated at the Kodiak Laboratory seawater facility beginning in January 2014 with octopus captured in the Gulf of Alaska cod pot fishery. In these experiments octopus were held for at least 24 days after capture. Preliminary results from this delayed mortality study support the conclusion that giant Pacific octopus experience a low level of mortality (10-25%) when captured during these fishing operations. This research will aid in the management of octopus within this region by providing better estimates of fishery induced mortality on this non target species.

Forage Fish Distributions in the Central and Eastern Gulf of Alaska

David McGowan
University of Washington (UW), mcgowand@uw.edu
John Horne
UW, jhorne@uw.edu

Within aquatic food webs, forage fish occupy an intermediate trophic position where they function as both predator and prey. In this role, they facilitate energy transfer from producers to higher trophic level piscivores. Forage fish communities in marine ecosystems exhibit high variability in their distributions, abundances, physiological conditions, and species compositions. Changes in forage fish distribution patterns and community structure may impact other trophic levels and be indicative of ecosystem health. To support an ecosystem-based approach to fisheries management, a better understanding of how distribution patterns of forage fish communities are influenced by physical and biological changes in their environment and potential impacts on predators is required. In the Gulf of Alaska (GOA), capelin (*Mallotus villosus*), Pacific herring (*Clupea pallasii*), and age-0 walleye pollock (*Gadus chalcogrammus*) are ecologically important forage fish species. Information on their offshore distribution and community structure over the continental shelf and slope is limited. As part of the GOA Integrated Ecosystem Research Program (IERP), an acoustic-trawl survey was conducted in the summer and fall of 2011 and 2013 to characterize forage fish distribution patterns in the central and eastern GOA. The survey extended up to 100 nmi offshore from coastal waters. Spatial, seasonal, and interannual changes in the distribution of capelin, herring, and age-0 pollock were observed during the study. Capelin were abundant in summer and fall during both years in the central GOA, but were rarely observed in the eastern GOA. Herring were rarely observed during summer surveys, but were common in the eastern GOA during fall surveys. Age-0 pollock were mostly absent throughout 2011, but were abundant and widely distributed in both regions during the summer of 2013. Differences in distribution patterns among these key forage fish species is likely to impact the availability of prey and potential growth of seabirds, marine mammals, and groundfish species.

Alaskan Groundfish Habitat Maps: High Latitudes on a Low Budget

Mark Zimmermann
NOAA, National Marine Fisheries Service, mark.zimmermann@noaa.gov
Megan Prescott
Ocean Associates, Inc., megan.prescott@noaa.gov

Alaskan marine waters lack adequate information, including depth and sediment type, to produce groundfish habitat maps, which are needed for a variety of research and management purposes. Groundfish habitat information can be produced with modern surveying techniques, such as multibeam, sidescan sonar and seafloor video surveys, but these methods are very expensive and time consuming. Smooth sheets - the precursors to the less-detailed navigational charts - are a cheaper alternative that include more soundings, substrates, shoreline and feature information which can be used for groundfish habitat mapping and other applications. Smooth sheets were used to supply the information for the juvenile groundfish habitat suitability modeling in the Gulf of Alaska Integrated Ecosystem Research Program (GOAIERP), site comparisons between GOAIERP inshore study sites, coral and sponge predictive modeling, trawlability analysis, geological substrate mapping, tide modeling and wetting/drying algorithms. Careful editing of the smooth sheet bathymetry has revealed significant shoreline changes and previously unknown details of significant seafloor features. We have published data sets for the Aleutian Islands and Cook Inlet - other areas, such as the central Gulf of Alaska, are in progress (http://www.afsc.noaa.gov/RACE/groundfish/bathymetry/).

Gulf of Alaska - Fishes and Fish Habitats

Development of Biochemical Measures of Age in the Alaskan Red King Crab: Validation, Refinement and Initial Assessment

Alexei Pinchuk
University of Alaska Fairbanks (UAF), aipinchuk@alaska.edu
Rodger Harvey
Old Dominion University, rharvey@odu.edu
Ginny Eckert
UAF, gleckert@alaska.edu

Age determination of marine organisms is a central metric for understanding the timing and magnitude of spawning, recruitment and habitat use, juvenile duration, and population age structure. For the commercially important red king crab (RKC) (*Paralithodes camtschaticus*) size-based models are used in lieu of age-based models for estimating population dynamics and for fishery management. Yet we know that crab growth and thus size is not a linear process, but typically is seen as a step function with intermittent molts of varied periodicity which complicates the estimation of population dynamics and timing of key life history parameters using carapace size alone. We have developed an alternative approach based on analysis of specific age pigments (lipofuscins) in neural tissues to assess RKC age and allow a more robust metric of age than carapace size measurements alone. A preliminary validation of the presence and utility of these biochemical markers for known age animal (0-4 years) in combination with a long term experimental assay to assess the effect of temperature on age pigment accumulation rates in juvenile RKC hatched in captivity has shown very promising results to address a variety of questions for management of the fishery.

Energetic Differences in Young of the Year Walleye Pollock Across the Gulf of Alaska

Marilyn Zaleski
NOAA, Alaska Fisheries Science Center (AFSC), marilyn.zaleski@noaa.gov
Ron Heintz
AFSC, ron.heintz@noaa.gov
Jamal Moss
AFSC, jamal.moss@noaa.gov

Walleye pollock (*Gadus chalcogrammus*) represent Alaska's largest commercial fishery in terms of biomass. Developing a better understanding of factors that influence survival will help improve the management of this commercially important species. The primary objective of this study is to compare the condition of juvenile pollock over varying spatial scales in the Gulf of Alaska (GOA) in order to understand the influence of various habitat features. Age-0 pollock were collected in August and September of 2012 and 2013 from the central and eastern GOA during the NPRB-funded Gulf of Alaska Integrated Ecosystem Research Project. We quantified dry weight/length residuals, energy density, length-adjusted energy (total somatic energy), and food habits across years and regions. Sea surface temperature and standard length increased from 2012 to 2013. Energy density and total somatic energy content decreased in 2013 in the central GOA but increased in 2013 in the eastern GOA. Sympatric age-0 Pacific cod (*Gadus macrocephalus*) exhibited similar regional differences in energy density and total somatic energy content. Age-0 pollock body condition and stomach contents also differed across years and regions. Observed differences suggest the GOA has regionally independent systems in which gadids are being reared and differences in rearing conditions between the regions have measureable impacts on the nutritional condition of these juvenile fish.

The Heat Is On: Comparing Growth Potential 'Hot Spots' of Young of the Year Walleye Pollock and Pacific Cod in the Gulf of Alaska

Marilyn Zaleski
NOAA, Alaska Fisheries Science Center (AFSC), marilyn.zaleski@noaa.gov
Ron Heintz
AFSC, ron.heintz@noaa.gov
Jamal Moss
AFSC, jamal.moss@noaa.gov

Walleye pollock (*Gadus chalcogrammus*) and Pacific cod (*Gadus macrocephalus*) are commercially and ecologically important species in Alaskan waters, but little is known about the mechanisms affecting survival during the first year of life. This study is part of the NPRB-funded Gulf of Alaska Integrated Ecosystem Research Project, which examines the biophysical factors influencing recruitment of gadids in the Gulf of Alaska. The goal of this study is to better understand how juvenile growth varies spatially in response to variations in temperature and food supply. We developed spatially explicit growth potential models for both species using sea surface temperature, average fish wet weight, average fish energy density, and the estimated prey energy density at each station where we obtained fish during the 2012 and 2013 summer surveys. Subsequent analyses will compare areas with high values of predicted growth for pollock to those for cod in order to determine growth potential 'hot spots' and identify areas of possible interspecific competition. We also will test which parameters have the greatest effect on predicted growth using sensitivity analyses by adjusted each parameter ± 1 standard deviation from the mean and calculating the percent difference in growth potential. Preliminary results show predicted growth of young-of-the-year (YOY) pollock differed regionally in both years with higher growth potential in the eastern GOA. For those pollock, temperature and fish wet weight had the greatest effect on predicted growth. This work will advance our understanding of interannual variability in early life survival through individual and multi-species based patterns.

Mercury and Selenium Health Benefit Values of Alaska's Pacific Halibut: Ecological and Human Health Implications

Christoff Furin
Alaska Department of Environmental Conservation (ADEC), christoff.furin@alaska.gov
Robert Gerlach
ADEC, bob.gerlach@alaska.gov

Pacific halibut (*Hippoglossus stenolepis*) are the target of important commercial, subsistence, and recreational fisheries in the State of Alaska. They provide a nutritious source of lean protein high in essential fatty acids (Omega-3s), minerals, and vitamins. The benefits of eating fish are well established but concerns over mercury (Hg) contamination have prompted consumption advisories for fish in some U.S. states, including Alaska. Most of those advisories are based solely on Hg levels in fish muscle. Selenium (Se), which is commonly found at significant levels in marine fish, has protective effects against the toxicity of methylmercury. The Se health benefit value (HBV_{Se}) provides a method to evaluate the risk of Hg toxicity in light of the protective effects of Se. On average, Alaskan halibut have a surplus of Se and positive HBV_{Se}. This has implications for all consumers in the food chain, humans and other top predators when considering the impacts and effects of mercury contamination in the marine ecosystem.

Growth, Consumption, and Energy Allocation Strategies of Age 0+ and 1+ Rockfish (*Sebastes* spp.) Reared at Three Different Temperatures

Ashwin Sreenivasan
Sitka Sound Science Center, asreenivasan@alaska.edu
Ron Heintz
NOAA, Alaska Fisheries Science Center, ron.heintz@noaa.gov

Rockfish (*Sebastes* spp.) are a commercially important groundfish in the Gulf of Alaska (GOA). Efficient management of rockfish requires knowledge of how these fish adapt to changing environmental conditions in the GOA. Since growth and condition of juveniles are important determinants of recruitment into the population, we conducted feeding studies with juvenile rockfish (ages 0+ and 1+) to understand the relationships between temperature, ration, growth, energy allocation, and age. Fish were held in the laboratory at three temperatures (4° C, 8° C, and 12° C) and fed one of three different ration levels (unlimited (C_{max}), medium (~50% C_{max}), and low (~15% C_{max})). We also compared cellular nucleic acid (RNA/DNA) ratios, an instantaneous growth index, and total body lipid, a long-term energy reserve. C_{max} depended on temperature. Age 0+ rockfish fed unlimited rations consumed ~6%-12%body-weight/day, while 1+ rockfish consumed ~13%-20%body-weight/day. At C_{max}, growth rates of age 0+ fish were more sensitive to temperature than age 1+ fish. RNA/DNA ratios of age 0+ fish showed increasing correlation with growth at higher temperature. Total-body lipid of age 0+ fish at C_{max} ranged from ~7.2%-9%, while that of age 1+ fish ranged from ~7.8%-6.5% over 4-12° C respectively. These data indicate that the growth response and energy allocation strategies of rockfish are temperature and age-dependent, and could reflect a strategy evolved to maximize growth and condition in the differing habitats occupied by each age class.

The Use of Ecosystem Metrics for Pre-season Forecasts of Pink Salmon Harvest in Southeast Alaska: What Have We Learned?

Joseph Orsi
NOAA, Alaska Fisheries Science Center (AFSC), joe.orsi@noaa.gov
Emily Fergusson
AFSC, emily.fergusson@noaa.gov
Alex Wertheimer
AFSC, alex.wertheimer@noaa.gov

Research conducted by the Alaska Fisheries Science Center's Southeast Alaska Coastal Monitoring (SECM) project has provided "relatively accurate" pre-season forecasts of pink salmon (*Oncorhynchus gorbuscha*) harvest to the resource stakeholders of Southeast Alaska (SEAK) for over a decade. The SECM project, which was launched in 1997, collects biophysical data associated with seaward migrating juvenile salmon, from May to August, and uses this data along with larger basin scale indexes to forecast adult pink salmon that return to SEAK the ensuing year. Because pink salmon only spend one ocean winter at sea, they lack leading indicator information from sibling models which are available for most other salmon species. Additionally, SEAK pink salmon originate from predominately wild stocks (97%), thus limited information is available from hatcheries on release and return rates. Consequently, previous attempts at forecasting pink salmon have typically failed leaving managers and stakeholders often with more questions than answers. Historically, the SECM forecast approach has used step-wise linear regression models to predict harvest with confidence intervals. SECM forecast predictions in nine of the past eleven years (2004-2014) have been 0-17% of the actual harvests, with an average forecast deviation of about 8%. This presentation will share the "track record" of the SECM forecast accuracy, give insights from the "outlier" years, and will introduce a newer forecast approach that incorporates a broader range of ecosystem indicators in a more qualitative fashion. A goal of this presentation is to provide a conceptual model of key factors that contribute to favorable conditions for high pink salmon production in SEAK. This applied research provides the Alaska Department of Fish and Game, commercial fisherman, and the fish processing industry with accurate pre-season salmon forecasts that help increase the economic efficiency of the fishery and promote resource sustainability.

Bomb Dating and Validation of the Age Determination Methodology for Big (*Beringraja binoculata*) and Longnose (*Raja rhina*) Skates

Jackie King
Fisheries and Oceans Canada, jackie.king@dfo-mpo.gc.ca
Thomas Helser
NOAA, Alaska Fisheries Science Center (AFSC), Thomas.Helser@noaa.gov
Chris Gburski
AFSC, chris.gburski@noaa.gov
Dave Ebert
Moss Landing Marine Laboratory (MLML), debert@mlml.calstate.edu
Greg Cailliet
MLML, cailliet@mlml.calstate.edu
Craig Kastelle
AFSC, craig.kastelle@noaa.gov

Age and growth curve estimates have been produced for (*Beringraja binoculata* [formerly *Raja binoculata*]) and longnose skate (*Raja rhina*) populations in the Gulf of Alaska, British Columbia, and California. Age estimation for these two skate species relies on growth band counts of sectioned vertebrae. However these studies have not produced similar results for either species, highlighting the need for age validation. Archived large specimens of big skate and longnose skate collected in 1980 and 1981 had minimum age estimates old enough to suggest that radiocarbon (^{14}C) signals from bomb testing conducted in the late-1960s could be used to establish dates of growth band formation. Atomic mass spectrometry provided measures of $\Delta^{14}C$ associated with a year of growth band formation based on skate age estimates. We used Bayesian statistics to compare these values to reference $\Delta^{14}C$ marine teleost otolith chronologies that exist for North Pacific. Results show that preliminary age estimates for big skate were overestimated, and none of the archived samples were truly old enough for validation of the age estimation approach. However, for longnose skate, the Bayesian modeling results provided indication that age estimates were accurate. We are able to validate the age estimation methodology for longnose skate and establish criteria for growth band counts. This validated method can now be used to generate region-specific accurate growth and life history parameters required for more reliable stock assessment approaches.

Humpback Whales as Indicators of Herring Movements in Prince William Sound

John Moran
NOAA, Alaska Fisheries Science Center, John.Moran@noaa.gov
Janice Straley
University of Alaska Southeast, jan.straley@gmail.com
Mayumi Arimitsu
U.S. Geological Survey, Alaska Science Center, marimitsu@usgs.gov

In the fall, adult Pacific herring (*Clupea pallasii*) move into the fjords of southeastern Alaska and Prince William Sound (PWS); residing in large shoals until staging for spawning in spring. During this time humpback whales (*Megaptera novaeangliae*) prey heavily on these dense concentrations of herring. However, in PWS, despite decades of research following the *Exxon Valdez* oil spill, herring movement throughout the sound is not well understood. From 2011 to 2014, humpback whale observations were used to track herring movement; documenting herring initially entering PWS through Montague Strait and moving to the wintering grounds in bays and fjords. While generally stable in timing and location across years, herring displayed some spatial and temporal shifts in their movements. It is unknown if these shifts are in response to whale predation or environmental variables. Regardless, whales are highly visible relative to other forms of marine life and concentrations of humpback whales proved to be good indicators of subsurface productivity. In addition, whales are often accompanied by forging sea birds, Steller sea lions (*Eumetopias jubatus*) and porpoises (Phocoenidae). Understanding the foraging behavior and movements of important predators has provided insight into herring behavior. These data demonstrate that a significant flux of energy between mid and upper trophic levels takes place during fall and winter in PWS.

