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ALASKA MARINE SCIENCE SYMPOSIUM

JANUARY 28 – FEBRUARY 1, 2019

HOTEL CAPTAIN COOK & ANCHORAGE HILTON
ANCHORAGE, ALASKA

2019 BOOK OF ABSTRACTS

Showcasing Marine Research in the Arctic Ocean, Bering Sea, and Gulf of Alaska

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2019 Alaska Marine Science Symposium
Abstracts & Poster Presentations

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The 2019 AMSS Keynote and Plenary speaker abstracts are presented in chronological order

Poster presentations are grouped by day per Wave category

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MONDAY, JANUARY 28, 2019

Opening Day
Keynote Schedule & Abstracts

WORKSHOPS & KEYNOTE SPEAKERS — MONDAY, JANUARY 28

TIME	TITLE	PRESENTER	SECTION
9:00 - 12:00	2019 Communicating Ocean Sciences Workshop	Jude Isabella	WORKSHOP
10:00 AM	Registration Opens		
1:00 - 1:30	Opening Remarks		
1:15 - 1:30	Congressional Video Introductions		
1:30 - 2:15	Earthquakes and tsunamis of the southern Alaska margin and their relationship to the 30 November 2018 M7 Anchorage earthquake	Peter Haeussler, Ph.D.	KEYNOTE
2:15 - 3:00	One More Complication: Alaska's Changing Oceans	Richard Thoman	KEYNOTE
3:00 - 3:15	COFFEE BREAK		
3:15 - 4:00	Opening our eyes to ecosystem change: the scientific legacy of the *Exxon Valdez* oil spill	Jeff Short, Ph.D.	KEYNOTE
4:00 - 4:45	The Origin of a Story	Jude Isabella	KEYNOTE
4:45 - 5:00	Presentation of ASLC Ocean Leadership Award for Marine Research	Kathy Frost & Lloyd Lowry	
6:30 - 7:30	Poster Session - Wave 1 - Gulf of Alaska & Bering Sea-Aleutians		
7:30 - 9:00	Poster Session - Wave 2 - Gulf of Alaska & Bering Sea-Aleutians		

PETER HAEUSSLER, PH.D., RESEARCH GEOLOGIST, U.S. GEOLOGICAL SURVEY

Earthquakes and Tsunamis of the Southern Alaska Margin and their Relationship to the 30 November 2018 M7 Anchorage Earthquake

The M7 Anchorage earthquake of 30 November 2018 served as a reminder that southern Alaska is situated above a tectonically active, earthquake-prone subduction zone. Subduction zone earthquakes, such as the 1964 M9.2 event, can produce strong shaking, and some may cause seafloor deformation that may in turn trigger tsunamis. The 2018 Anchorage earthquake occurred at a depth of about 45 km within the slab of ocean lithosphere that is subducting beneath the North American plate, thus it is referred to as an “intraslab” earthquake. The source mechanism of the earthquake indicates it was related to the slab being pulled apart as it sinks into the mantle. Smaller magnitude earthquakes of this type are common in the Anchorage region, but dramatically different in nature than the 1964 M9.2 earthquake, which remains the second largest ever recorded worldwide. The 1964 earthquake occurred on the shallow “megathrust” fault that marks the interface between converging tectonic plates. Slip on the fault caused large areas on- and offshore to uplift (to 10 m) and subside (to 2 m). In contrast, the 2018 earthquake resulted in subsidence (to 0.08 m) over a limited area onland in the Matanuska-Susitna Valley without an associated tsunami. In contrast, the 1964 earthquake produced large-scale change of the ocean bottom, because the megathrust ruptured the seafloor and generated shaking that lasted as long as 4-5 minutes. These effects dislodged blocks and resurfaced the bottom of many fjords, generating tsunamis that killed many people along the coastline as well as fish in the water column. Both types of earthquakes are inevitable consequences of a tectonically active plate boundary and they reflect different processes occurring at different depths along a subduction zone. Although these earthquakes vary in size and effects, they both show that Alaska needs to be prepared for, and resilient to, the effects of earthquakes and tsunamis.

Peter J. Haeussler is a Research Geologist at the U.S. Geological Survey in Anchorage, Alaska, where he has lived and worked for the last 26 years. His current research focuses on understanding active tectonic processes in southern Alaska, with studies on the frequency of earthquakes, the location and rate-of-movement of active faults, and mountain building. Other research efforts relate to submarine-landslides and their role in tsunami generation, as well as framework geology for energy and mineral resource assessments. He is author or co-author on more than 130 scientific publications. He completed his B.S. in Geology from Michigan State University, and his Ph.D at the University of California Santa Cruz.