A Bioenergetics Model for Pacific Halibut Reveals the Potential for Bottom-up Controls on Growth and Size-at-Age

Kirstin Holsman
University of Washington (UW), kirstin.holsman@noaa.gov
Kerim Aydin
NOAA, Alaska Fisheries Science Center (AFSC), Kerim.Aydin@noaa.gov
Gordon Kruse
University of Alaska Fairbanks (UAF), Gordon.Kruse@alaska.edu
Bruce Leaman
International Pacific Halibut Commission (IPHC), bruce@iphc.int
Steve Martell
IPHC, SteveM@iphc.int
Jane Sullivan
UAF, jysullivan@alaska.edu
Bruce Miller
UW, bsm@uw.edu
Stephani Zador
AFSC, stephani.zador@noaa.gov

With a maximum weight of more than 500 pounds and maximum length of over 8 feet, Pacific halibut (*Hippoglossus stenolepis*; hereafter “halibut”) are ecologically, commercially, and culturally one of the most important Alaskan groundfish species. However, recent stock assessments found declining trends in halibut biomass over the last decade. Potential drivers of low biomass vary regionally but include climate, trophic, and fishery effects on growth that have influenced recent declines in mean size-at-age over the past two decades (> 50% in some cases). Changes in size-at-age can arise from a variety of physical, ecological, and fishery effects (as well as aging and sampling artifacts) including size-dependent fishery or predation mortality, alteration in growth from variability in prey quality or quantity, and changes in temperature-dependent metabolic demands. Spatial variability in mean size-at-age has been documented for halibut across International Pacific Halibut Commission regulatory areas and regional contrast in size-at-age and climate and trophic conditions provides a unique opportunity to use a bioenergetic model to evaluate the effects of changes in diet and thermal experience on potential growth rates. Here we apply a recently developed bioenergetics model for Pacific halibut to survey-based diet and temperature data for Alaska and discuss the potential for spatial variability in size-at-age to have arisen from physical- and trophic-driven changes in growth.

Intensive Concurrent Acoustic and Trawl Surveys of Overwintering Juvenile Herring (*Clupea pallasii*) in Two Potential Nursery Bays in Prince William Sound

Michele Buckhorn
Prince William Sound Science Center (PWSSC), mbuckhorn@pwssc.org
Megan McKinzie
Auburn University, mmckinzie@pwssc.org
Mary Anne Bishop
PWSSC, mbiship@pwssc.org
Richard Thorne
PWSSC, rthorne@pwssc.org

Hydroacoustic surveys of juvenile Pacific herring (*Clupea pallasii*) nursery areas in Prince William Sound have been conducted during fall and late-winter for the last several years. The number of locations surveyed have varied from 5-9, including the 4 Sound Ecosystem Assessment (SEA) bays. Thorne (2010) examined seasonal changes from fall 2006 to spring 2009. However, each seasonal effort has conducted only a single night survey in each of these locations without direct confirmation of fish species identification. The differences in seasonal abundance could be attributed to mortality, emigration, or changes in ambient light. We addressed these uncertainties with an intensive fall and late winter/spring set of surveys that combined hydroacoustic data collection with direct capture effort using a midwater trawl. The fall series started October 2, 2013 and extended approximately every two weeks to the first week of December. The late winter/spring series began February 21, 2014 and extended approximately every two weeks until the first week of April. The surveys were conducted in Simpson Bay and Windy Bay, two bays sufficiently adjacent to cover each bay each night for three consecutive nights per survey. Preliminary results indicate a prevalence of scyphozoans in both bays during the fall surveys (91-99% of biomass) that decreased in the spring surveys (0-25% of biomass). In Simpson Bay, catches comprised of 3-10 fish species and were dominated by Pacific herring of all life stages. In Windy Bay, catches comprised of 2-6 fish species and were dominated by walleye pollock (*Gadus chalcogrammus*) juveniles. Presence of juvenile herring increased in both bays during the spring surveys compared to the fall surveys and the most juvenile herring caught was during the last survey in Simpson Bay after the ice formation at the head of the bay broke up, indicating that juvenile herring may use the ice edge as a refuge from predators.

Age, Growth, and Sexual Maturity of the Deepsea Skate, *Bathyraja abyssicola* (Gilbert, 1896)

Cameron Provost
Alaska Pacific University (APU), cprovost@alaskapacific.edu
Bradley Harris
APU, bharris@alaskapacific.edu
David Ebert
Moss Landing Marine Lab, debert@mlml.calstate.edu
Kenneth Goldman
Alaska Department of Fish & Game, ken.goldman@alaska.gov
Cindy Tribuzio
NOAA, Alaska Fisheries Science Center, cindy.tribuzio@noaa.gov

Our understanding of the age, growth, and sexual maturity traits of many elasmobranch fishes is nascent. This study aims to validate age determination using vertebral centra and caudal thorns, determine size at age, and determine maturity at size and age in the deepsea skate (*Bathyraja abyssicola*). Sex, maturity, total length, thorns, and vertebra were collected from 52 specimens taken on National Marine Fisheries Service cruises between the years 2001 and 2012. First, we aim to define annual banding patterns in vertebral centra with gross sectioning and histology and in caudal thorns using surface stains. Once annuli are detected an array of size at age models will be assessed to determine which best describes deepsea skate growth characteristics. Next, sexual maturity information from each specimen will be used to establish maturity at size/age ranges. During initial experimentation with vertebral centra and thorns we found these structures are fragile, potentially due to low calcification. Preliminary analysis of vertebral centra and estimates of age indicate that these animals mature late and have long lifespans. Sexually juvenile individuals (n = 3) were all approximately 20+ years of age. These Rajiformes are found in deep waters (350 - 3000 meters) from northern Baja, California to the Bering Sea, and may occur as bycatch in the deep fisheries. This project will provide the first assessment of *Bathyraja abyssicola* age, growth, and sexual maturity traits; information needed for informed skate management.

Gulf of Alaska - Fishes and Fish Habitats

Activity Costs for Swimming Pacific Herring (*Clupea pallasii*)

Bonita Nelson
NOAA, Alaska Fisheries Science Center (AFSC), bonita.nelson@noaa.gov
Ron Heintz
AFSC, ron.heintz@noaa.gov
Andrew Eller
Fish Assist, andrew.eller@noaa.gov

Bioenergetics models usually include an arbitrary multiplier to account for metabolic costs of activity due to lack of experimental data. This is especially true of schooling fish such as Pacific herring (*Clupea pallasii*). We conducted swim trials using an intermittent respirometer with schools of 4 – 6 herring at two ambient mean temperatures (5.5 and 8.5 °C) to determine oxygen consumption (mg $O_2 \cdot kg^{-1} \cdot h^{-1}$) with increasing swimming speed measured in body lengths per second ($B \cdot s^{-1}$). Results indicate that fish were apparently stressed at low velocities (less than 3 $B \cdot s^{-1}$). A positive linear correlation existed between oxygen consumption and velocity exists until critical swimming speed (U_{crit}) was reached near 5 $B \cdot s^{-1}$. Levels of oxygen consumption seemed to be influenced by the length of time held in the laboratory before the swim trials occurred. These data will be applied to individual based bioenergetic models used to investigate the cost of predator avoidance.

Quantifying *Ichthyophonus hoferi* prevalence and intensity in Pacific Halibut (*Hippoglossus stenolepis*) in Cook Inlet, Alaska

Caitlin Grenier
Alaska Pacific University (APU), cgrenier@alaskapacific.edu
Bradley Harris
APU, bharris@alaskapacific.edu
Paul Hershberger
U.S. Geological Survey, phershberger@usgs.gov
Leslie Cornick
APU, lcornick@alaskapacific.edu

Ichthyophonus hoferi, a non-specific fungus-like protozoan fish parasite, has caused epizootic events among economically important fish stocks including herring and salmon and can result in reduced growth, stamina, and overall fish health. Recently *Ichthyophonus* was detected in Pacific halibut (*Hippoglossus stenolepis*) in Cook Inlet, Prince William Sound, Gulf of Alaska, and the Bering Sea. To date no studies have investigated the prevalence, intensity or associated physiological impacts of *Ichthyophonus* on Pacific halibut. During the summers of 2012 and 2013 we sampled sex, length, age, diet composition, heart, spleen, liver, and kidney tissues from 563 halibut (364 females, 199 males) landed by the Homer sport-charter fishery using the "*pre-dumpster*, *post-mortem*" method. *Ichthyophonus* prevalence was determined by MEM culture and intensity (schizonts/ gram) was determined using Pepsin digestion. In 2012, 29% of the fish sampled had *Ichthyophonus*; 32% in 2013. We found no evidence of the parasite in liver, spleen or kidney tissues and there was no difference in prevalence between males and females. Preliminary pepsin digestion analysis (97 fish) indicates a wide range of intensity among infected fish with 5 to 1,223 *Ichthyophonus* schizonts per gram of heart tissue. Analyses to determine the diet composition of sick fish using gut contents and stable isotopes are ongoing.

A Bayesian Assessment Model of Prince William Sound Herring

Melissa L. Muradian
University of Washington (UW), murad17@uw.edu
Trevor A. Branch
UW, tbranch@uw.edu

The Pacific herring (*Clupea pallasii*) population in the Prince William Sound crashed in 1992-93 and has yet to recover, affecting food web dynamics in the Sound. The commercial herring fishery has been closed for 18 years due to low biomass, resulting in approximately $230 million in lost income to Alaskan communities. Today many questions persist about what caused the crash and the future of the population. Was it toxicity or habitat loss from the *Exxon Valdez* Oil Spill in 1989, an increase in disease mortality, or an increase in whale predation that caused the crash? Are these the same factors contributing to recent low abundance or have new pressures been introduced? To explore these questions we used a Bayesian assessment model which combines multiple data sets with prior knowledge to provide estimates of key ecological metrics with uncertainty, as well as probabilities of alternative hypotheses or states of the herring population. Herring biomass in 2013 was estimated to be between 28,000 and 79,000 t (95% credibility interval). There was a > 99% probability that biomass in 2013 was above the management threshold of 20,000 t required before the fishery is reopened, but mean current estimates are lower than those prior to the collapse. This model will be used in a simulation study to explore which data types are most informative for estimating status. This research provides critical information about how to prioritize current and future monitoring efforts to better understand the past and future ecology of the species.

Upper Thermal Tolerances for Red and Blue King Crabs

William Long
NOAA, Alaska Fisheries Science Center, chris.long@noaa.gov
Benjamin Daly
AFSC, ben.daly@noaa.gov

Red and blue king crabs (*Paralithodes camtschaticus* and *P. platypus*) are commercially important in Alaskan waters. Yet little is known about their thermal tolerance despite its likely importance for many aspects of their life history, including growth, survival, and spatial distribution. In laboratory experiments, we determined the upper thermal limits for lethal and sub-lethal responses for year-0 juvenile red and blue king crabs. Acute thermal tolerance was determined by exposing crabs to a range of temperatures for 24 hours and determining the lethal temperature at which mortality was 50% (LT_{50}).We then determined feeding ration of crabs over 24 hours at sub-lethal temperatures for each species (10-23 °C for red king crabs and 2-20 °C for blue king crabs) based on the results of the first experiment. Finally, we examined the effect of temperature on molting probability and mortality by holding crabs for 45 days at sub-lethal temperatures. Red king crabs had an acute LT_{50} of 24.3 °C and blue king crabs a LT_{50} of 21.3 °C. Feeding ration was highest for red king crabs between 12 and 17 °C and was highest for blue king crab between 5 and 10 °C. The probability of molting during the 45 day experiment increased with temperature for both species up to 15 °C, but significant mortality was experienced by red king crabs at 20 °C, and blue king crabs at 17 °C. The higher upper thermal tolerance for red king crab may partially explain their more southerly distribution compared to blue king crabs although they are well outside the normal temperature range in the Bering Sea. This work suggests that, given their current distribution, the juveniles of both species could withstand warming of several degrees without becoming thermally stressed; however, more response variables should be examined and changing temperatures could alter species interactions in a way detrimental to king crabs. Further work should be performed examine the upper thermal tolerance of adult crab and the effect of temperature on reproduction in both species.

The Effectiveness of Biodegradable Plastic Panels for Crab Pots in Alaskan Waters

Kevin Heffern
Under contract to NOAA, Alaska Fisheries Science Center (AFSC), kevin.crossland@gmail.com
Jacek Maselko
AFSC, jacek.maselko@noaa.gov

Previous studies conducted by personnel at NMFS' Auke Bay Laboratories have shown an increase in derelict crab pots in southeast Alaskan waters along with substantial amounts of ghost fishing. Biodegradable panels have been shown to be a viable alternative to rot cotton in Chesapeake Bay, Virginia, and have the potential to decrease ghost fishing. This study was designed to test of the viability of using biodegradable escapement panels to replace rot cotton for Dungeness crab (*Metacarcinus magister*) pots in Alaskan waters. A field study was conducted on biodegradable escapement panels at three sites selected around Juneau, Alaska. Six pots, three using rot cotton and three using biodegradable panels, were deployed at each location. Pots were monitored once per month for nine months to determine the rate of degradation and number of crabs present. Biodegradable panels showed no signs of degradation over the nine month study period, suggesting that biodegradable panels are not an effective alternative to rot cotton for Alaskan waters.

A Multivariate Method for the Characterization of IBM Larval Life Histories in the Gulf of Alaska

Albert Hermann
University of Washington (UW), albert.j.hermann@noaa.gov
Sarah Hinckley
UW, sarah.hinckley@noaa.gov
Ken Coyle
University of Alaska Fairbanks, kocoyle@alaska.edu

The modeling component of the Gulf of Alaska Integrated Ecosystem Research Program (GOAIERP) includes spatially-explicit Individual-Based Models (IBM) of fish larvae for five target species (walleye pollock (*Gadus chalcogrammus*), Pacific cod (*Gadus macrocephalus*), Pacific ocean perch (*Sebastes alutus*), sablefish (*Anoplopoma fimbria*) and arrowtooth flounder (*Atheresthes stomias*)). The physical advection and food environment of larvae within these IBMs is based on a 17-year (1996-2012) simulation of currents, hydrography and plankton at 3-km horizontal resolution, derived using the Regional Ocean Modeling System. The circulation fields so generated include substantial mesoscale variability, and the IBM simulations themselves entail multiple release times and release locations over many years. This leads to a very large number of individual life histories (time series) of location, size, temperature, and food environment, with substantial variance among individuals. Here, a novel method is sought to summarize these life histories using Principal Component Analysis (PCA). Individuals are first binned by release time and location. For all individuals from the same starting bin, the life history time series are normalized and subjected to multivariate PCA. This approach potentially identifies canonical life histories which are successful (e.g., experience adequate food and successful settlement to nursery grounds) vs. canonical life histories associated with larval mortality. We explore the relative merits of this approach as compared to simpler methods, such as averaging across successful individuals to get the mean life history (e.g. mean path and mean food environment) of successful individuals.

Influences of Size, Condition, and Diet on Winter Survival of Juvenile Pacific Herring in Prince William Sound

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

Survival of juvenile Pacific herring (*Clupea pallasii*) through their first winter is likely an important factor influencing recruitment. It is generally accepted that temperate fishes survive food scarcity in winter by metabolizing their stored lipids; however, greater winter survival may be expected when favorable feeding conditions reduce risks of starvation and predation mortality. Starvation may be averted if herring can consume adequate energy through winter months. Predation risk likewise may be reduced when less foraging activity is required, due to greater abundance or energy content of planktonic prey. Variation in zooplankton prey quantity and quality are thus expected to be highly influential on herring survival, and survival models assuming no winter food intake may be improved by incorporating winter diet data. Despite this, few studies have examined the winter diets of juvenile herring.

For this study, a component of the Prince William Sound (PWS) Herring Research and Monitoring program, we investigated seasonal trends in young-of-the-year (YOY) herring condition and diet in Simpson Bay, Alaska, from autumn 2011 through summer 2012. Juvenile herring lipid stores peaked in November, then declined and remained low until summer. Few small herring were captured in March, suggesting size-dependent mortality. The change in size distribution was unlikely due to growth, as indicated by low RNA/DNA ratios through winter. Feeding was evident throughout the winter, with only 3% empty stomachs from December through March. Stomach contents analysis showed that the level of feeding varied monthly over winter, and was influenced by fish size and condition. Smaller fish captured in cast nets had exhausted their lipid stores by March and were reliant on diet energy for their survival. However, estimated diet energy content in March appeared insufficient to meet daily metabolic needs. Larger fish captured in gill nets had higher lipid levels and showed less evidence of foraging. These findings suggest that smaller juvenile herring in Simpson Bay were unlikely to survive through winter, due to a combination of low lipid stores and limited diet energy intake in March. Quantifying winter survival in the population will require representative sampling of juvenile herring size, condition and diet energy.

Surviving the Biophysical Gauntlet: Juvenile Pacific Ocean Perch in the Gulf of Alaska 2010-2013

Wyatt Rhea-Fournier
NOAA, Alaska Fisheries Science Center, wyatt.fournier@noaa.gov

Pacific ocean perch (POP) are an important component of both the Bering Sea and Gulf of Alaska groundfish fisheries. POP are believed to spawn near the shelf break in the spring with their larva occupying the epi-pelagic through their first summer before settling into a benthic existence. As part of the Gulf of Alaska Integrated Ecosystem Research Project, we hypothesized movement through these habitats represents a biophysical gauntlet that influences juvenile survival.

Young-of-the-year POP were collected by surface trawl during July (eastern GOA) and August (central GOA) from 2010-2013. Specimens were retained for diet, growth (RNA/DNA), and energy allocation. Diets were also analyzed for Pacific salmon, the most abundant species in the epipelagic GOA, for predation and prey sharing observations.

The biophysical gauntlet for POP begins up to 80 miles from shore over the deep basin in the east and over the steep slope of the Aleutian trench in the central GOA. Abundance and size varied across years with the fewest fish caught during the 2011 El Niño and smaller fish observed during 2010 (negative North Pacific Index). POP had a high degree of associate ion and prey sharing with juvenile Pacific salmon that increased during warmer years of high euphausiid consumption. Pink salmon, the dominant biomass in the system, had record returns during this study and were found to be predating on POP both as adults and juveniles. Larval POP appear to increase allocation of energy to protein growth in order to escape predation and metamorphose into juveniles. After this transformation at ~30mm, allocations to lipids increase as POP begin storing energy to prepare for the end of summer feeding, swim towards the shelf, and the descent into the benthos.

As young of the year POP transition from the offshore epipelagic to the shelf benthos they are subject to predation, competition, and prey changes all while attempting to consume enough energy to transform into juveniles and store energy for the upcoming winter. Any shift of these pressures that negatively influences survival in the gauntlet before settlement may be mechanisms for controlling recruitment into the fishery.

Phylogeography of Threespine Stickleback (*Gasterosteus aculeatus*) from the North Pacific Basin

Emily Lescak
University of Alaska Fairbanks (UAF), elescak@alaska.edu
Ryan Lucas
University of Alaska Anchorage (UAA), rblucas@uaa.alaska.edu
Jeffrey Colgren
UAA, jcolgren@alaska.edu
Frank von Hippel
UAA, affvh@uaa.alaska.edu
J. Andres Lopez
UAF, jalopez2@alaska.edu

How is the genetic diversity of a species distributed across its geographic range? We are examining the distribution of genetic variation among coastal resident freshwater populations of threespine stickleback (*Gasterosteus aculeatus*) in the North Pacific to estimate the extent of gene flow in this region and infer historic movement from source populations. During an ancient period of allopatry, two mitochondrial lineages formed that are still represented in present-day populations throughout the North Pacific. To complement our recent work describing the distribution of these lineages across this region, we are now analyzing sequence variation in four neutral nuclear loci. We hypothesize that the nuclear genomes similarly differentiated during the ancient period of allopatry and that evidence of these ancestral lineages may still be detectable. We also analyze the role of geography in shaping contemporary genetic variation. Our results provide evidence of extensive variation in the nuclear genome that is largely structured by geography. Taken together, mtDNA and nuclear variation show that genetic admixture of ancient stickleback lineages along the north Pacific Coast is an ongoing and dynamic process producing complex patterns that are likely underlain by a suite of factors including colonization history, landscape, and ecology.

Habitat Suitability Models for Groundfish in the Gulf of Alaska

Jodi Pirtle
NOAA, Alaska Fisheries Science Center (AFSC), jodi.pirtle@noaa.gov
Kalei Shotwell
AFSC, kalei.shotwell@noaa.gov
Mark Zimmermann
AFSC, mark.zimmermann@noaa.gov
Jane Reid
U.S. Geological Survey (USGS), jareid@usgs.gov
Nadine Golden
USGS, ngolden@usgs.gov

Habitat-based predictors that may be useful to inform fish population estimates include habitat suitability by life history stage and the influence of encountering suitable habitat on survival. The Gulf of Alaska (GOA) Integrated Ecosystem Research Program is a major research effort that seeks to identify and quantify the ecological regulators that influence recruitment strength for five federally managed groundfish species, Pacific cod (*Gadus macrocephalus*), walleye pollock (*Gadus chalcogrammus*), arrowtooth flounder (*Atheresthes stomias*), Pacific ocean perch (*Sebastes alutus*), and sablefish (*Anoplopoma fimbria*). As a key element of this process, benthic habitat suitability models (HSM) and maps were developed to generate a habitat metric for settlement stage juveniles to inform survival to recruitment for these species. To that end, a literature review was completed for each species to identify habitat requirements that could be modeled using spatial data. Gridded bathymetry and sediment surfaces were produced from datasets that were developed for this research program. Multi-scale terrain analysis was performed on these surfaces to develop a suite of benthic predictor variables (e.g., slope) to evaluate habitat suitability in the models. Given the paucity of observations for these early life stages, presence-only HSM were developed using maximum entropy modeling for each species. GOA-wide maps were produced from the literature synthesis and model results that describe the proportion of available suitable habitat. For example, the sablefish HSM was informed by depth, entrances to inside waters, and benthic terrain that corresponds to locations where this species is found. The settlement stage habitat suitability maps will be incorporated into stock assessment ecosystem considerations sections for these species. This information may also be used to inform recruitment indices within the population models and to refine stage-specific definitions of Essential Fish Habitat. Ultimately this research may improve efforts to develop stage-specific habitat-based stock assessment models.

Refining Remote Observation: Techniques of Monitoring Black-legged Kittiwakes (*Rissa tridactyla*) in Resurrection Bay in the Northern Gulf of Alaska

Sarah Tanedo
University of Alaska Fairbanks (UAF), satanedo@alaska.edu
Tuula Hollmén
UAF, tuulah@alaskasealife.org

Remote methods of monitoring are becoming an increasingly valuable approach of observing wildlife, particularly with species that live in remote, hard to reach locations. Observations can be recorded permanently to video or photographs, systems generally can be operated with minimal staffing, and there is minimal disturbance to the animals. This approach can be useful for observing seabirds, as many species can be difficult to observe during the breeding season. As conditions are likely to vary among studies, the question of how often to monitor and what types of setups to use for specific species and locations is an important consideration. To investigate the refinement of remote observation for cliff-nesting seabirds, we used remote observation techniques to observe a sub-colony of black-legged kittiwakes (*Rissa tridactyla*, kittiwake) in Resurrection Bay in the northern Gulf of Alaska. Remote video and photographic methods were used to monitor kittiwakes daily throughout the breeding seasons (May-August) of 2013 and 2014. The first objective of this project is to determine the effect of monitoring frequency on productivity estimates. To complete this objective, observations will be systematically reduced from daily to 2-, 3-, 4-, 5-, 6-, and 7-day interval between observations. Individual nest success and productivity will be calculated for daily observations (control) and each reduced interval to compare with the control. The second objective is to determine the effect of remote method used on productivity estimates. We will calculate individual nest success using both video and photographic records to determine the degree of difference between methods. Evaluating effects in interval of observation and type of method utilized will help refine and provide guidance on monitoring and data collection techniques for remote observation of seabird colonies.

Kittlitz's Murrelet - a Leading Indicator of Ecological Changes in Three Alaska Marine Ecosystems?

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

Kittlitz's murrelet (*Brachyramphus brevirostris*), a small seabird in the auk family, evolved in Beringia during the Pleistocene and thrives in icy-cold environments. Present-day breeding populations are associated with glaciated coastal areas of the Gulf of Alaska (GOA) and Bering Sea. During summer, murrelets nest in these areas and lay a single egg on bare rocks on alpine mountain slopes up to about 2,000 m in elevation and 50 km inland. Nesting adults forage away at sea on energy-rich prey such as sand lance, capelin and krill, typically in cold or glacially-modified marine waters where such prey are abundant. Satellite tagging and isotopic diet studies suggest that after breeding, murrelets from the GOA migrate up to 3,500 km into the Bering, Chukchi and Beaufort seas, probably in search of dense forage fish schools to sustain a flightless molt and add fat reserves for winter. Many murrelets then overwinter in polynyas or along the sea-ice edge of the Bering Sea. Compared to other alcids, murrelets have a more limited capacity to buffer against food shortages, and the annual odyssey of Kittlitz's murrelets among three marine ecosystems— and within extreme cold corners of those ecosystems— must be challenging. How have they fared during recent warm climate cycles? Evidence suggests that as water temperatures warmed in the GOA and Bering Sea after the 1976 regime shift, murrelet populations declined markedly until the mid- 2000s. These declines coincided with large-scale changes in biogeography of forage species in the GOA and Bering Sea that were in turn linked with multi-decadal climate cycles. Effects may resonate across seas and seasons. For example, the decline of murrelets in Prince William Sound between 1989 and 2007 was correlated with an increase in average trophic level and northward spatial displacement of fish communities on the SE Bering Sea shelf. As conditions returned to normal (cold) in the SE Bering Sea and GOA after the mid-2000s, murrelet populations started increasing again for the first time in 30 years. Thus it appears that murrelet population dynamics may provide an integrated and leading indicator of foraging conditions in three different marine ecosystems of Alaska.

Long-term Trends of Seabird Density and Biomass in the North Pacific (1975-2012)

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

Seabirds are highly visible and well-distributed marine predators, and can be useful indicators of marine ecosystem status, and changes in seabird ecology have frequently been linked to local or regional food resources and oceanographic conditions. Our recent compilation of more than 350,000 standardized at-sea survey transects collected over 40 years into the North Pacific Pelagic Seabird Database (NPPSD, Ver. 2) now provides us with the ability to detect trends and/or resolve patterns at large marine ecosystem or basin scales using seabirds as indicators. We explored the use of the NPPSD to address large-scale ecological questions by binning the data into 100 km × 100 km cells and applying a series of filters; selecting only cells with long sample records. This time-series of data, geographically spanning from the western Aleutian Islands to British Columbia Canada in the east, was tested for general trends in biomass and density. Results indicate there has been a decrease in overall seabird density (# birds/km2) and biomass (kg/km2) in the North Pacific over the last 4 decades. This result agrees with the general negative trends of various marine top predators in the Northern Gulf of Alaska and Bering Sea since 1990.

Spatio-temporal Changes in Beluga Whale, *Delphinapterus leucas*, Distribution: Results from Aerial Surveys (1977-2012), Opportunistic Sightings (1975-2012), and Satellite Tagging (1999-2003) in Cook Inlet, Alaska

Kim Shelden
NOAA, Alaska Fisheries Science Center (AFSC), kim.shelden@noaa.gov
Kimberly Goetz
AFSC, kim.goetz@noaa.gov
David Rugh
AFSC, dave.rugh@noaa.gov
Donald Calkins
North Pacific Wildlife Consulting, LLC, don_calkins@northpacificwildlife.com
Barbara Mahoney
NOAA, Alaska Regional Office, barbara.mahoney@noaa.gov
Rod Hobbs
AFSC, rod.hobbs@noaa.gov

Cook Inlet, Alaska, is inhabited year-round by a small, distinct population of beluga whales (*Delphinapterus leucas*). This endangered population lives in close proximity to Anchorage, the largest city in Alaska, and waterways frequented by fishing fleets, container ships, oil and gas development, and military operations. The summer distribution of this population has been studied extensively, particularly in June, but little has been documented during other seasons of the year. This review includes results from aerial surveys, satellite-tagging studies, and opportunistic sightings. Systematic aerial surveys documenting beluga distribution in Cook Inlet were conducted by the Alaska Department of Fish and Game (1977-1979, 1982-1983), Minerals Management Service (1997), and the National Marine Fisheries Service (NMFS) (1991, 1993-2012). Beluga whales were tagged with satellite-linked, time-depth recorders during each summer from 1999 to 2002. Beluga whale sightings reported by the public, aircraft patrols, and other wildlife surveys have been collected by the NMFS since 1975. Results from these datasets show that since the decline of this population in the 1990s, its range has contracted into the upper inlet (north of East and West Foreland) not only during June, but also during the later summer months and into fall. Dispersal of large numbers of whales into lower inlet waters in the fall was not evident in the later years of the NMFS surveys. Tagged whales still transmitting locations by the end of the fall had remained in or returned to the upper inlet. This differs markedly from surveys in the 1970s, when whales began to disperse into the lower inlet by midsummer. The combination of poor sighting conditions (low light levels in winter and white whales among ice floes) and whale behavior (close association with ice, longer, deeper diving patterns, and smaller groups) made it difficult to ground truth or even detect groups during winter and early spring. Combining satellite-tagging with acoustic monitoring and aerial ground-truthing of real-time detections may be the best option for quantifying habitat use patterns during these seasons. Based on our review, additional studies are needed to better quantify habitat use patterns during seasons other than early summer.

Evaluating Methods for Monitoring Humpback Whales in the Juneau Area

Suzanne Teerlink
University of Alaska Fairbanks (UAF), s.teerlink@alaska.edu
Larissa Horstmann-Dehn
UAF, Lara.horstmann@alaska.edu

Humpback whales (*Megaptera novaeangliae*) are commonly the focus of whale watching tourism worldwide. One of the primary humpback whale watching industries is in Juneau, Alaska, where nearly 300,000 tourists go on boat-based whale watching excursions each summer. The Juneau tour area is relatively small, (roughly, 15 km N-S and 30 km E-W) but currently hosts 25-30 whale-watching vessels. As whale watching pressure has increased, so too have concerns about potential impacts from the high density of boats and associated vessel noise. Further, there have been anecdotal reports of fluctuating humpback whale abundance that could threaten this lucrative industry when abundance is low. We partnered with the tourism industry to explore ways to monitor humpback whales in the Juneau area. We conducted weekly surveys during the summer season (2013-2014) to collect fluke photographs and associated data used to track individual whales. Simultaneously, participating industry volunteers collected fluke photographs on their tours. Data from these platforms of opportunity (tour boats) were compared to data from our dedicated survey by using each dataset in the same suite of analyses, including estimates from: mark-recapture analysis for abundance by month and by year, site fidelity, transience, and total number of whale-days. By exposing the consistencies and discrepancies in estimates from each dataset, we are able to evaluate the strengths and weaknesses of platforms of opportunity and objectively access it as an alternative to dedicated surveys. Further, we will report on temporal-spatial trends in humpback whale habitat use within the Juneau tour area derived from AIS (Automatic Identification System) satellite vessel tracking data. Here, we use whale watching vessels as a proxy for humpback whales and map the locations where vessels are slowing to view whales throughout the 2014 summer season. Together, the population parameters and the temporal-spatial data provide a comprehensive understanding of the use of the Juneau area by humpback whales. These data can then be used as comparison for interpreting future fluctuations in humpback whale abundance and distribution within the Juneau tour area. This collaborative project works to increase tools available for monitoring an important marine resource while building partnerships with the tourism industry.

Acoustic Monitoring for Belugas (*Delphinapterus leucas*) and Harbor Porpoises (*Phocoena phocoena*) off Two River Mouths in Yakutat Bay, Alaska

Manuel Castellote
NOAA, Alaska Fisheries Science Center, manuel.castellote@noaa.gov
Kathleen Stafford
University of Washington, stafford@apl.washington.edu
William Lucey
City and Borough of Yakutat, w.g.lucey@gmail.com

Little is known about the ecology of belugas (*Delphinapterus leucas*) and harbor porpoise (*Phocoena phocoena*) inhabiting Yakutat Bay. Using passive acoustic monitoring techniques, their year-round presence was monitored off the mouths of two glacial rivers. Fishery trawl transects were run in both areas in June-August to assess fish and invertebrate diversity and identify potential beluga and harbor porpoise prey. Results supported year-round presence for both species, with restricted home range for belugas and a wide distribution for porpoises. Opposite diel patterns in beluga and harbor porpoise presence suggest potential competitive overlap in prey between species. Based on fishery catch-per-unit effort trends, snake prickleback (*Lumpenus sagitta*), northern rock sole (*Lepidopsetta polyxystra*), crangon shrimp, and Dungeness crab (*Metacarcinus magister*) were identified as potential prey for belugas. Results support the notion that shrimp may be an important part of beluga and porpoise diet in Yakutat, and suggest that harbor porpoises might also prey on starry flounder (*Platichthys stellatus*) and snailfish (Liparida), two species that have not yet been described as part of the harbor porpoise diet in Alaska. Both river mouth areas are of interest for harbor porpoises but their seasonality might not be driven solely by prey diversity or abundance. Beluga detection results during a coho salmon (*Oncorhynchus kisutch*) run were indicative of predation by belugas on this species during their spawning migration. This pilot study demonstrates the utility of remote passive acoustic monitoring technology to better understand the seasonal distribution patterns and association with prey of belugas and harbor porpoises in Yakutat Bay.

Life History and Population Dynamics of Southern Alaska Resident Killer Whales (*Orcinus orca*)

Eva Saulitis
North Gulf Oceanic Society, elsaulitis@gmail.com
J. Ward Testa
NOAA, Northwest Fisheries Science Center, ward.testa@noaa.gov
Graeme Ellis
Pacific Biological Station, graeme.tarka@gmail.com
Craig Matkin
North Gulf Oceanic Society, comatkin@gmail.com

Resident (fish eating) killer whales *(Orcinus orca*) in the North Pacific have been the subject of long-term studies in several geographical regions. The current study examines population parameters in the southern Alaska resident population from 1984 to 2010 and develops a population model. The southern Alaska resident population ranges from southeastern Alaska through the Kodiak archipelago and contains over 700 individuals. We followed the life histories of 343 identifiable whales in 10 pods from two clans born before and during the study. Population parameters were comparable to those of the British Columbia northern resident population during the 1970s and 1980s, except that age of maturity was approximately one year earlier. The average annual rate of increase was slightly higher in Alaska (3.5%) than for the British Columbia northern residents (2.9%) and probably represents a population at r-max (maximum rate of growth). Reasons for the high growth rate in Alaska could be a recovery following past anthropogenic mortalities, or more likely, a response to increasing salmon returns in recent decades, resulting in an increase in carrying capacity. The slow maturation and low rate of reproductive response makes these whales slow to recover from natural or anthropogenic catastrophes.