RICHARD THOMAN, ALASKA CENTER FOR CLIMATE ASSESSMENT AND POLICY, ALASKA CLIMATE SPECIALIST

One More Complication: Alaska's Changing Oceans

The oceans around Alaska are vital to the state and the world. But the oceans are no longer passive players to be traveled upon, to be studied or holding resources to be exploited. Our oceans are changing: warming water and decreasing sea ice are already generating cascading impacts to the biology and the larger climate and environmental system for which we have only a limited understanding. This talk will review some of the ongoing changes in the oceans around Alaska and present some challenges in moving forward.

Bio: Rick Thoman has worked in Alaskan weather and climate for more than 30 years. He recently retired from the National Weather Service Alaska Region as the Climate Science and Services Manager and is spending his golden years working as a Climate Specialist with the Alaska Center for Climate Assessment and Policy.

JEFF SHORT, PH.D. (RET.), FORMER EVOS SCIENTIST

Opening Our Eyes to Ecosystem Change: the Scientific Legacy of the Exxon Valdez Oil Spill

Thirty years ago, the 1989 *Exxon Valdez* oil spill strongly perturbed the nearly-pristine marine ecosystem in Prince William Sound (PWS). Occurring during oceanographic spring, the spill polluted thousands of square kilometers of sea surface just before the arrival of innumerable birds, mammals and fish to reproduce. The affront to the nation released unprecedented resources to evaluate the effects, which were especially clear with the general absence of other contamination sources. State and federal agencies recognized the need to distinguish natural ecosystem change from responses attributable to the spill. Supported with a $900M fund from the settlement, the *Exxon Valdez* Oil Spill Trustee Council (EVOSTC) was created to meet these challenges. The administrative procedures of the EVOSTC were designed at the outset to ensure that funded studies met the highest scientific standards of evaluation, monitoring and review. Funded research led to major discoveries regarding the effects of the spill, including the ecotoxicology of oil pollution, the persistence of oil, and long-term impairment of affected marine life populations. These discoveries have informed damage assessments of every subsequent large oil spill worldwide. Companion studies on the functioning and secular change of the marine ecosystems revealed previously unknown ecosystem processes and created long-term time-series of ecosystem behavior. Direct benefits include early detection of abrupt ecosystem change such as oceanographic regime shifts, and the recent marine heat wave in the Gulf of Alaska (aka "the blob"). Moreover, recognition of the need for participating researchers to collaborate and share their findings led to the EVOSTC Oil Spill Symposium in January, 1993, which subsequently evolved into the Alaska Marine Science Symposium. This visionary approach to integrated ecosystem research continues to provide Alaskans, the nation and the world with the knowledge needed to plan for an increasingly uncertain future.

Jeffrey Short retired from a 31-year career as a research chemist at the U.S. National Oceanic and Atmospheric Administration, where he worked primarily on oil pollution and other contaminant issues. He was the leading chemist for the governments of Alaska and the United States for the damage assessment and restoration phases of 1989 *Exxon Valdez* oil spill, and did numerous studies on the distribution, persistence and effects of the oil on the marine ecosystem affected by it. Dr. Short is the author of more than 70 scientific publications and has contributed to 3 books on oil pollution. Dr. Short now works as a consultant on oil pollution fate and effects, and has worked on projects and advised government agencies of Canada, China, Ecuador, Korea, Norway and the Russian Federation regarding issues related to oil spills and oil pollution.

JUDE ISABELLA, EDITOR, HAKAI MAGAZINE

The Origin of a Story

When I fell into journalism in the pre-internet age, I discovered that stories could inspire people to change their thinking, behavior, or situation. Narratives proved themselves to have power. And over the years it's become apparent that the stories with the strongest impact on an audience are the ones that sweep away writers before they place their hands on a computer keyboard—they grab the scent of an idea and hunt for the elements that give it form.

It seems an act of wizardry to conjure 6,000 — or 50,000 — words out of what begins as a thought. But writers train themselves to recognize a story's building blocks, to identify compelling characters, and to connect details incongruent on the surface. And that's all so much easier if you pay attention to what sets your mind on fire, and to the thoughts that jab you at odd times again and again.