Changes in Harbor Seal Heart Rate with Vessel Encounters in Glacial Fjords of Southeast Alaska: an Alternative Approach for Assigning Biological Significance to Disturbance

John Skinner
Alaska Department of Fish & Game (ADFG), john.skinner@alaska.gov
Shawna Karpovich
ADFG, shawna.karpovich@alaska.gov
Gail Blundell
ADFG, gail.blundell@alaska.gov

Vessel disturbances have been proposed as one of the potential factors influencing declines in harbor seal (*Phoca vitulina*) numbers in Southeast Alaska. A seal is typically considered disturbed when it abandons its haulout, however, the cost in terms of potential increased energy expenditure due to the vessel encounter and subsequent entry into the water is unknown. Between April and July, 2008-2010, we studied the effects of broad-scale vessel traffic and intentional vessel approaches on the heart rate of 11 male (mass range, 37.6-53.0 kg) and 13 female (mass range, 31.3-53.4 kg) seals ranging from juveniles to adults, captured within Endicott Glacial Fjord of Southeast Alaska. During the study, we deployed VHF transmitters and data-loggers to measure depth, temperature, light , heart rate, and determine seal presence/absence at glacial haulouts. Additionally, we estimated vessel traffic from time-lapse images. Using generalized linear mixed-effects models (LMEs), controlling for within-individual correlations, we found a significant positive association between seal heart rate during haulouts and fjord-wide vessel traffic ($p < 0.01$) after controlling for significant effects of time of day, ambient temperature, and proportion of tagged seals present, as well as effects of individual sex, mass, haul-out duration, and previous time spent in the water. During 30 intentional approaches of 15 tagged seals, average hauled-out heart rate was significantly elevated after seals lifted their head (LME, $\hat{\beta}$-hat = 5.6, $p < 0.01$). Furthermore, for the first 60 minutes after entering the water, average heart rate was significantly lower ($p < 0.01$) compared to water entries at other times ($n = 425$), after controlling for significant effects of day of year, hour of day, temperature, light , and previous time in water (a proxy for activity), and heart rate at end of haulout (a proxy for amount of rest). The estimated effect was different depending on seal sex and mass, with smaller males and larger females showing the greatest changes. These results offer a basis for estimating the onset, magnitude, and duration of physiological effects on seals caused by encounters with vessels that travel within glacial fjords in Southeast Alaska.

Gulf of Alaska - Mammals

Space Use of Northern Sea Otters Within an Exploited and Growing Population

Zac Hoyt
University of Alaska Fairbanks (UAF), znhoyt@alaska.edu
Verena Gill
Bureau of Ocean Energy Management, verena.gill@boem.gov
Ginny Eckert
UAF, gleckert@alaska.edu
Tim Tinker
U.S. Geological Survey, ttinker@usgs.gov

The distribution of the growing sea otter (*Enhydra lutris*) population in southeast Alaska is most influenced by hunting pressure and habitat segregation between non-territorial males and females. The understanding of space use by the expanding sea otter population in southeast Alaska is critical due to conflict between sea otters and commercial fisheries and increased harvest of sea otters by coastal Alaska Natives. To investigate space use we monitored the movements of 30 sea otters tagged with VHF transmitters from May 2011-April 2014 near Kake, Alaska, which was the distributional edge of an expanding population during a 2010 survey. We collected a total of 1,056 geo-locations from these animals using aerial and ground-based telemetry. We then evaluated habitat selection and generated models of occurrence based on a bivariate normal probability distribution function, as well as the following covariates: 1) hunting pressure, 2) exposure, 3) canopy kelp coverage, 4) bathymetry, 5) distance to shore, and 6) sea otter survey strata for females, territorial males and non-territorial males. Because sea otter harvest drastically increased around Kake during the study (from 10 annual reported takes prior to 2012, to 188 annual takes for 2012-2013), we compared space use before (2011-2012) and after (2012-2014) this increase in hunting. Exposure was found to be the primary factor influencing resource selection by non-territorial male sea otters, while the primary factor for females was canopy kelp coverage. The best-fit models indicated segregation of space use between females and non-territorial males. Covariates influencing territorial males were more variable, and showed overlap in selection parameter estimates with both female and non-territorial males. Space use from pre- to post-hunting time periods was reduced by 18.7% for females and 25.3% for non-territorial males, suggesting reduction in the area occupied by this population as a function of hunting, while space use remained relatively unchanged for territorial males throughout the study.

Changes in Blood Profiles of Steller Sea Lions Due to Age, Exercise Regime, and Nutritional Status

David Rosen
University of British Columbia (UBC), rosen@zoology.ubc.ca
Carling Gerlinsky
UBC, c.gerlinsky@fisheries.ubc.ca
Andrew Trites
UBC, a.trites@fisheries.ubc.ca

Clinical hematology and blood chemistry (HBC) parameters are a standard tool for assessing the health of individual animals or populations, but species-specific reference ranges must first be derived from animals of known physiological states. Blood samples were serially obtained from 12 female, long-term captive Steller sea lions (*Eumetopias jubatus*) ranging in age from 3 weeks to 16 years, to establish baseline values, and to investigate how these parameters change with age, exercise level, and nutritional status. Most of the 41 HBC parameters investigated changed with age, many between weanling and juvenile stages. Comparisons between animals diving in the open ocean and those in a traditional aquarium setting confirmed that most HBC values were unaffected by captivity, although increased diving activity led to increases in some parameters (MCV and MCH). More important for addressing potential causes of population declines, we also identified several parameters that changed reliably with known episodes of nutritional stress, such as urea, liver enzymes (ALT and GGT), and iron saturation. Additionally, many of the observed HBC changes could identify specific types of nutritional stress: complete fasting, long-term under-nutrition, and recovery from past episodes of low prey intake. We present age-specific HBC values that can be used to assess the health of individual sea lions in the field. We also propose a suite of key HBC parameters that change reliably in response to different levels and types of nutrition challenges, and also demonstrate large enough deviations to be of value for cross-sectional population sampling. Together, the results of this study provide an additional tool for field research investigating the decline of Steller sea lions in Alaska, and highlight the value of long-term longitudinal studies of captive animals.

Foraging Decisions by Steller Sea Lions: Unexpected Consequences of Prey Distribution on Foraging Efficiency

Elizabeth Goundie
University of British Columbia (UBC), e.goundie@fisheries.ubc.ca
David Rosen
UBC, rosen@zoology.ubc.ca
Andrew Trites
UBC, a.trites@fisheries.ubc.ca

Reduced prey availability is hypothesized to be contributing to the decline of Steller sea lions (*Eumetopias jubatus*) in the Gulf of Alaska and Bering Sea. Resulting potential changes in foraging strategies could also have dramatic effects on an individual's energy balance and subsequent survival. We tested the effects of changes in prey availability on sea lion foraging behavior and efficiency by measuring diving metabolic rate, dive durations and food intake of 4 trained Steller sea lions diving in the open ocean on prey patches of different densities. We created simulated prey patches at two depths (10 and 40 m) with high and low prey encounter rates. Each sea lion completed bouts of 5 consecutive dives in which they chose dive duration and time at the surface. We found that the rate of energy expenditure did not change under any of the imposed foraging conditions (mean ± SD: 0.22 ± 0.02 kJ min^{-1} kg^{-1}), but that the proportion of time spent consuming prey increased with prey patch density due to changes in diving patterns. At both depths, sea lions spent a greater proportion of the dive bout foraging on prey patches with high prey encounter rates, which led to high rates of energy gain (4.3 ± 0.96 kJ min^{-1} kg^{-1}) and high foraging efficiency (cost:benefit – 1:20). In contrast, sea lions spent a smaller proportion of their dive bout actively feeding at prey patches with low prey encounter rates, and consequently had a lower energetic gain (0.91 ± 0.29 kJ min^{-1} kg^{-1}) and foraging efficiency (1:4)—beyond what was expected simply due to the decrease in food availability. Our results suggest that sea lions faced with reduced prey availability are also much less efficient foragers, making it more difficult for them to reach their daily energy requirements. This has implications for population recovery, as individual sea lions will either be at a lower nutritional plane, or will have to spend more time foraging—making them more susceptible to predation and taking away time and energy for other essential activities, such as maternal care.

Implications of Recolonization and Food Limitation for Sea Otters in Soft-bottom Habitats of Glacier Bay, AK

Benjamin Weitzman
U.S. Geological Survey (USGS), bweitzman@usgs.gov
George Esslinger
USGS,gesslinger@usgs.gov
James Bodkin
USGS, jbodkin@usgs.gov
Kim Kloecker
USGS, kkloecker@usgs.gov
Daniel Monson
USGS, dmonson@usgs.gov
Tim Tinker
USGS, Western Ecological Research Center, ttinker@usgs.gov
James Estes
University of California, Santa Cruz, jestes@ucsc.edu

Sea otters (*Enhydra lutris*) regularly occur in both soft-bottom and rocky habitats, although most studies of trophic interactions have occurred in rocky areas. Otters have been observed at higher than expected densities in some soft-bottom habitats, based on previous findings of resource exploitation and population regulation in hard substrate systems. To evaluate the predator-prey dynamics underlying this observation, we monitored sea otter foraging patterns and their invertebrate prey before, during, and after recolonization in Glacier Bay, Alaska, a soft-bottom habitat. We began in 1993, as otters first began to colonize the Bay, and worked through 2012 when numbers were estimated to be 8,508 ± 2,243 at a density of 10.0 otters/km^2. We quantified sea otter diet through observation of over 15,200 foraging dives and measured the size and abundance of all urchins, clams, and mussels at benthic community monitoring sites. We coupled the cumulative predation effect, determined by density and occupancy duration, with observation of *in situ* prey to quantify spatiotemporal variation in diet composition and energy recovery rates. Sea otter diet aggregated over time was primarily clams (34%), horse mussels (*Modiolus modiolus*) (34%), and sea urchins (22%). However, sea otters sequentially targeted their prey, feeding first on sea urchins, then horse mussels, eventually feeding predominantly on infaunal bivalves over longer time scales. Epifauna, urchins and mussels, were heavily depleted during initial colonization but infauna appeared more resilient, providing a mechanism by which sea otter populations in soft-bottom habitats reach equilibrium densities more slowly than populations in rocky habitats and possibly attain higher equilibrium densities. In areas within Glacier Bay occupied for most of the last 2 decades, sea otter energy intake rates declined from 18.0 kcal/min to 9.2 kcal/min. This lower feeding rate is similar to rates reported for other long established populations assumed to be at equilibrium densities in both hard and soft bottom habitats. Understanding feedback mechanisms between predator and prey across habitat types allows more complete estimation of how North Pacific nearshore ecosystems will respond to sea otter population recovery and recolonization.

Factors That Influence Free-ranging Harbor Seal Heart Rates During Resting Periods

Shawna Karpovich
Alaska Department of Fish & Game (ADFG), shawna.karpovich@alaska.gov
John Skinner
ADFG, john.skinner@alaska.gov
Jeff Mondragon
ADFG, jeff.mondragon@alaska.gov
Gail Blundell
ADFG, gail.blundell@alaska.gov

Previous research has shown a predictable relationship between heart rate (HR) and energetic expenditure. This project examined harbor seal (*Phoca vitulina*) HR during resting periods to explore what additional factors may influence HR in a natural environment. During springs of 2008, 2009, and 2010 in Endicott Arm Alaska, data loggers, programmed to record HR, depth, light, temperature, and wet/dry data, were deployed on 22 adult and sub-adult harbor seals for periods lasting 47 ± 24 days (range 8-99 days). During active (predominantly wet) and resting (predominantly dry) periods, 1 min averages of maximum HR falls into a bimodal distribution and, for each seal, were classified as either bradycardic (slow) or tachycardic (fast) HR using an expected maximization finite mixture model. Individual resting HR (RHR) was defined as the value at 5% in the lower tail of the tachycardic HR distribution, averaged 88.7 ± 6.9 beats • min^{-1}, scaled with mass for both sexes, and was significantly higher for males. Using linear mixed-effects models (LMEs), with individual as a random effect, we examined changes in three response variables: (a) duration of haul-out period, (b) duration of initial tachycardic period following haul out (RTP, time until HR < RHR), and (c) total number of tachycardic heart beats (THB, heart beats while HR > RHR). Response variables were examined with respect to sex, mass, temperature while resting, temperature during the active period prior to resting, light level, week of year, hour of day, level of activity during active period, duration of active and resting periods, and dunks (water entries < 5 min within resting periods). An increase in duration of the active period resulted in significant increases in RTP duration and THB, and an increase in number of dunks significantly increased resting duration, RTP duration, and THB. All environmental and temporal variables influenced both RTP and THB; and all variables, except week, influenced duration of the resting period. These results suggest that there is a complex relationship between seal HR and morphology, behavior, and environmental conditions; and that these factors must be included when considering the use of HR to estimate energetic expenditure in harbor seals.

The Efficacy of an Early Detection Pregnancy Hormone in Determining Steller Sea Lion (*Eumetopias jubatus*) Pregnancy Rates at Multiple Haulouts in Resurrection Bay, AK

Renae Sattler
Alaska SeaLife Center (ASLC), renaes@alaskasealife.org
Lori Polasek
ASLC, lorip@alaskasealife.org
John Maniscalco
ALSC, johnm@alaskasealife.org

The western stock of Steller sea lions (*Eumetopias jubatus*) is currently listed as endangered. While the variable(s) responsible for population decline are still being investigated, a primary concern is declining fecundity rates. However, identifying pregnant Steller sea lions requires live animal capturing and handling, which is both logistically and financially challenging. Fecal samples deposited on haulouts throughout the year provide an opportunity to identify and track pregnancy rates through fecal hormones while minimizing the impact on an endangered species. Prostaglandin $F_{2\alpha}$ (PGFM) is a reproductive hormone associated with embryonic development and has been successfully used to identify pregnancy from fecal samples in felids. Using 50 Steller sea lion fecal samples collected from each Mary's Bay and Cape Resurrection haulout located within Resurrection Bay in April of 2013, we assessed the ability of PGFM to detect pregnancy.

Individual Identification and Sighting Histories of Dead Cook Inlet Beluga Whales (*Delphinapterus leucas*) Obtained From a Left-side Photo-id Catalog

Amber Stephens
LGL Alaska Research Associates, Inc. (LGL), astephens@lglalaska.com
Tamara McGuire
LGL, tmcguire@lglalaska.com

Photo-identification has proven to be a useful method for studying Cook Inlet beluga whales (*Delphinapterus leucas*) (CIBW). The CIBW photo-id study has been ongoing since 2005, and has demonstrated that a large number of beluga whales in Upper Cook Inlet possess distinct natural marks that persist across years, and that these marks can be effectively identified and re-sighted with digital photography. The catalog of digital images of individually-identified CIBW photographed over ten field seasons (2005-2014) has provided information about residency/movement patterns, habitat utilization, reproduction, injury, disease, mortality, and abundance. The current left-side CIBW photo-id catalog consists of 299 individually identified CIBW. Between 2005 and October 2014, the CIBW photo-id study has photographed, or has been provided photos from NMFS, the Alaska Marine Mammal Stranding Network and others, of 15 dead whales displaying their left sides. Of these, seven whales have been identified as known individuals in the photo-id catalog. One of these identified whales had been previously satellite-tagged by NMFS in the previous decade. Four whales were not able to be identified due to advanced states of decomposition, two whales had photos that were taken too far away to discern marks, and two whales were not able to be matched to known catalog whales. Here we present the sighting histories (occurrence patterns and calving histories) of the seven dead CIBW that were identified using the left-side photo-id catalog.

The Geology of Sea Lions? Size, Mass and Occurrence of Gastroliths in Juvenile Steller sea lions (*Eumetopias jubatus*)

Courtney Shuert
University of Alaska Fairbanks (UAF), crshuert@alaska.edu
Jo-Ann Mellish
UAF, joannm@alaskasealife.org

Gastroliths, defined as stones or concretions in the digestive tract, are commonly occurring in many vertebrate taxa. Hypotheses as to their function include buoyancy regulation, digestion, mineral supplementation, and alleviation of hunger. Buoyancy and digestion aids are the most popular theories for their presence in marine mammals. By default, most information is anecdotal, with limited data on occurrence and size. Presented here is a summary of gastroliths from temporarily captive juvenile wild Steller sea lions (*Eumetopias jubatus*, n = 22). These animals were part of the Transient Juvenile Steller sea lion and LHX2 Projects at the Alaska SeaLife Center in Seward, Alaska. No access to rocks were available in the quarantine facility, so all gastroliths were ingested prior to temporary holding. A total of 125 gastroliths were collected, ranging from 3.9 g to 412 g (mean 86.8 g). Individual maximum lengths of gastroliths averaged 55.78 mm with a range of 23.31 mm to 109.74 mm. Gastrolith mass was unrelated to animal characteristics, including body mass, standard length, and axillary girth. Gastroliths can however contribute up to 1.5% of the total body mass, which could add to error in the modeling of body condition and composition, especially in methods where the amount of non-metabolic tissue and material becomes an important correction factor. The hypotheses of buoyancy and hunger were investigated with comparisons to blubber depth and prey consumption records. Presence or absence of gastroliths by cohort and year groupings was considered on a broader scale of comparison to seasonality and climate indices to investigate possible links to food availability and type.

Haul-out Patterns and the Effects of Vessel Disturbance on Harbor Seals in an Alaskan Glacial Fjord

Grey Pendleton
Alaska Department of Fish & Game (ADFG), grey.pendleton@alaska.gov
Lauri Jemison
ADFG, lauri.jemison@alaska.gov
Elizabeth Mathews
University of Alaska Southeast, bethannmathews@gmail.com
Karen Blejwas
ADFG, karen.blejwas@alaska.gov
Kevin Hood
U.S. Forest Service, kehood@fs.fed.us

From May-June 2001-2006, we documented harbor seal (*Phoca vitulina*) abundance, pupping phenology, vessel activity, and vessel disturbance in Tracy Arm, a glacial fjord in Southeast Alaska. We conducted counts, determined frequency of seals entering water in the presence and absence of boats using randomized observations of focal seals, and visually estimated reaction distances of seals that entered the water in response to a vessel approach. We observed the first harbor seal birth on 30 May and the last on 25 June with peak births (4-8/day) observed from 7 - 13 June and a maximum of 408 pups on 24 June. The number of observed vessels in Tracy Arm varied from >10/day in 2001 to < 2/day in 2006 with a maximum of 33 vessels on 26 June 2001. Tour boats and power boats were the most common vessel in most years but seals had the highest probability of entering the water when approached by kayaks or cruise ships. Seals were twice as likely to enter the water when boats were present than when absent. Because dependent pups are present in Tracy Arm throughout much of the tourist season, the potential for population-level impacts in this glacial fjord appears high.

Factors Affecting Haulout Behavior of Harbor Seals in Tidewater Glacier Inlets

Gail Blundell
Alaska Department of Fish & Game (ADFG), gail.blundell@alaska.gov
Grey Pendleton
ADFG, grey.pendleton@alaska.gov
Justin Smith
ADFG, justin.smith@alaska.gov

Large numbers of harbor seals (*Phoca vitulina*) use tidewater glaciers in Alaska for pupping, breeding, and molting. Glacial fjords are popular tourist destinations; however, visitation by numerous vessels can result in disturbance of seals during critical life-history phases. We explored factors affecting haul-out behavior of harbor seals at a glacial site frequented by cruise ships and tourism vessels. In 2008-10, we radio-tagged 107 seals (53 females, 54 males) in Endicott Arm, Southeast Alaska, with VHF transmitters. We remotely monitored presence and behavior of tagged seals in Endicott and adjoining Tracy Arm and documented vessel presence with time-lapse cameras. We evaluated the influence of year, location, date, time of day (hour), sex, tidal flow, precipitation, sky condition, ice availability, and vessel presence, on the probability of being hauled out, duration of haul-out bouts, and as factors associated with the end of a haul-out bout. Location, date, hour, and interactions of location by year, date, hour and sex significantly influenced haul-out probability as did ice, weather, and vessels. Seals were more likely to be hauled out with greater ice availability, during the middle of the day, and less likely to be hauled out if vessels were present. Cruise ships had the strongest negative effect; however, smaller vessels also negatively affected haul-out probability. Haul-out duration was longest in association with starting on incoming tides, clear skies, no precipitation, occurring in the middle of the day, and ending in the late afternoon or evening. End of haulouts was associated with increasing cloud cover, low ice availability and vessel presence; intermediate-sized tourism vessels (≥ 50m; the most prevalent vessel type) or all vessel-types combined were significant predictors of ending a haul-out bout. Seals were most likely to be hauled out between 08:00 and 18:00 during most of the dates monitored; haulouts initiated between 07:00 and 15:00 and ending between 14:00 and 19:00 had the longest durations. Potential disturbances of harbor seals could be reduced, enabling longer resting times for seals, if vessels focused the majority of visits before or after the hours of 08:00-17:00 or, less optimally, 09:00-16:00.

Coxiella burnetii Exposure in Northern Sea Otters (*Enhydra lutris kenyoni*)

Verena Gill
Bureau of Ocean Energy Management, verena.gill@boem.gov
Kristin Worman
U.S. Fish and Wildlife Service, kristin_worman@fws.gov
Kathy Burek
Alaska Veterinary Pathology Services, avps.kbh@gmail.com
Kristy Pabilonia
Colorado State University (CSU), kristy.pabilonia@colostate.edu
Sam Johnson
CSU, swj@lamar.colostate.edu
Kelly Fitzpatrick
Center for Disease Control and Prevention (CDC), hwm8@cdc.gov
Gil Kersh
CDC, hws7@cdc.gov
Colleen Duncan
CSU, colleen.duncan@colostate.edu

Valvular endocarditis has been well described in northern sea otters (*Enhydra lutris kenyoni*) of Alaska and in many cases no cause has been identified. One of the most common conditions observed in people with chronic *Coxiella burnetii* infection is inflammation of the heart valve (endocarditis). Given the high levels of *C. burnetii* exposure in marine mammals distributed throughout the same geographic range as the northern sea otter and the similarity of endocarditis lesions seen in otters to human *C. burnetii* infection, the objective of this study was to determine the level of *C. burnetii* exposure in otters and investigate any association between exposure, infection and valvular disease in this species. Archived serum from 75 live captured, apparently healthy, otters (25 from each of the 3 stocks) and 30 dead otters were tested for *C. burnetii* antibodies by indirect florescent antibody assay (IFA). Archived bone marrow (n = 30) and heart valves (n = 67) were tested for *C. burnetii* DNA by real-time polymerase chain reaction assay (qPCR). Overall the seroprevalence in live otters was 17%, with significantly more exposed animals in the south central (40%) stock relative to the southwest (8%) and southeast (4%). The seroprevalence of animals sampled post mortem was 27% and none of the bone marrow or heart valve samples were positive by PCR. Results of this study failed to demonstrate a significant association between *C. burnetii* infection and valvular endocarditis in sea otters; however, the differing seroprevalence suggests that exposure opportunities vary geographically.

Examining Resident Killer Whale (*Orcinus orca*) Subpopulation Structure and Social Connectivity in the Aleutian Islands, Alaska Using Stereotyped Acoustic Calls

Athena Palmer
Alaska Pacific University (APU), apalmer@alaskapacific.edu
Paul Wade
NOAA, Alaska Fisheries Science Center (AFSC), paul.wade@noaa.gov
Manuel Castellote
AFSC, manuel.castellote@noaa.gov
Leslie Cornick
APU, lcornick@alaskapacific.edu

Acoustic recordings are increasingly used to study populations of top predators such as killer whales (*Orcinus orca*) in the North Pacific. Although resident-type (fish-eating) populations of the North Pacific are arguably the most well-studied killer whales in the world, there remains a large gap in our understanding of the population and social structuring in the greater North Pacific, especially the Aleutian Islands. We examined subpopulation (e.g., acoustic clans) structure of resident killer whales utilizing acoustic data from three Aleutian Island regions (EAL: Eastern Aleutians, CAL: Central Aleutians, and WAL: Western Aleutians), by characterizing partial stereotyped call repertoires for resident-type whales encountered in each region. Acoustic data were collected in 2010 using SSQ-57B omni-directional broadband sonobuoys deployed during killer whale encounters on ship-based surveys. From a total of 15 encounters (4 EAL, 6 CAL, 5 WAL) 10 hrs: 45 min of acoustic data were collected for the EAL, 19 hrs: 53 min for the CAL, and 19 hrs: 24 min for the WAL. We used acoustic software (Adobe Audition CS6 and Raven Pro 64 1.4) to identify and classify stereotyped calls within encounter recordings, based on aural and visual characteristics. Of the 64 call types found to date 38 belong to the EAL, 11 to the CAL, and 15 to the WAL. We have detected no overlap in regional call types identified to date, which could support the presence of subpopulation structure for each region. This project is an essential stepping stone to understand the vocal repertoire and subpopulation structure of resident-type killer whales in the North Pacific and Aleutian Islands, and the subpopulation structure indicated by the acoustic data will be compared to population structure identified by genetic studies (Parsons et al. 2013). A complete vocal repertoire of resident-type killer whales for this region will also benefit an additional study, as it will allow accurate identification of killer whale type from calls recorded on long-term passive acoustic systems deployed adjacent to Steller sea lion (*Eumetopias jubatus*) rookeries. Accurately identifying killer whale type is essential for studies of potential predation by Biggs (transient-type) killer whales on Steller sea lions.

In Cold Blood: Evidence of Sleeper Shark Predation on Steller Sea Lions from Life History Transmitter Implants

Markus Horning
Oregon State University, markus.horning@oregonstate.edu
Jo-Ann Mellish
University of Alaska Fairbanks, joannm@alaskasealife.org

Temperature data transmitted post-mortem from 15 of 36 juvenile Steller sea lions (*Eumetopias jubatus*) with implanted Life History Transmitters (LHX tags, Wildlife Computers) suggest all 15 animals died by predation. In three cases at least one of two LHX tags was ingested by a cold-blooded predator and tags recorded temperatures corresponding to deep-water values after death. These tags were ejected 5 – 11 days later and transmitted after sensing light and air while floating at the surface, reporting temperatures corresponding to regional sea surface estimates. A fourth case is ambiguous, and eleven cases recorded immediate tag liberation that did not allow inferences of predator species. Among reported predators of Steller sea lions, only sleeper sharks are known to have body core temperatures near ambient. Our data suggests that Pacific sleeper sharks (*Somniosus pacificus*) need to be considered as a possible source of juvenile Steller sea lion mortality in the Gulf of Alaska region. In contrast, published studies of sleeper shark stomach contents near rookeries provided no evidence of sea lion tissue. However, estimates revealed a less than 5% likelihood of sampling such tissue amongst 200 sharks, while the probability of detecting sleeper shark attacks from LHX tags implanted into 36 sea lions is near 100%.

Combining Opportunistic Re-encounter Data with Known Fate Mortality Data in Vital Rate Telemetry: Linking Implanted Satellite Transmitters to Stationary Receivers

Markus Horning
Oregon State University, markus.horning@oregonstate.edu
Roger Hill
Wildlife Computers, roger@wildlifecomputers.com

First generation implantable Life History Transmitters (LHX tags, Wildlife Computers) were developed to transmit post-mortem data on dates, locations, and causes of mortality in Steller sea lions (*Eumetopias jubatus*). Second generation LHX tags additionally will provide temperature-based data on birth events in female hosts, to provide age at primiparity and lifetime birth event counts. However, UHF transmitters cannot uplink to satellites from within the host body and thus data is only retrieved after LHX tags are liberated from the deceased host. Such end-of-life data recovery constrains experimental designs. A promising solution may be periodic short-range transmissions from implanted tags to shore-based automated receiving stations. For host species with high terrestrial site fidelity such as Steller sea lions this may allow telemetric detection of parturition on an annual basis irrespective of the eventual life span of individuals, reducing a potential sampling bias. Furthermore, opportunistic tag links to receiving stations would allow combining and comparing known fate with mark-re-encounter approaches for the estimation of survival rates.

Individual Differences in Humpback Whale Foraging Behavior at Salmon Hatchery Release Sites

Ellen Chenoweth
University of Alaska Fairbanks, emchenoweth@alaska.edu
Janice Straley
University of Alaska Southeast, jmstraley@uas.alaska.edu
D. Nevé Baker
Whitman College, bakerdn@whitman.edu
Steve Reifenstuhl
Northern Southeast Regional Aquaculture Association, steve.reifenstuhl@gmail.com

During late spring in southeast Alaska, hatcheries release juvenile salmon (*Oncorhynchus* spp.) from holding pens close to shore. Since 2008, humpback whales (*Megaptera novaeangliae*) have targeted these salmon releases resulting in potential economic implications for fisheries and risk of entanglement for humpback whales. This study was piloted in 2010 with visual predator surveys at five hatchery release sites on eastern Baranof Island. In 2014, we intensified field effort at Hidden Falls and Takatz release sites. Using photographic identification, we documented a minimum of 24 unique individuals during 43 encounters across 28 field days. All sightings per individual per day were considered as one encounter. Four whales were feeding on juvenile salmon, as confirmed by subsurface videography and collection of target prey. Each these whales, and no others, were observed surface lunging and/or single animal bubble-net feeding within 4 m of shore or a holding pen. Whales were documented feeding in this manner during all parts of the diurnal cycle. Among these four whales, were the two most frequently sighted (10 and 5 days). The other two were first sighted on the second to last day of the study. In the population at large, the average number of days sighted was 1.8, but most whales, (78%, n = 18) were sighted only once. The location and season of the study suggests that these whales could have been migrating to primary feeding areas elsewhere. Indeed, some of the whales had been sighted in different feeding areas throughout Southeast Alaska in previous years. In addition to salmon fry, we collected three known types of humpback whale prey: herring (*Clupea pallasii*), sand lance (*Ammodytes hexapterus*), and krill (Euphausiacea). Echosounders surveys near some feeding whales suggesting adult herring were being targeted. There appears to be individual differences in prey selection at hatchery release sites with few whales targeting juvenile salmon but demonstrating higher site fidelity and distinctive behaviors.

Analysis of MHC Class II Promoter Regions in Beluga Whales and Related Species

Heidi Pagan
Florida Atlantic University (FAU), hpagan1@fau.edu
Tatiana Ferrer
FAU, tferrer2@fau.edu
Gregory O'Corry-Crowe
FAU, gocorryc@fau.edu

The mammalian immune response is a highly regulated system which treads a delicate balance between preventing disease and producing autoimmunity. The genes involved in this process lie within the major histocompatibility complex (MHC), the most variable portion of the vertebrate genome. Patterns of diversity within specific gene exons of MHC confer immunocompetence and are believed to reflect patterns of balancing selection over time. Thus, characterizing this diversity has become the subject of an increasing number of studies. Few studies, however, have focused on the regulatory aspects of MHC gene expression. Although all class II MHC genes are controlled by a single master switch, the class II transactivator (CIITA), expression across the different loci is not uniform. Class II MHC genes carry regulatory motifs in their proximal promoter region which must be bound by a complex of transcription factors and CIITA to turn on expression. Genetic variation within the promoter region may alter the capacity for this complex to form and thus the ability of the organism to launch an appropriate immune response. The regulatory motifs for three cetacean class II loci, DQA, DQB, and DRB, were identified from the *Tursiops truncatus* whole genome shotgun sequence. Primers were then designed to PCR amplify those regions in *T. truncatus*, *Delphinapterus leucas*, and *Orcinus orca*. Sequencing revealed a complete duplication of a 15 bp T-box motif in the DQA promoter region of both *T. truncatus* and *O. orca* that was absent in *D. leucas*. This is the first genetic characterization of MHC regulatory motifs in cetaceans and the only known motif duplication event in a mammalian MHC promoter. This regulatory adaptation may divulge unique immunogenetic strategies between the different cetacean species.

Gulf of Alaska - Mammals

Live Capture and Disentanglement of Steller Sea Lions in Alaska

Lauri Jemison
Alaska Department of Fish & Game (ADFG), lauri.jemison@alaska.gov
Kate Savage
NOAA, Alaska Regional Office, kate.savage@noaa.gov
Justin Jenniges
ADFG, justin.jenniges@alaska.gov
Mike Rehberg
ADFG, michael.rehberg@alaska.gov
Marty Haulena
Vancouver Aquarium, martin.haulena@vanaqua.org
Kimberlee Beckmen
ADFG, kimberlee.beckmen@alaska.gov
Kim Raum-Suryan
ADFG, kraumsuryan@charter.net
Greg Snedgen
ADFG, greg.snedgen@alaska.gov
Dennis McAllister
ADFG, dcm.alaSka@gmail.com
Neil Barten
ADFG, neil.barten@alaska.gov
Betsy Van Burgh
ADFG, betsvburgh@gmail.com
Chad Rice
ADFG, chad.rice@alaska.gov

Entanglement in marine debris and ingestion of fishing gear contribute to Steller sea lion (*Eumetopias jubatus*) (SSL) injury and mortality. In southeast Alaska, from 2000-2014 we photo-documented ~330 live SSLs that were entangled in marine debris, most with debris encircling and cutting into their necks. Entangling debris may cause respiratory distress, lacerations, and infection, with eventual death possible through strangulation, starvation, or drowning. Short of removing the material, there is little that can be done for animals with a durable neck entanglement. We additionally documented ~ 385 SSLs that had ingested fishing gear, including lures (e.g., flasher, spoon) hanging out of the animal's mouth, presumably with an ingested hook in esophagus or stomach. SSLs with these ingestions also face injury and possible death. Historically, getting close enough to remove these entanglements has not been possible. However, recent development of a drug combination that allows for sedation without respiratory compromise has enabled targeted captures of hauled out SSLs. In 2013-2014, Alaska Department of Fish and Game researchers and veterinarians from the National Marine Fisheries Service and Vancouver Aquarium chemically immobilized three entangled animals; entanglement/gear was removed from two and a satellite tag attached to one animal. We have been actively involved with educating the public about impacts of entangling debris on marine animals. The separate problem of SSL-fishery interactions in southeast Alaska may be increasing, to the detriment of both SSLs and fishermen who lose gear, money,

and time. Currently there are no legally approved, non-harmful methods of deterrence that we can suggest to fishermen, leaving them to suffer losses without compensation or even a clear means to reduce those interactions. We believe the survival of SSLs that ingest fishing gear may be increased by modifying gear, including creating a weak link between the hook and the lure. We hope to test this idea by removing lures/flashers from SSLs and attaching transmitters to track their survival. This may help in the short term by reducing SSL injury and some loss of gear (lures) for fishermen, but what is needed is a non-harmful deterrent that prevents SSLs from interacting with fishing gear.