Jude Isabella has been a science journalist for over 25 years. She has a BA in political science and history from the University of Rhode Island, and an MA in writing and anthropology from the University of Victoria. As a journalist she has worked for newspapers and magazines on staff and as a freelancer. She spent a dozen years as managing editor of the award-winning *YES Mag, Canada's science magazine for kids*, while also freelancing for science publications and writing the book, *Salmon, a Scientific Memoir*. After four years of research and field work, Jude created a narrative that offers readers an understanding of the salmon ecosystem through the different lenses.

In 2015, she launched *Hakai Magazine*, an online publication focused on coastal science and societies. Supported by the Tula Foundation, *Hakai Magazine* has made a name for itself in the science journalism world and won numerous awards. As rewarding as it is to edit and write long form science journalism, Jude continues to write for young readers. She's written five books for kids, one of which won the prestigious American Institute of Physics award. Her latest book, about the wolves of Yellowstone National Park for Kids Can Press, is slated for publication in 2019.

TUESDAY, JANUARY 29, 2019

GULF OF ALASKA
PLENARY SESSION

PLENARY SESSIONS: TUESDAY, JANUARY 29 — GULF OF ALASKA

TIME	TITLE	PRESENTER	SECTION
8:00 - 8:15	Influence of ocean acidification and climate change on the biogeochemistry in the Gulf of Alaska: A regional modeling study	Claudine Hauri	Climate & Oceanography
8:15 - 8:30	Impact of elevated, variable pH on the Pacific razor clam in Alaska	Marina Washburn	Climate & Oceanography
8:30 - 8:45	Potential role of marine snow in the fate of spilled oil in Cook Inlet, Alaska	Jesse Ross	Climate & Oceanography
8:45 - 9:00	Impact of the marine heat wave on Gulf of Alaska plankton communities. Has normal service now been resumed?	Sonia Batten	Lower Trophic Levels
9:00 - 9:15	Mixotrophy in the Gulf of Alaska: Abundant plant-animal cells have major implications for ecology and biogeochemistry	Suzanne Strom	Lower Trophic Levels
9:15 - 9:30	Ocean acidification driven biological vulnerability in the high latitudes: comparison between the Gulf of Alaska, Bering Sea and Beaufort Sea	Nina Bednarsek	Lower Trophic Levels
9:30 - 10:00	COFFEE BREAK		
10:00 - 10:15	Examining the effects of ocean acidification on Alaska bivalves of subsistence importance	Ashley Rossin	Lower Trophic Levels
10:15 - 10:30	Manager's perspective on the recovery of East Cook Inlet razor clams	Mike Booz	Fishes & Fish Habitats
10:30 - 10:45	Harnessing environmental DNA to monitor the spatial and temporal dynamics of eulachon in Northern Southeast Alaska	Meredith Pochardt	Fishes & Fish Habitats
10:45 - 11:00	Spatial and temporal dynamics of capelin (*Mallotus villosus*) in the Gulf of Alaska: Implications for fisheries and ecosystem-based management	David McGowan	Fishes & Fish Habitats
11:00 - 11:15	Size-based patterns of energy allocation in juvenile sablefish	Matt Callahan	Fishes & Fish Habitats
11:15 - 11:30	Relative reproductive success between hatchery strays and wild pink salmon in a natural stream in Prince William Sound	Kyle Shedd	Fishes & Fish Habitats
11:30 - 1:00	LUNCH PROVIDED		
1:00 - 1:15	Birds of a feather flock together… or do they? Regional and temporal patterns of community composition and abundance in nearshore marine birds across the Gulf of Alaska	Heather Coletti	Seabirds
1:15 - 1:30	Trophic connections between sperm whales and their prey in the Gulf of Alaska	Lauren Wild	Marine Mammals
1:30 - 1:45	Revelations from an aerial perspective: how hungry whales work smarter not harder	Madison Kosma	Marine Mammals
1:45 - 2:00	Assessing cetacean populations using integrated population models: an example with Cook Inlet beluga whales	Eiren Jacobson	Marine Mammals
2:00 - 2:15	Brown bears and sea otters along the Katmai coast: Offshore islands as predator pits.	Daniel Monson	Marine Mammals
2:15 - 2:30	Ecosystem implications for the decline in reproductive success in humpback whales in the Gulf of Alaska	Jan Straley	Marine Mammals
2:30 - 3:00	COFFEE BREAK		
3:00 - 3:15	Managing the invasive tunicate, didemnum vexillum, in Sitka, Alaska: Is eradication feasible?	Ian Davidson	Human Dimensions
3:15 - 3:30	Boats, whales, humans, dollars: Teasing apart the many dimensions of Juneau's growing whale-watching industry	Suzie Teerlink	Human Dimensions
3:30 - 3:45	The first Ocean Guardian School Program in Alaska: Inspiring marine stewardship in schools	Kimberly Raum-Suryan	Human Dimensions
3:45 - 4:00	Paralytic shellfish toxins in butter clam tissues and effect of cleaning methods used by Kodiak harvesters	Julie A. Matweyou	Human Dimensions
4:00 - 4:15	Pacific herring trophodynamics and fisheries in the southeastern Gulf of Alaska	Szymon Surma	Ecosystem Perspectives
4:15 - 4:30	Physiological and gene transcription assays in combination: a new paradigm for marine intertidal assessment	Katrina Counihan	Ecosystem Perspectives
4:30 - 4:45	Ecological relationships between recovering sea otters and eelgrass communities in southeast Alaska	Wendel Raymond	Ecosystem Perspectives
4:45 - 5:00	Development of socio-ecological conceptual models as the basis for an IEA framework in Southeast Alaska	Judith Rosellon-Druker	Ecosystem Perspectives