The Interaction of Intraspecific Competition and Habitat on Individual Diet Specialization: a Near Range-wide Examination of Sea Otters

Seth Newsome
University of New Mexico, newsome@unm.edu
Tim Tinker
U.S. Geological Survey (USGS), ttinker@usgs.gov
Verena Gill
U.S. Fish and Wildlfie Service, verena_gill@fws.gov
Zachary Hoyt
University of Alaska Fairbanks, znhoyt@alaska.edu
Angela Doroff
Alaska Department of Fish & Game, angela.doroff@alaska.gov
Linda Nichol
Fisheries and Oceans Canada, Linda.Nichol@dfo-mpo.gc.ca
James Bodkin
USGS, Alaska Science Center, jbodkin@usgs.gov

The quantification of individuality is a common research theme in the fields of population, community, and evolutionary ecology. The potential for individuality to arise is likely context dependent, and the influence of habitat characteristics on its prevalence has received less attention than intraspecific competition. We examined individual diet specialization in 16 sea otter (*Enhydra lutris*) populations from southern California to the Aleutian Islands in Alaska. Because population histories, relative densities, and habitat characteristics vary widely among sites, we could examine the effects of intraspecific competition and habitat on the prevalence of individual diet specialization. Using observed diet data, we classified half of our sites as rocky substrate habitats, and the other half containing a mixture of rocky and unconsolidated (soft) sediment substrates. We used stable isotope data to quantify population- and individual-level diet variation. Among rocky substrate sites, the slope (± SE) of the positive significant relationship between the within-individual component (WIC) and total isotopic niche width (TINW) was shallow (0.23 ± 0.07) and negatively correlated with sea otter density. In contrast, the slope of the positive WIC/TINW relationship for populations inhabiting mixed substrate habitats was much higher (0.53 ± 0.14), suggesting a low degree of individuality irrespective of intraspecific competition. Our results show that the potential for individuality to occur as a result of increasing intraspecific competition is context dependent and that habitat characteristics, which ultimately influence prey diversity, relative abundance, and the range of skillsets required for efficient prey procurement are important in determining when and where individual diet specialization occurs in nature.

Estimating Lactation Parameters in Harbor Seals Using Aerial Photography

John Jansen
NOAA, Alaska Fisheries Science Center (AFSC), john.jansen@noaa.gov
Gavin Brady
AFSC, gavin.brady@noaa.gov
Jay Ver Hoef
AFSC, jay.verhoef@noaa.gov
Peter Boveng
AFSC, peter.boveng@noaa.gov

The time it takes to wean a pup is related to a species' life-history traits, and to strategies of mothers to maximize energy transfer to pups while minimizing other threats. Shifts in the timing and duration of the weaning period can signal environmental and demographic changes with implications for pup survival and the long-term health of populations. We developed a non-invasive method for estimating lactation parameters for large samples of harbor seal (*Phoca vitulina richardi*) pups (n = 9608 pups on 49 survey-days) from aerial photographs at two glacial fjords in Alaska which have some of the largest aggregations of this species in the world. Using a combination of an estimated population structure (which distinguishes pups via actual growth rates and size ranges of known pups/yearlings), the absence/presence of mothers, and pup coloration and nursing behavior, we derived a time series of pup occurrence with and without attendant mothers throughout the weaning period. Our method provides an alternative to methods at terrestrial sites that involve repeated captures and tagging of animals, and represents the only practical means of studying ice-associated harbor seals. This new technique has the potential to detect changes in maternal life-history traits and point to potential causes of changes in abundance. It also stands to increase our understanding of distributional patterns of harbor seals in Alaska especially adjacent to tidewater glaciers where floating ice attracts unusually large aggregations with seemingly disproportionate numbers of pups.

Effects of Marine Vessel Management on the Underwater Acoustic Environment of Glacier Bay National Park, Alaska

Megan F. McKenna
U.S. National Park Service (NPS), megan_f_mckenna@nps.gov
Christine Gabriele
NPS - Glacier Bay National Park & Preserve, chris_gabriele@nps.gov
Blair Kipple
U.S. Navy, blair.kipple@navy.mil

Marine vessel traffic, although essential to visitor use and park administration, produces underwater noise that degrades the acoustic habitat for marine species inhabiting Glacier Bay National Park, Alaska. To protect the underwater acoustic environment and the marine mammals that depend upon it, the Park implements vessel quotas, speed regulations and routing restrictions in important areas like lower Glacier Bay. Here, we characterize the underwater acoustic environment in lower Glacier Bay using a single hydrophone to quantify changes related to an increase in vessel quotas that occurred between two time periods (2000-2002 vs. 2007-2008). We also compare ambient acoustic conditions across seasons. Analysis of hourly 30-second acoustic samples obtained from a seafloor hydrophone included aural identification of physical, biological and human-made acoustic sources and measuring 1/3 octave band sound pressure levels (10Hz-10kHz). A total of 14,294 acoustic samples (119 hours) were collected, reviewed and deemed useable. A variety of sources contributed to the underwater acoustic environment. In summer months, a combination of biological and vessels sources dominated, whereas in winter months wind noise dominated. The occurrence of noise from marine vessels, measured as the proportion of acoustic samples with vessel noise present, differed between time periods. For small marine vessels, a 59% increase in occurrence was observed from 2000-2002 to 2007-2008, likely related to an increase in the private vessel quota and park administrative traffic. The medium vessel category, which includes a variety of vessel types (e.g., tour, charter, private) showed a 10% decrease in occurrence. The occurrence of noise from large marine vessels (e.g., cruise ships) decreased despite an increase in the vessel quotas, likely due to changes in the timing of cruise ship entries. Use of a 10 knot speed limit versus a 20 knot limit speed decreased average noise levels but increased the duration/occurrence of noise in the environment. These first descriptions of ambient acoustic conditions in a protected coastal habitat indicate that both regulations and vessel behavior independent of regulations have discernible effects on the underwater acoustic environment. Quantitatively describing these changes is a crucial first step toward restoration of this important underwater resource.

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

Roderick Hobbs
NOAA, Alaska Fisheries Science Center (AFSC), rod.hobbs@noaa.gov
Daniel Vos
Consultant, djvbam@acsalaska.net
Kim Shelden
AFSC, kim.shelden@noaa.gov

The beluga whales (*Delphinapterus leucas*) of Cook Inlet have declined from an estimated population size of 1,300 animals in 1979 to 650 in 1994; the most recent estimate is 312 individuals in 2012. 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 in 1999. At the time it was hypothesized that the population would not begin to recover immediately after the hunt was restricted because the hunters had targeted mature adults and consequently the mature females in the population were depleted. A recent population modeling exercise has found that this hypothesis has a low probability of being correct, but the model analysis did not estimate the mortality rates during the unrestricted hunt and the more recent decline. Here, we extend the population model from the previous analysis to include 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 from1994 to 2012, and age at death data for over 100 individuals. Preliminary results for age-dependent mortality rates during the unrestricted hunting and in the current period will be presented; age estimates of a number of individuals will not be available until spring 2015.

Comparisons of Whole Blood and Fur Concentrations of Total Mercury Among Three Pinniped Species: Validation of Cellulose Filter Paper Methodology

Amanda Grimes
University of Alaska Fairbanks (UAF), algrimes@alaska.edu
Stephanie Hughes
UAF, snhughes@alaska.edu
J. Margaret Castellini
UAF, jcastellini@alaska.edu
Frances Gulland
The Marine Mammal Center, Gullandf@tmmc.org
Lorrie Rea
UAF, ldrea@alaska.edu
Todd O'Hara
UAF, tmohara@alaska.edu

Many marine mammal species are subject to bioaccumulation of mercury due to their long life spans and relatively high trophic level feeding, and are important environmental sentinels. Sentinel species are key to the One Health concept linking animal, human, and environmental health. Total mercury concentrations ([THg]) can be monitored in tissues like fur and/or whole blood (WB), but collecting these samples in the field can present logistical challenges. Blood soaked cellulose filter papers (FP) provide a method for sampling WB and may be useful for monitoring pinnipeds in Alaska. FPs can be dried and easily stored in the field without refrigeration, making them a good choice for wildlife biologists and for hunter-collected samples. To determine the relationship of fur and FP [THg] to WB [THg], and assess differences in mean concentrations between various pinniped species, [THg] was measured in samples collected from California sea lions (CSL), elephant seals (ES), and Pacific harbor seals (*Phoca vitulina*) (HS) admitted to The Marine Mammal Center, Sausalito, CA for rehabilitation from 2013 to 2014. Comparison over a wide range of [THg] in WB (0.009 – 0.302 ppm) with [THg] measured in FP resulted in a significantly positive linear regression ($R^2 = 0.9507$, $p < 0.05$). Compared within species (paired t-test), WB and FP [THg] were significantly different ($p < 0.05$) for CSL and ES but not for HS ($p = 0.1504$). However, linear regression of WB [THg] versus FP [THg] revealed significant ($p < 0.05$) strong relationships within each species (CSL, $R^2 = 0.9826$; ES, $R^2 = 0.8038$; HS, $R^2 = 0.9655$). Relationships between fur [THg] and WB [THg] were significant ($p < 0.05$), but not as strong (HS, $R^2 = 0.3023$), although comparisons were limited to HS in this case. These results indicate that blood soaked filter papers provide a viable method to measure the [THg] in blood of pinnipeds and have implications for monitoring Alaskan pinniped species, including those collected through subsistence biomonitoring programs. Continued biomonitoring of [THg] in marine mammals can have important One Health implications and use of cellulose filter papers should be considered for sampling in future

studies. We are now assessing monitoring of additional elements using FP in these samples.

Distinguishing Sources of Foraging Pits Using Pit Dimensions and Shell Litter in Nearshore Soft Substrates

Sarah Traiger
University of Alaska Fairbanks (UAF), sbtraiger@alaska.edu
Brenda Konar
UAF, bhkonar@alaska.edu
Angela Doroff
Kachemak Bay Research Reserve (KBRR), angela.doroff@alaska.gov
Lauren McCaslin
KBRR, lem6875@uncw.edu

Otters and sea stars such as *Pycnopodia helianthoides* excavate clams in the low intertidal and subtidal and leave behind pits. In the literature, foraging pits have been used to infer presence and feeding activity of sea otters (*Enhydra lutris*). To date, general descriptions of pit size and shape without direct observations of digging are available, making it difficult to attribute pits to either predator. The goals of this study were to determine if existing pits can be attributed to otters or sea stars, and to investigate changes in pit dimensions and density over three months. Biweekly surveys were completed along the 10 m MLLW depth contour at four sites and at 0 m at two sites. Major axis, minor axis, pit depth, and piled sediment were measured for each pit encountered and *P. helianthoides* were counted along three 10 × 2 m transects at each site. Each pit was marked to track changes in pit dimensions over time and to distinguish newly formed pits from those previously surveyed. Additionally, shells were collected along each transect and characterized as preyed on by otters or sea stars. To determine the degree to which foraging pit dimensions change over three months, experimental pits were dug at each site to match literature descriptions of otter pits (n = 6) and sea star pits (n = 6). Cluster analysis provided a satisfactory first step at distinguishing the sources of foraging pits. Proportion of shells preyed on by otters and sea stars at each site generally matched patterns of pit source from the survey data. There was a significant, weakly positive correlation between density of *P. helianthoides* and density of foraging pits. Dimensions of experimental pits changed rapidly and most filled in after one month. Experimental otter and sea star pits were not distinguishable from each other after two weeks. Using the described metrics for foraging pits to differentiate those made by otters and sea stars is likely only accurate for recently formed foraging pits. We found that collecting shells and repeated surveys of sites helped us draw conclusions about the sources of pits at each site.

Technique Development for Monitoring Physiology in Large Whales

Shannon Atkinson
University of Alaska Fairbanks (UAF), shannon.atkinson@alaska.edu
Kelly Cates
UAF, cateskann@yahoo.com
Jan Straley
University of Alaska Southeast, jan.straley@gmail.com

Recent studies have confirmed that the North Pacific humpback whale (*Megaptera novaeangliae)* population has increased and in some regions is now greater than estimates for pre-whaling abundances. As such, we expect the frequency of interactions between humpback whales and humans to increase. These encounters can cause fluctuations in physiology, which can be measured using stress and reproductive hormones. We aim to quantify baseline levels of stress and reproductive hormones in humpback whales by validating blubber steroid analysis. These baselines will enable us to compare stress and reproductive hormones to physiological function relative to anthropogenic disturbances. Without knowledge of an animal's baseline physiology, it is difficult to discriminate between natural fluctuations in hormones and fluctuations due to increased stress as a result of anthropogenic disturbances. This information can then be used to aid in effective management of large whale species.

Calculating Acoustic Environment Metrics for Glacier Bay Marine Mammals

Christine Gabriele
Glacier Bay National Park & Preserve (GBNPP), chris_gabriele@nps.gov
Dimitri Ponirakis
Cornell University (CU), dwp22@cornell.edu
Christopher Clark
CU, cwc2@cornell.edu
Jamie Womble
GBNPP, jamie_womble@nps.gov
Phoebe Vanselow
GBNPP, phoebe_vanselow@nps.gov

Vessel-generated underwater noise can affect humpback whales (*Megaptera novaeangliae*), harbor seals (*Phoca vitulina*) and other Alaska marine mammals by decreasing the distance over which they can communicate and their ability to detect predators and prey. Glacier Bay National Park actively manages vessel traffic through vessel quotas and operating requirements. Managers need quantitative vessel noise metrics to assess noise influences on marine mammals. We used models to simulate the acoustic environment experienced by humpback whales and harbor seals on days near the start, middle and end of the summer visitor season. Whale and seal distributions were based on visual survey data collected for each species and movement parameters were based on published values and professional judgments. We modeled the propagation of the most common whale and seal sounds: humpback whale "whup" calls (71 - 224 Hz frequency band, 155 dB re 1 µPa source level (SL)); humpback song (224 - 708 Hz band, 175 dB SL), and harbor seal roars (206- 354 Hz, 155 dB SL). For each day, for each species sound, we created an acoustic ecology masking metric model at a 10-min resolution (Clark et al. 2009, Hatch et al. 2012). GPS and AIS data were used as tracks for commercial, private and government vessels. If a vessel's track was not available, we created a proxy track by either constructing a track from known destination(s) and speed capabilities of the vessel, or an AIS track from a similar vessel. Calibrated noise signatures for cruise, tour and government vessels were used if available, or estimated based on published and unpublished sound signatures for similar vessels. Sound propagation used known bathymetry and sound velocity profiles from Glacier Bay. Results indicate significant differences in communication masking between days with low, moderate and high levels of vessel traffic. The greatest loss of communication space for all three sound types occurred under high traffic conditions in the middle of the season, with whups experiencing the greatest masking independent of traffic conditions, followed by roars and songs.

Life-History Strategies, Population Trends, and the Relative Lack of Elasticity in Steller Sea Lion Natality Rates

John Maniscalco
Alaska SeaLife Center (ASLC) , johnm@alaskasealife.org
Alan Springer
University of Alaska Fairbanks, amspringer@alaska.edu
Pamela Parker
ASLC , pamp@alaskasealife.org

Mark-recapture analyses of juvenile survival, and adult female survival and natality rates were conducted for Steller sea lions (*Eumetopias jubatus*) in the eastern Gulf of Alaska (EGOA) region of the Western Distinct Population Segment between 2003 and 2013. Juvenile survival was greatly improved for males and females that continued to suckle between 1 and 2 years of age (88.2% combined) compared to those that were weaned by 1 year of age (40.6% for males and 64.2% for females). However, only an estimated 19% of juveniles continued to suckle beyond 1 year of age. Natality rates were considered very good with an average of 70% of mature females giving birth each year throughout the study period. Steller sea lions that skipped a year of giving birth typically continued to nurse a dependent offspring for additional year(s). As such, these adaptable pinnipeds have a life-history strategy that can offset reductions in natality by improving juvenile survival. Life history tables were also created based on these vital rates and showed that the population in the EGOA was increasing by an average of 4.1% per year over the study period and may be entering a period of density-independent growth. Finally, population trends were subjected to a prospective analysis where vital rates were varied systematically to determine which of those rates would pose the greatest threats to recovery. Natality showed the least elasticity indicating that large fluctuations in natality will have relatively little impact on population trends. Variation in juvenile survival followed by adult survival had increasing effects on population trends, respectively. These results have important implications for population recovery and suggest current research priorities should be shifted to a greater emphasis on survival rates and causes of mortality.

The Use of Passive Acoustic Monitoring to Study Cetacean Distribution and Estimate Abundance in the Gulf of Alaska

Tina Yack
Bio-Waves, Inc., tina.yack@bio-waves.net
Shannon Coates
Bio-waves, Inc., shannon.coates@bio-waves.net
Thomas Norris
Bio-Waves, Inc., thomas.f.norris@bio-waves.net
Brenda Rone
NOAA, Alaska Fisheries Science Center, brenda.rone@noaa.gov

A visual and acoustic line-transect survey of marine mammals was conducted in the central Gulf of Alaska (GoA) during the summer of 2013. The survey area was divided into four sub-strata to reflect four distinct habitats: 'inshore', 'slope', 'offshore' and 'seamount'. A five-element towed hydrophone array system was employed around-the-clock to acoustically detect and monitor marine mammals. During 23 days of acoustic effort, 456 hours of real-time monitoring and recording were conducted over 6,678 kilometers of trackline. There were 449 acoustic encounters of odontocetes comprising at least 6 species: resident/transient ecotype killer whale (*Orcinus orca*; n = 32), offshore ecotype killer whale (*Orcinus orca;* n = 3), sperm whale (*Physeter macrocephalus*; *n* = 241), Baird's beaked whale (*Berardius bairdii*; n = 35), Cuvier's beaked whale (*Ziphius cavirostris*; n = 60), Stejneger's beaked whale (*Mesoplodon stejnegeri*; n = 21), Dall's porpoise (*Phocoenoides dalli*; n = 3), unidentified porpoise (n = 13) and unidentified odontocetes (n = 41). Target motion analysis was used to obtain perpendicular distances to individuals both in real-time and during post processing. Using perpendicular distances, distance sampling methods were used to estimate a sperm whale detection function. Density and abundance estimates of sperm whales were obtained for each stratum (offshore: N = 78, CV = 0.36; seamount: N = 16, CV = 0.55; slope: N = 121, CV = 0.18) and for the entire survey area (N = 215, D = 0.0013, CV = 0.18). Additionally, species distribution and habitat use were examined within the study area. Sperm whales were the most frequent species encountered and were detected primarily in the slope stratum, as were Baird's beaked whales. Cuvier's beaked whales occurred primarily in seamount areas, and Stejneger's beaked whales were encountered equally in both the slope and seamount strata. These results suggest that species specific habitat preferences occur in the GoA. We anticipate conducting future work to model habitat preferences for beaked whales and sperm whales in this region as well as produce the first ever towed array acoustic only beaked whale density estimates. The survey provided the opportunity to collect high quality passive acoustic data that can be used to better inform conservation and management efforts.

Exploring Spatial Changes in Sport Fishing Areas Using Interview and Historical Data in Southeast Alaska

Maggie Nga Chan
University of Alaska Fairbanks (UAF), nlchan@alaska.edu
Anne Beaudreau
UAF, abeaudreau@alaska.edu

This poster explores spatial changes in fishing areas for Pacific halibut (*Hippoglossus stenolepis*) and salmon (*Oncorhynchus* spp.) in southeast Alaska. This poster presents preliminary findings based on interviews with sport charter operators in May 2014 in Sitka, Alaska. Respondents were asked to mark fishing locations for halibut and salmon over his or her charter fishing experience. Additional open-ended questions asked respondents to describe drivers of changes in where they fish. Spatial data from interviews were compared with historical maps displaying halibut and salmon sport fishing areas. Interview and historical maps were digitized in ArcGIS. Changes in location and size of fishing areas were examined over time. Research into spatial changes in fishing areas may help identify local trends to fish populations, such as changes to distribution.

Graying of the Fleet: Alaska's Next Generation of Commercial Fishermen

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

Since 1980 the average age of permit holders in Alaska commercial fisheries has increased from 40.9 years to 49.7 years in 2013. As current permit holders approach retirement age, the potential impacts of succession and access rights on rural livelihoods and coastal economies become an increasingly pressing management issue. This study seeks to better define this problem of the "graying of the fleet" in Alaska fisheries, and to identify potential policy responses and develop specific recommendations to address this growing problem. Based in the vital commercial fishing regions of Bristol Bay and the Kodiak Archipelago, this multi-sited ethnographic research project: 1) documents and compares barriers to entry into, and upward mobility within, fisheries among youth and young fishery participants; 2) examines factors influencing young people's attitudes towards, and level of participation in, Alaska fisheries; and 3) identifies models of successful pathways to establishing fishing careers among young residents. This poster will present initial results of interviews conducted with fishermen and community members in Bristol Bay and Kodiak.

This project is funded by the North Pacific Research Board and Alaska Sea Grant.

Paralytic Shellfish Poisoning: Novel Biosensor and Potentiostat for Detecting Saxitoxins

Thomas Stewart
Mercury Science, Inc. (MSI), tom@mercuryscience.com
Theresa Forshey
MSI, tforshey@mercuryscience.com
Ryan Boehm
MSI, ryandboehm@gmail.com
Wayne Litaker
NOAA, National Ocean Service (NOS), wayne.litaker@noaa.gov
Pat Tester
NOS, patricia.tester@noaa.gov

Paralytic shellfish poisoning (PSP) is a deadly public health threat caused by the consumption of shellfish contaminated with saxitoxins (STX). Monitoring and detection of PSP is difficult due to the widespread and variable occurrence of PSP produced by harmful algal blooms. In 2013, China banned the importation of Alaskan shellfish due to concerns about PSP, highlighting the need for more PSP testing. Current methods to monitor PSP toxins are costly and time consuming. A rapid, simple, low-cost method to measure saxitoxins in shellfish can help ensure public safety and provide vital support to subsistence, recreational and commercial shellfish harvesters.

We report the development of a novel biosensor and portable potentiostat that detects saxitoxins in shellfish extracts. The biosensor is a single use disposable electrode coated with antibodies able to detect the different structural forms of saxitoxin. The PSP biosensor plugs into a custom potentiostat that measures an electrical current inversely proportional to the amount of PSP in the sample. The potentiostat is precalibrated to quantitate PSP without the need to run standard solutions. The assay can be performed on the beach or boat.

The sensitivity of a prototype PSP assay was determined to be 20 µg STX/100 g shellfish. A method for extraction and detection of STX in shellfish was demonstrated. Preliminary test characteristics are presented along with description of plans to validate the method and develop test kits.

NEPA, ESA, and MMPA: Conservation of Marine Species Through Federal Permitting

Suzann Speckman
HDR, Inc., suzann.speckman@hdrinc.com
Donna Robertson Aderhold
HDR, Inc., donna.aderhold@hdrinc.com
Bonnie Easley-Appleyard
HDR, Inc., bonnie.easleyappleyard@hdrinc.com

The National Environmental Policy Act (NEPA) of 1969 provides the foundation for conservation in the United States by establishing national policy and goals for the protection, maintenance, and enhancement of the environment. NEPA mandates that Federal agency decision makers, in carrying out their duties, use all practicable means to create and maintain conditions under which people and nature can exist in productive harmony and fulfill the social, economic, and other needs of present and future generations of Americans. The Endangered Species Act (ESA) of 1973 was established to protect and recover imperiled species and the ecosystems upon which they depend. The Marine Mammal Protection Act (MMPA) of 1972 was established to protect marine mammals by prohibiting harassment, injury, or death ("take") in U.S. waters, with an exemption for subsistence harvests by Alaska Native peoples. How do the regulatory functions of this triad of seminal conservation Acts integrate with one another during consideration and assessment of potential impacts from projects in the marine environment? How do they address impacts to individuals, populations, and habitat? We examine the relationships among the NEPA, ESA, and MMPA regulatory processes, and the importance of baseline studies and empirical research to the validity of federal regulatory documentation and decision-making.

Evaluation of the Abraxis Saxitoxin Enzyme-Linked Immunosorbent Assay (ELISA) for Testing Subsistence Alaska Shellfish

Brian Himelbloom
University of Alaska Fairbanks (UAF), bhhimelbloom@alaska.edu
Julie Matweyou
UAF, julie.matweyou@alaska.edu
Tia Leber
UAF, tleber@alaska.edu
Ray RaLonde
UAF, ray.ralonde@alaska.edu

We evaluated a commercial test kit designed to quantify saxitoxin in four species of Alaska subsistence shellfish, in two widely separated geographic locations over the summers of 2012 and 2013. The Abraxis Saxitoxin (PSP) Enzyme-Linked Immunoassay (ELISA) uses a competitive format and is more sensitive than the mouse bioassay (MBA). The kit is also considerably less expensive than the MBA or high-performance liquid chromatography (HPLC). Shellfish collected on Kodiak and Annette Island were processed following modified AOAC Official Method 959.08 and split extracts were tested using the ELISA at the Kodiak Seafood and Marine Science Center and using the HPLC by the Alaska Department of Environmental Conservation, Environmental Health Laboratory. Linear regression analysis showed fair to good correlation ($r^2 = 0.814$ and 0.774) for combined field samples and recreational samples, respectively. The highest correlations were found for blue mussels (*Mytilus trossulus*) with $r^2 = 0.959$ and 0.894 for field and recreational samples, respectively. Saxitoxin (STX), neosaxitoxin (NEO), and gonyautoxin-1, -2, -3 and -4 (GTX1-4) predominated the toxin profile of blue mussels and butter clams (*Saxidomus giganteus*) in early July 2012, when high toxin (> 1,000 µg STX equivalence (eq)/100 g shellfish tissue by the Abraxis kit) occurred in Kodiak. Toxin levels declined in the subsequent harvests and the toxin profiles shifted to predominance of STX. The kit appears to underestimate total toxicity in cockles (*Clinocardium nuttallii*) and in littleneck clams (*Protothaca staminea*) due to the prevalence of other congeners. Toxin levels, as determined by Abraxis, are presented for both seasons, while HPLC data is limited to 2012 samples. High toxin levels were recorded in Kodiak in 2012 for all species tested, but remained near the regulatory level in 2013. Annette Island butter clams exhibited elevated toxins in 2012. HPLC included analysis of 11-12 toxin congeners and provided insight into toxin composition by species and changing toxin profiles over time. Project 1215 was funded by the North Pacific Research Board.

"Just Look at the Harbor": Fisheries Privatization, Social Transitions, and Well-Being in Kodiak, Alaska

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

Scholars and fishermen alike view the privatization of fishing rights as a fundamental driver of social change in fishing communities. This paper presents the results of a mixed-methods ethnographic study in Kodiak, Alaska, exploring how fisheries privatization processes remake fishery systems. Findings from this study suggest that a diverse range of fishery participants share core values about the social dimensions of fishery systems. Support or opposition to past privatization processes tended to be articulated in reference to how these core values (e.g., hard work, opportunity, and fairness) were perceived to have been strengthened or eroded by such processes. Data from this study suggest that while still widespread in the Kodiak fishing community, core social values in fishing may be changing as a result of privatization processes. While ethnographic and survey data showed a range of perspectives on the effects of privatization on fishing and the Kodiak community, study participants tended to talk about privatization as a significant change that had divisive, negative impacts in the community. Crew members and the next generation of fishermen were identified as disproportionately affected by privatization processes. Ethnographic data detail important shifts in the power, status, and livelihoods of crew members. Nearly all Kodiak fishery participants interviewed expressed concern about the future of fisheries access in the community for the next generation, in large part because of the substantial financial barriers to entry generated by privatization of fisheries access. Many discussed the need for more entry-level opportunities necessary for access in all fisheries.

Static Habitat Attributes Influence Biological Variability in Intertidal Communities in the Central Gulf of Alaska

Brenda Konar
University of Alaska Fairbanks (UAF), bhkonar@alaska.edu
Katrin Iken
UAF, kbiken@alaska.edu
Heather Coletti
National Park Service, Heather_Coletti@nps.gov
Thomas Dean
Coastal Resources Associate, tomdean@coastalresources.us
Daniel Monson
U.S. Geological Survey, Alaska Science Center, dmonson@usgs.gov

Intertidal communities naturally experience and are typically resilient to a large range of physical conditions. Some physical conditions are dynamic and temporally fluctuate (e.g., temperature, salinity, nutrients, etc.), while others are static and do not greatly fluctuate from year to year (substrate, slope, exposure, etc.). Although invariant in time, static attributes can vary greatly among sites and even within a site and can influence biological community structure. It is important to assess how and on which spatial scales (regional, local, intertidal stratum) static attributes structure intertidal communities if we are to isolate and understand the influence of more temporally variable attributes, especially in the context of changing climate conditions. We used percent cover data of sessile invertebrates and algae in mid and low intertidal communities at 31 sites in six regions across the central Gulf of Alaska. Static habitat attributes that were assessed included distance to freshwater, tidewater glacial presence, exposure, fetch, slope, and substrate type. Most of the variation in the data occurred among sites within regions and strata, with moderate variation among regions and only little variation between sampling years (2012 vs. 2013). Biological communities had higher similarity if sites were grouped based on static habitat attributes than by region. Tidewater glacial presence, exposure, fetch at 200 m, and percent cover mud/sand were the most important attributes in driving intertidal communities. The importance of static habitat attributes was also confirmed for both intertidal strata separately. Hence, while the general species pool is probably similar throughout the Gulf of Alaska, our results imply that static habitat attributes are important in dictating species occurrence at a local/site level.

Widespread Kelp Carbon Assimilation by Pelagic and Benthic Nearshore Fishes

Vanessa von Biela
U.S. Geological Survey (USGS), Alaska Science Center, vvonbiela@usgs.gov
Seth Newsome
University of New Mexico, newsome@unm.edu
James Bodkin
USGS, Alaska Science Center, jbodkin@usgs.gov
Gordon Kruse
University of Alaska Fairbanks, gordon.kruse@alaska.edu
Christian Zimmerman
USGS, Alaska Science Center, czimmerman@usgs.gov

Use of multiple energy pathways by predators may lead to enhanced food web stability by providing resilience to disruptions caused by declines in any one source. When predators use multiple energy pathways, the result of declining availability in any one source may be balanced by continued availability of another source. To explore the relative use of phytoplankton and kelp sources of carbon in nearshore marine fish predators, we measured carbon isotope values ($d^{13}C$) in epaxial muscle sampled from benthic-foraging kelp greenling (*Hexagrammos decagrammus*) and pelagic-foraging black rockfish (*Sebastes melanops*) at eight sites spanning ~35 – 60°N across the California Current (upwelling system) and Alaska Coastal Current (downwelling system) in the northeast Pacific Ocean. Muscle $d^{13}C$ values were expected to be highest for fish primarily assimilating carbon from kelp, lowest for those primarily assimilating carbon from phytoplankton, and intermediate for those assimilating a combination of both. The $d^{13}C$ values were higher in benthic-feeding kelp greenling than in pelagic-feeding black rockfish at most sites, indicating more kelp carbon use for greenling (paired t-tests, 7 of 8 locations, $P < 0.001$). Nevertheless, isotope mixing models suggested that both black rockfish and kelp greenling consistently use both kelp- and phytoplankton-derived carbon at all study sites and revealed moderate to high kelp carbon use. Kelp carbon use varied by location ranging from 51-98% in kelp greenling and 54-80% in black rockfish. We conclude that these two nearshore fishes routinely combine kelp and phytoplankton carbon pathways across coastal upwelling and downwelling systems. This pattern of dual-source carbon use, taken together with findings from other studies, appears to reflect a pervasive mechanism that could foster resilience of nearshore marine food webs to climate and human disturbances.