Influence of Ocean Acidification and Climate Change on the Biogeochemistry in the Gulf of Alaska: A Regional Modeling Study

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The biogeochemistry of the Gulf of Alaska is heavily influenced by hundreds of glacially fed rivers that enter into this pristine environment. Projected increased melting of glaciers and changes in precipitation may further change the biogeochemistry and accelerate the progression of ocean acidification. To get a better understanding of the physical and biogeochemical mechanisms that control pH, aragonite saturation state, oxygen and productivity, we have developed a new regional ROMS-Cobalt (Regional Ocean Modeling System – Carbon Ocean Biogeochemistry and Lower Trophics) model domain covering the Alaskan coastline along the Gulf of Alaska. Our new carbon based model is explicitly forced with coastal freshwater discharges, thereby not only affecting salinity, but also alkalinity, dissolved inorganic carbon and nutrient concentrations. The model's performance is carefully evaluated with in situ observations from the Northern Gulf of Alaska Long Term Ecological Research site. We explore the seasonal, interannual, and decadal variability of inorganic carbon, oxygen, and productivity, and detangle the complex interplay of underlying mechanisms. The 35 yearlong hindcast simulation also gives insights into how rising atmospheric CO2, increased freshwater discharges and other physical changes may have already affected the biogeochemistry of this highly productive and socio-economically important ecosystem.

Impact of Elevated, Variable ph on the Pacific Razor Clam in Alaska

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Ocean change, facilitated by the increase of anthropogenic carbon dioxide is driving oceanic chemical changes resulting in a long-term global decrease in ocean pH, colloquially termed ocean acidification (OA). Previous studies have shown that OA can have negative physiological consequences for calcifying organisms, particularly bivalves. This study examines the effects of ocean acidification- increased pCO_2 and lowered pH, on larval *Siliqua patula,* the Pacific razor clam. Experimental work was conducted during the summer of 2018 at the Alutiiq Pride Shellfish Hatchery in Seward, Alaska. Larvae were spawned and cultured over a month until the juvenile phase was reached under three future OA scenarios. The treatments include a static high pCO_2 of 867 µatm/7.7 pH units (projected for the year 2100, based on *in situ* pH measurements with an -0.3 pH offset), variable pCO_2 of 357 µatm/8.0 pH units to 867 µatm/7.7 pH units, and current ambient pCO_2 of 357 µatm/8.0 pH units. The variable treatment fluctuated between the static high treatment and the static, current ambient treatment on a diurnal cycle. A much-needed developmental time-series was also assembled for *S. patula.* Response variables include analysis of shell growth rate, shell mineralization, shell composition and dissolution, as well as changes in gene expression- via mRNA expression levels for both HSP-70 and Carbonic Anhydrase, two genes identified as bioindicators of OA stress. This work aims to answer important questions regarding the susceptibility or resilience of *S. patula* to conditions of OA and perhaps shed light on the current population decline of this cornerstone species in Alaskan waters.