Testing the Use of Unmanned Aircraft Systems for Intertidal Surveys – Proof of Concept

Brenda Konar
University of Alaska Fairbanks (UAF), bhkonar@alaska.edu
Katrin Iken
UAF, kbiken@alaska.edu
Marty Rogers
UAF, mrogers@gi.alaska.edu
Samuel Vanderwaal
Northern Embedded Solutions, LLC, s.vanderwaal@noremsol.com

Intertidal monitoring is essential to establish biological benchmarks and to monitor important resources. One of the shortfalls of traditional biological monitoring methods is the small area that can be feasibly surveyed with limited people-power, and in the intertidal, the limited time of exposure during low tide series. For example, the current Gulf Watch Alaska project can feasibly only monitor intertidal systems along 50-m long beach stretches during a single low-tide series. Here, we are exploring as a proof-of-concept, the use of unmanned aircraft systems (UAS) as a cost-effective tool to expand the small-scale (on the order of meters) with larger-scale (on the order of kilometers) monitoring. Specifically, we are testing if high resolution imagery from low-flying UAS in intertidal seagrass and rocky systems in Kachemak Bay can be utilized in coastal monitoring. Should UAS prove to be a valuable tool, the area being monitored during a single low-tide series could be greatly expanded, as well as other areas included where benchmark data are currently lacking. Our first trial using an Aeryon Scout and a GoPro camera was completed in June 2014. This trial showed that this UAS was able to follow an intertidal transect but that battery time for the Scout and image resolution of the GoPro needed improvement. Another trail is planned for April 2015 using a Hexacopter and higher resolution camera.

Subsidy Pathways from Glacial Melt Water to Gulf of Alaska's Coastal Marine Food Webs

Mayumi Arimitsu
U.S. Geological Survey (USGS), Alaska Science Center, marimitsu@usgs.gov
John Piatt
USGS, Alaska Science Center, jpiatt@usgs.gov
Keith Hobson
University of Saskatchewan, Keith.Hobson@ec.gc.ca
Eran Hood
University of Alaska Southeast (UASE), eran.hood@uas.alaska.edu
Jason Fellman
UASE, jbfellman@uas.alaska.edu
Franz Mueter
University of Alaska Fairbanks (UAF), fmueter@alaska.edu
Anne Beaudreau
UAF, abeaudreau@alaska.edu

Freshwater runoff maintains the Alaska Coastal Current and influences the Gulf of Alaska ecosystem, which is highly productive and supports upper trophic level marine predators such as commercial fish, marine birds and mammals. Due to a warming climate in Alaska during recent decades, freshwater dynamics are changing rapidly and we are interested in any impacts this may have on marine ecosystems. Glacial melt water provides a seasonal pulse of modern terrestrial and ancient glacier-derived organic carbon, inorganic nutrients, and large volumes of freshwater. Our studies indicate that adjacent to and down-current of tidewater glaciers, abundant communities of krill, forage fish, and higher trophic-level marine predators persist during summer. We used stable isotopes as food web tracers to explore the impacts of freshwater and terrestrial subsidies on trophic dynamics in this marine ecosystem. We hypothesized that subsidies from tidewater glaciers influence these marine food webs: 1) through the transfer of glacier-derived organic matter to zooplankton via heterotrophic bacteria and/or 2) through enhancement of marine primary production via input of inorganic nutrients. We used naturally occurring stable isotopes ($\delta^{13}C$, $\delta^{15}N$, and $\delta^{2}H$) and radiocarbon ($\Delta^{14}C$) to trace terrestrial subsidies from glacier melt water through marine food webs. We measured chlorophyll a to estimate phytoplankton standing stock and inorganic nutrient availability to assess potential indirect effects of glacial subsidies to marine communities. Estimated contributions of organic subsidies based on mixing models, radiocarbon dating of carbon in water and biota, and modeled phytoplankton-nutrient dynamics suggest that both organic and inorganic subsidies may be important in regulating ecosystem processes. This research provides greater understanding of the influence of glaciers on marine ecosystems and may allow us to predict changes in marine community structure in response to Alaska's rapidly fluctuating climate.

Volunteer Photos Document 26th Year of Intertidal Biota Variability in Western Prince William Sound

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

In 1989 and 1990, NOAA's Emergency Response Division established and began monitoring intertidal biota at rocky and gravel intertidal sites around western Prince William Sound. During the past quarter century a number of these sites have been visited annually and photographed by NOAA and volunteers. The photos reveal wide interannual and long-term variability in the cover of conspicuous marine life including rockweed (*Fucus* sp.), mussels (*Mytilus* sp.), and barnacles.

During the summer of 2014 volunteer scientists and local citizens, guided by the author's photo site job aid, again visited 8 long-term rocky and gravel intertidal photo sites. The photos continue to reveal wide variability. This year, after several years of low abundance, the photos reveal a resurgence of mussels at several sites, documenting the fourth major recruitment during the past quarter century. There was also moderate to heavy cover of rockweed at most sites, but it appeared to be declining from peak cover in 2012 and 2013.

An earthquake in the winter of 2000 caused a landslide creating a new shoreline on northern Knight Island. Annual photos confirmed colonization of the bare rock within three years, followed by interannual variability in concert with that observed at the other shorelines. Finally, summer 2014 aerial and ground photos again confirm that a large mussel bed that disappeared in the mid 1990s has not recovered during the succeeding 20 years. Simple, repeated annual low tide photo surveys at fixed photopoints, and implemented by local scientists and citizens, can reveal inter-annual and longer-term changes that may have implications for climate variability and climate change.

Conceptual Models are Flexible Tools for Research Planning, Prioritization, and Communication

Tuula Hollmen
Alaska SeaLife Center, tuulah@alaskasealife.org
Suresh Sethi
U.S. Fish and Wildlife Service, sasethi@gmail.com

Conceptual ecological models synthesize information about complex systems into simplified visual diagrams, and can be used to communicate, represent, and prioritize system components and processes for research or management attention. We introduce conceptual modeling methods which incorporate expert ratings about properties of system components and linkages, including assessment of the state of knowledge, the strength of ecological impact, and the state of management or research attention devoted to a given component, among other properties. These quantitative ratings of the properties of system components can be subsequently used to synthesize expert input and prioritize model components for research or management attention. We present a selection of case studies regarding strategic research planning. For example, in a Chinook salmon (*Oncorhynchus tshawytscha*) case study, participants at a natural resource management agency used conceptual modeling and expert opinion to identify stressors on Chinook salmon survival which were rated as high ecological impact, but low state of knowledge and low state of management or research attention. By addressing both state of knowledge and attention gaps, participants implemented a strategy for research planning that complemented existing Chinook salmon research and management in the study region. In another case study, we asked experts to rate properties of linkages (strength, spatial scale, temporal scale, variability, and state of knowledge) in a conceptual model representing a pelagic trophic web in the Gulf of Alaska, to help identify uncertainties and prioritize research needs for a long-term monitoring program. Case studies demonstrated that conceptual ecological models could successfully be completed with an economy of time. We suggest that conceptual models will provide useful tools for both natural resource management and research groups, providing a framework for organizing collaborative efforts and communicating research or management progress to stakeholders or funders.

GOAIERP: Into the Home Stretch

Olav Ormseth
NOAA, Alaska Fisheries Science Center (AFSC), olav.ormseth@noaa.gov
Russ Hopcroft
University of Alaska Fairbanks (UAF), rrhopcroft@alaska.edu
Carol Ladd
NOAA, Pacific Marine Environmental Laboratory, carol.ladd@noaa.gov
Franz Mueter
UAF, fmueter@alaska.edu
Kalei Shotwell
AFSC, kalei.shotwell@noaa.gov

The Gulf of Alaska Integrated Ecosystem Research Program (GOAIERP) is entering its final stages. The goal of the GOAIERP (duration 2010-2015) is to use coordinated investigations at multiple trophic levels to better understand the dynamics of the GOA ecosystem and the forces that influence the survival of juvenile fishes. Researchers have now completed retrospective data analysis, two intensive years of field work, laboratory studies, and numerous biophysical model runs (including nutrient-phytoplankton-zooplankton ocean-circulation models and individual-based models). As we analyze and interpret the vast amount of data generated during the GOAIERP, significant findings are beginning to emerge. The first year of life appears to be very different for each of the five focal fish species, resulting from interactions between species' behaviors and consequent differences in their environmental exposure. We have identified a consistent breakpoint between the eastern and central GOA that occurs across many physical and biological components of the ecosystem, and have identified potential mechanisms to explain this result. The two main field years, 2011 and 2013, were very different at multiple trophic levels and we are exploring potential drivers of that variability. Our results also suggest that in the GOA, localized processes (e.g. the influence of Cross Sound in southeast Alaska) may be just as important as larger-scale ecosystem drivers. The research conducted during GOAIERP is expected to generate 50+ peer-reviewed papers, indicating just how productive an integrated ecosystem approach can be. Planning is underway for an extended synthesis period through 2017 that will further enhance the level of integration and expand on some of the key themes of the GOAIERP. This talk will present a summary of findings to date and specifically address the value of the IERP approach.

Seasonal Oceanography of Inshore Waters in the Gulf of Alaska

Olav Ormseth
NOAA, Alaska Fisheries Science Center (AFSC), olav.ormseth@noaa.gov
Kim Rand
AFSC, kimberly.rand@noaa.gov

Through our participation in the Gulf of Alaska Integrated Ecosystem Research Program (GOAIERP), we conducted extensive oceanographical studies of inshore waters in the Gulf of Alaska. The research focused on eleven sites on the eastern and western sides of the GOA: nine bays and two island areas that harbor seabird breeding sites. The bays varied widely in their geographical extent, degree and type of freshwater influence, exposure to offshore waters, and other environmental factors. Sampling was performed during three seasons (March/April, July/August, September/October) in 2011 and 2013. A number of closely-spaced oceanography stations were sampled at each site. At each station we deployed a Seabird 19+ instrument package that measured depth, temperature, salinity, dissolved oxygen, fluorescence, light, and turbidity continuously throughout the water column to within 5 meters of the seafloor. We also performed a vertical zooplankton tow using a 1m ring net. We used a surface water sampler and a hand-deployed Niskin bottle to take water samples at 0 m and 20 m depth to measure nutrients and chlorophyll. Preliminary results, presented in this poster, display a high degree of spatial variability in water column characteristics within and among the inshore sites. There is also seasonal variability in these characteristics. The results will be used to describe environmental conditions for fish and other life forms, and also to study connectivity among inshore and offshore regions.

Inter-annual and Spatial Variation in Pacific Blue Mussels (*Mytilus trossulus*) in the Gulf of Alaska, 2006-2013

Daniel Monson
U.S. Geological Survey, Alaska Science Center, dmonson@usgs.gov
Thomas Dean
Coastal Resources Associate, tomdean@coastalresources.us
Mandy Lindeberg
NOAA, Alaska Fisheries Science Center (AFSC), Mandy.Lindeberg@noaa.gov
James Bodkin
U.S. Geological Survey (USGS), jbodkin@usgs.gov
Heather Coletti
National Park Service, Heather_Coletti@nps.gov
Daniel Esler
USGS, desler@usgs.gov
Kimberly Kloecker
USGS, kkloecker@usgs.gov
Benjamin Weitzman
USGS bweitzman@usgs.gov
Brenda Ballachey
USGS, bballachey@usgs.gov

Pacific blue mussels (*Mytilus trossulus*) are abundant and widespread in the nearshore intertidal zone from Central California to the Arctic including the Gulf of Alaska (GOA). *M. trossulus* occur along sheltered shorelines on both rocky and cobble dominated substrates, where they are one of the primary occupiers of space. Mussels dramatically influence communities and ecosystems as they provide critical food resources to a variety of nearshore predators, can alter habitats through construction of dense beds, and link benthic and pelagic systems through filtration of the water column and deposition in the benthos. The Gulf Watch Alaska program monitors spatial and temporal variation in mussel abundance along with the abundance and prey preferences of two key nearshore vertebrate predators (sea otter (*Enhydra lutris*) and black oystercatcher (*Haematopus bachmani*)) at > 25 sites spanning > 500 km from eastern Prince William Sound to the west end of Katmai National Park on the Alaska Peninsula. Mussel abundance peaked in 2008-2009, then declined significantly across northern GOA sites coincident with declines in the proportion of mussels in the diets of sea otters and black oystercatchers, at Kenai Fjords in particular. The overall pattern suggests a GOA-scale mussel recruitment event may have occurred in 2007 boosting mussel standing stocks for several years, which then asynchronously declined due to site-specific mortality factors. In conjunction with additional mussel data sets available from GOA sites since 1989, we hypothesize that: 1) annual site-specific mussel recruitment is variable and generally below levels required to maintain mussel standing stocks from losses due to predation and disturbance, 2) large-scale mussel recruitment events that increase mussel abundance on the scale of the northern GOA occur episodically, 3) predators respond to variation in mussel biomass, and 4) dynamics of *M. trossulus* in protected waters of the north GOA may be driven by different forces than those of *M. californianus* along open coasts of more

southern latitudes. Additional understanding of factors driving variation in mussel populations and effects on mussel consumers will be facilitated by continued monitoring as part of Gulf Watch Alaska, along with directed research to understand functional relationships among ecosystem components.

Effects of Glacial Discharge on Recruitment and Succession in Subtidal Kelp Beds

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

Melting of subarctic glaciers discharges sediment-laden freshwater that can structure benthic communities by restricting settlement and altering succession. The goal of this study was to determine the influence of glacial discharge on recruitment and succession in subtidal kelp communities. Recruitment and succession was monitored at six sites along a glacial discharge gradient by estimating benthic algal and invertebrate cover on cleared rocks at 10 m depth from March 2013 to September 2014. Sedimentation rate, temperature, salinity, light, and nutrient concentration are environmental factors directly influenced by glacial discharge that were monitored at each site. Additionally, wave exposure, substrate rugosity, nearby adult kelp density, and invertebrate grazers and predators were analyzed to determine importance of these drivers to structuring communities. Cluster analysis on community structure that formed on the cleared rocks grouped the sites into three regions within the bay: two sites on the southern side of the outer bay upstream of glacial discharge, three inner bay estuarine sites, and one site on the outer northern side of the bay. Early recruits to the outer southern sites consisted of spirorbid worms, followed by encrusting brown algae and kelp. Bare space at inner bay sites was quickly filled by barnacles. Rocks at the outer northern site remained bare for several months, with encrusting brown and crustose coralline algae recruiting in mid to late summer. Species composition of recruits and early succession were similar in 2013 and 2014 with some differences in timing. Some glacially-influenced factors as well as non-glacial factors did influence community structure.

Gulf Watch Alaska: Monitoring the Pulse of the Gulf of Alaska's Changing Ecosystems

Kris Holderied
NOAA, National Ocean Service (NOS), kris.holderied@noaa.gov
Molly McCammon
Alaska Ocean Observing System (AOOS), McCammon@aoos.org
Katrina Hoffman
Prince William Sound Science Center, khoffman@pwssc.org
Tammy Neher
NOS, tammy.neher@noaa.gov
Tom Weingartner
University of Alaska Fairbanks (UAF), tjweingartner@alaska.edu
Russ Hopcroft
UAF, rrhopcroft@alaska.edu
Mandy Lindeberg
NOAA, Alaska Fisheries Science Center, mandy.lindeberg@noaa.gov
Brenda Ballachey
U.S. Geological Survey, Alaska Science Center, bballachey@usgs.gov

Gulf Watch Alaska, the long-term ecosystem monitoring program of the *Exxon Valdez* Oil Spill Trustee Council, integrates efforts of 15 field monitoring projects within the northern Gulf of Alaska from Prince William Sound to Katmai National Park and Preserve. Over 40 scientists participate in the collection and distribution of data ranging from physical ocean conditions and nearshore habitats to species distributions and lingering oil exposure. The program fosters collaboration across research specialties with a focus on providing integrated physical and biological information to support management of spill-affected species. The program also uses conceptual modeling to guide synthesis efforts and identify potential data gaps and sources of variability. Several data sets within the program extend across decades and are being used to focus process studies, examine the long-term effects of the spill, and identify potential drivers of ecosystem change in the context of a changing climate. We review recent results from several of the monitoring projects and discuss highlights from the initial Gulf Watch Alaska science synthesis completed in 2014. We also highlight program resources including publicly available data sets, visualization tools, and recent publications.

Where Have All the Starfish Gone: An Examination of Sea Star Wasting in Alaska

Joel Markis
University of Alaska Southeast (UASE), joel.markis@uas.alaska.edu
Marnie Chapman
UASE, mdchapman@uas.alaska.edu
Taylor White
Sitka Sound Science Center, twhite@sitkascience.org
Melissa Miner
University of California (UC), Santa Cruz, cmminer@ucsc.edu
Peter Raimondi
UC, Santa Cruz, raimondi@ucsc.edu

Sea star (Asteroidea) wasting syndrome is a term used to describe a group of symptoms that include lesions, tissue decay, body fragmentation, and eventual death leading to mass die-off of sea star populations. Cases were first detected in June of 2013 along the Olympic Coast in Washington. Since then the syndrome has been detected from Mexico to Alaska. We present an initial look at the status of the syndrome in Alaska as well as a detailed examination of an outbreak and mass die-off detected in Sitka Sound. We document changes in surface morphology, sequential syndrome progression from species to species and the timeframe from largely asymptomatic populations to mass appearance of symptoms to mass die-off for several species affected in intertidal and subtidal habitats. Neither the cause of this syndrome nor its transmission vectors are understood. The ecological implications of removing top level predators from intertidal and subtidal habitats will be profound. If the syndrome transitions to other echinoderm species it could also have severe economic impacts to commercial dive fisheries.