Potential Role of Marine Snow in the Fate of Spilled Oil in Cook Inlet, Alaska

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The objective of the research is to characterize the potential role of marine snow and suspended minerals in the fate of spilled oil in Cook Inlet, Alaska. While extensive research has been conducted on minerals aggregating with spilled oil, larger organic aggregates, such as marine snow, have only recently been studied as a significant transport mechanism. This knowledge gap was highlighted following the Deepwater Horizon (DWH) blowout in the Gulf of Mexico (2010) when a significant percentage of the spilled oil was observed settling to the seafloor as a result of association with marine snow. Research following the DWH blowout suggests marine snow and mineral aggregation are processes that must be considered during spill response. The U.S. Geological Survey (USGS) and others have noted that the understanding of baseline marine snow conditions in areas of petroleum exploration and extraction is urgently needed. In the summer of 2018, marine snow samples were collected with a surface-tethered sediment trap in eastern Cook Inlet. The sediment trap was deployed at three sites in Kachemak Bay for 1.5 hours at 20 meters, up to 5 times at each site, from mid-June to early August. The particle mass flux ranged from 30 to 220 g m^{-2} day^{-1}. The particles collected were composed of 19-38% organic carbon with little variation between inner and outer Kachemak Bay. Samples were processed at NOAA's Kasitsna Bay Lab and qualitatively examined for particle composition. The data collected, in addition to local knowledge, was used to inform laboratory scale roller table experiments at the University of New Hampshire (UNH) during Fall 2018. The laboratory experiments include growing marine oil snow in roller tanks while varying diatom, sediment, oil and dispersant concentrations. The marine oil snow is tested for settling rates and oil content and placed into a flume for resuspension studies. Characterization of baseline marine snow conditions and the formation potential of marine oil snow will contribute to understanding oil spill fate and response in Cook Inlet.

Impact of the Marine Heat Wave on Gulf of Alaska Plankton Communities: Has Normal Service Now Been Resumed?

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The 2014-2016 marine heat wave in the Northeast Pacific had noticeable impacts on many organisms in the Gulf of Alaska that have been widely reported. Plankton are the base of most marine food chains supporting fish, marine birds and mammals. Here we use time series of Continuous Plankton Recorder data to show how the plankton communities were impacted during this event. CPR data have been collected in the GoA since 2000, with sampling encompassing other periods of warmer (as well as cooler) than average conditions, thus allowing such comparisons. In general, both phytoplankton and zooplankton communities decreased in mean size with different groups of organisms benefitting from, or adversely impacted by, the warmth in 2014-2016. In some groups the impacts were as predicted from sampling during previous warm years (an increase in the number of warm water species for example) but in other groups impacts were not as expected, suggesting that not all the changes were caused directly by temperature and indirect effects on water properties also likely influenced the communities. We assess whether, as 2017 and 2018 returned to more typical ocean conditions, the plankton also returned to normal.

Mixotrophy in the Gulf of Alaska: Abundant Plant-animal Cells Have Major Implications for Ecology and Biogeochemistry

Suzanne Strom
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Mixotrophic organisms combine the abilities to photosynthesize and to eat in a single organism. Our recent study of mixotrophic protists in the coastal Gulf of Alaska (CGOA) has shown that two types can be abundant: ciliates that retain chloroplasts from their microalgal prey, and photosynthetic dinoflagellates that also prey upon other phytoplankton. These groups often make up most of the 'microzooplankton' community in the coastal Gulf of Alaska. In addition to estimating abundance and species composition using several types of microscopy, we measured the chlorophyll content of individual chloroplast-retaining ciliates, sequenced ciliates for 18s rRNA-based identification, and conducted prey addition experiments to asses the potential grazing impact of mixotrophic dinoflagellates on commonly occurring CGOA phytoplankton types. Species previously known to be mixotrophic were found, as well as others for whom this trophic identification is novel. Mixotrophic ciliates sometimes contributed a substantial fraction of the total chlorophyll biomass, particularly the >20 µm chlorophyll size fraction. Relationships between mixotrophy prevalence and environmental conditions (season, location, nutrient and light availability) will be described. Protist mixotrophy is known to enhance primary production, trophic transfer efficiency, and export flux in planktonic ecosystems. We will present a conceptual model describing the implications of mixotrophy for the support of higher trophic levels in the CGOA.

Ocean Acidification Driven Biological Vulnerability in the High Latitudes: Comparison Between the Gulf of Alaska, Bering Sea and Beaufort Sea

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High latitudinal ecosystems are under accelerating ocean acidification (OA) that represents a particular threat to marine calcifiers. Pteropods are found in high abundances in the subarctic regions of the North Pacific, Gulf of Alaska (GOA), Bering Sea and Beaufort Sea. They are key forage for a variety of different fish, including juvenile salmon, sole and pollock and provide crucial lipids the absence of which can lead to delays in fish development. Due to their extreme sensitivity, pteropods are regarded as an excellent OA indicator, with the potential to provide insights into the changes in ecosystem integrity that is essential to effective fisheries and marine resource management. Developing baseline information on the number of species, species distribution and incidence of shell dissolution and their coupling with the OA parameters, is a key first step towards these efforts. Pteropod samples were collected on hydrographic P16 cruise in 2015 in the GOA, NOAA cruises in the Bering Sea in 2017, and DFO cruises in the Beaufort Sea in 2014 and 2017. Our results based demonstrate differential biological vulnerability to OA across different high latitudinal environments; the Beaufort Sea pteropods were the most affected, followed by the Western part of GOA, while at least seasonally, the Bering Sea has not yet did not showed signs of vulnerability. However, the exposure to OA would not necessary result in pteropod vulnerability if there were evidence of large-scale population connectivity within species, or if there was evidence of co-occurring cryptic species or subspecies. For that, we used genetic approaches to determine whether there is evidence of species structure throughout these regions and found a uniform pteropod population indicative of their high vulnerability. This susceptibility is leveraged by their potential phenotypic variation and high population connectivity, derived from the individual-based biophysical modeling outputs in the GOA, but not in the Beaufort Sea. Ultimately, our study will contribute to robust baseline data sets that can help to recognize potential refugia and habitats of concerns, to identify priority for future monitoring, and provide information to better manage ecosystem health and investigate of OA in the larger subarctic and Arctic ecosystems.

Examining the Effects of Ocean Acidification on Alaska Bivalves of Subsistence Importance

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Leukoma staminea, the littleneck clam, and *Clinocardium nuttallii,* the heart cockle, are two clam species within the Gulf of Alaska that are used for subsistence. Clam populations throughout the state have been in decline over the past several decades with no known cause. This decline is coupled with the anthropogenically-induced carbon dioxide emissions that are lowering the ocean's pH levels. Ocean acidification is more rapidly increasing in high-latitude seas, and is a larger concern for calcifying organisms, particularly in colder waters. Adult clams were spawned at the Alutiiq Pride Shellfish Hatchery in Seward, Alaska, in May of 2016, and the larvae grew in ambient hatchery conditions and settled. The juveniles were then exposed to ambient (pH 8) and acidified (pH 7.7) seawater for 24 days. The acidified treatment conditions reflect the prediction for Alaskan coastal waters for 2100 based on the International Panel on Climate Change RCP 8.5. Samples were taken at seven timepoints throughout the experiment in order to observe the physiological changes through time. Measurement variables include shell dissolution, shell composition, and molecular responses including gene expression across species, treatment, and time. In addition to the experimental work, a citizen science approach to measuring clam population dynamics through observations along the Alaskan coastline by using the LEO Network and EpiCollect5. Our "Clam Survey" project on Epicollect5 has been available since September 2018 and allows for locals to log their clam collections and observations along the Alaskan coastline to facilitate a better understanding of current clam distribution and abundance, and how it may be changing over time. Collectively, this work will provide valuable information on the sensitivity of culturally important clam species to ocean acidification while engaging the general public through citizen science.

Manager's Perspective on the Recovery of East Cook Inlet Razor Clams

Mike Booz
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East Cook Inlet razor clams have historically supported Alaska's largest clam sport fishery. A downward shift in productivity with this stock was first detected in the mid 2000s. Precipitous declines of adult clam abundances in 2012 and 2013 led to emergency order restrictions to the sport fishery and the eventual closure of the fishery in 2015. Over recent years, monitoring efforts have been refined to better understand recruitment and natural mortality. Starting in 2015, three consecutive large cohorts of juvenile clams recruited to both Ninilchik and Clam Gulch beaches. Currently, clam density on these beaches is well above historical averages, although adult abundances remain at historic lows. Preliminary annual natural mortality estimates for these juvenile clams has differed by beach and has differed from adult clam mortality rates. As these juvenile clams approach recruiting to the adult size, a better understanding of these divergent recruitment and natural mortality rates will help managers identify the stock's ability to once again support harvest opportunities. These assessments have also been beneficial in communicating the current status and possible mechanisms behind the decline of East Cook Inlet razor clams to stakeholders.

Harnessing Environmental DNA to Monitor the Spatial and Temporal Dynamics of Eulachon in Northern Southeast Alaska

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Eulachon (*Thaleichthys pacificus*) are a culturally and biologically important anadromous forage fish with historic range stretching from northern California to Alaska. Today all populations that spawn south of the Nass River in northern British Columbia are severely depleted or extinct, leaving Alaska's populations as a critical stronghold. In southeast Alaska, eulachon remain a key resource for indigenous people and wildlife, but little is known about their population status, trend, or spatiotemporal dynamics. In 2010, the Chilkoot Indian Association began a mark-recapture project to monitor eulachon in the Chilkoot River near the town of Haines, Alaska. From 2013-2017, Oregon State University paired the use of environmental DNA (eDNA) concentrations from the Chilkoot River as an alternative index of eulachon abundance. Our results thus far have demonstrated that the concentration of eulachon eDNA provides a reliable measure of eulachon phenology and abundance. Based on our results from the Chilkoot River, in 2017 we initiated a regional eulachon monitoring program across 11 rivers in Northern Southeast Alaska. Because eulachon do not have high site fidelity like salmon, regional monitoring is key to understanding population trends. The goal of our regional eulachon monitoring program is to (1) determine the spatial and temporal correlation of eulachon spawning biomass among 11 rivers in northern Southeast Alaska, (2) to test for correlations with environmental parameters that may affect eulachon run size, timing, and distribution, and ultimately (3) to work with community harvesters and managers in the region to set thresholds for population level changes that would trigger management action.

Spatial and Temporal Dynamics of Pacific Capelin (*Mallotus catervarius*) in the Gulf of Alaska: Implications for Fisheries and Ecosystem-Based Management

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In the Alaska North Pacific, capelin (*Mallotus villosus*) is a planktivorous, pelagic fish that serves an intermediate trophic role in marine food webs. There is limited information on spatial patterns and population dynamics of capelin in the Gulf of Alaska (GOA), but we know that fluctuations in their distribution and abundance occur in response to changes in environmental conditions and that this affects their availability to predators. To help fill these information gaps, we modeled distributions of capelin spawning habitat and larval dispersal, and we synthesized spatially-indexed data from multiple surveys in the GOA from 2000 to 2015. Potential capelin spawning areas were identified within all regions of the GOA. Modeled trajectories of larval drift show that capelin are dispersed over the continental shelf and slope by the GOA's advective circulation patterns, indicating potential connections between spawning areas and observed offshore distributions. Simulations of larval dispersal also suggest that larval trajectories are influenced by the location and timing of spawning. Larval and age-1+ capelin are patchily distributed across the GOA, but concentrate primarily over the shelf near the Kodiak Archipelago. Spatiotemporal variations in densities indicate that the availability of capelin to monitoring surveys in the GOA is highly variable and that interannual variations in capelin abundance may not be directly related to ocean temperatures. We identify physical and biological factors associated with areas where capelin consistently occur and concentrate, spatiotemporal trends in capelin abundance, implications for management of the GOA ecosystem, and recommendations for improved monitoring of capelin in the GOA.

Size-Based Patterns of Energy Allocation in Juvenile Sablefish

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Juvenile fish may persist or perish based on growth and condition prior to their first winter. Increased growth provides the opportunity to consume larger, higher energy prey while reducing risk of size dependent predation. High energy stores entering winter reduce the amount of energy intake necessary to survive, which decreases the chance of starvation and may allow fish to avoid predation risk associated with foraging. This study examines growth and nutritional condition of juvenile sablefish (*Anopolopoma fimbria*), an economically and ecologically important demersal fish species in the Gulf of Alaska, before and after their first winter. We collected post-settlement juvenile sablefish from Saint John Baptist Bay, Baranof Island, Alaska in October 2017, July 2018, and October 2018 to measure energy density (an index of nutritional condition) and RNA:DNA ratios (a metric of growth). Data on condition and growth of pelagic YOY sablefish in the Gulf of Alaska during summer 2017 and of age-1 sablefish from Saint John Baptist Bay during July of 2014-2017 were provided by NOAA. Condition increased with fish size through YOY summer and fall, but post-winter age-1 fish experienced energy loss over winter. July age-1 sablefish had lower length-energy density relationships than pre-winter juveniles. However, July age-1 fish did have significantly higher total energy than age-0s in the previous October. Age-1 juveniles in 2018 had the highest energy densities of years examined while 2017 fish were in the poorest condition, with 2014 and 2016 intermediate. We also identified seasonal and interannual variation in growth of juvenile sablefish. This work will refine the conceptual model of energy allocation by sablefish during their early life history and may provide further insight into the drivers of sablefish recruitment.

Relative Reproductive Success Between Hatchery Strays and Wild Pink Salmon in a Natural tream in Prince William Sound

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Extensive ocean-ranching aquaculture of Pacific salmon is practiced by private non-profit (PNP) hatcheries in Alaska. Most of the 1.8B juvenile salmon that PNP hatcheries release annually are pink salmon (*Oncorhynchus gorbuscha*) in Prince William Sound and chum salmon (*O. keta*) in Southeast Alaska. While policies exist to reduce risk to wild stocks, the scale of these hatchery programs has raised concerns regarding the impact of hatchery-origin fish on the productivity and sustainability of wild stocks of Alaska salmon. To study the fitness impacts of hatchery strays, this project estimated the relative reproductive success of stray hatchery pink salmon relative to their wild counterparts in a natural stream (Hogan Bay) in Prince William Sound. We reconstructed pedigrees for brood years 2013 and 2014 by combining origin information from thermal otolith marks with parentage information from genetic data analyses of 8,000 fish to compare the reproductive success (number of returning adult salmon) of hatchery strays to wild salmon in the same stream. This research is part of the larger Alaska Hatchery Research Program that seeks to better understand hatchery and wild stock interactions and inform resource management decisions regarding future hatchery production.

Birds of a Feather Flock Together… Or Do They? Regional and Temporal Patterns of Community Composition and Abundance in Nearshore Marine Birds Across the Gulf Of Alaska

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We compiled nearshore marine bird survey data from several long-term monitoring programs conducted across coastal regions within the northern Gulf of Alaska, from Katmai National Park and Preserve on the Alaska Peninsula to Kachemak Bay, Kenai Fjords National Park, Resurrection Bay, and Prince William Sound. We evaluated differences in community composition related to season (summer vs. winter) and location. We also examined temporal trends in a select set of bird species that represent consumers of benthic invertebrates and consumers of forage fish. Overall bird abundance was similar between summer and winter within localized regions but community composition was drastically different between seasons. For example, winter coastal marine communities were characterized by a marked increase in benthic foragers and highlights the importance of nearshore coastal resources to sea ducks that primarily breed in the interior of Alaska but migrate to the coast in winter. Summer marine coastal communities were generally found to support large numbers of forage fish consumers as colonies, absent of marine birds in the winter, were occupied in the summer. We found variation in trends of some species at the regional scale, which suggests that drivers to abundance of marine birds are not coherent across the Gulf of Alaska Large Marine Ecosystem. For other species, however, the lack of variation in trends across regions may indicate Gulf-wide drivers to abundance. Taken holistically, contrasting trends in a variety of species can inform as to the underlying factors driving individual species' abundance and distribution.

Trophic Connections Between Sperm Whales and Their Prey in the Gulf of Alaska

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Understanding a top predator's diet and role in food webs is important to managing fisheries and mammals from an ecosystem perspective. Sperm whales are a top predator interacting with economically important groundfish fisheries in their overlapping habitat offshore in the Gulf of Alaska. While historical diets were largely determined by stomach contents of whales killed by commercial whaling ships, their current diet is largely unknown and potentially biased by fisheries interactions. Recently stable isotope analysis (SIA) has become a viable way to estimate trophic position and food web connections as a proxy for diet. In particular, SIA has been used increasingly in dietary mixing models to estimate contribution of prey to predators' diets. In this study our goal was to use SIA to better understand the trophic position and variability of sperm whale diets, and to estimate the importance of potential prey items to their diets. We used skin samples from 41 sperm whales, as well as 262 tissue samples from seven prey (five groundfish and two squid) species known to have been found in sperm whale stomachs during commercial whaling. Samples were analyzed for stable carbon ($\delta^{13}C$) and nitrogen ($\delta^{15}N$) isotope ratios, and diet composition was estimated using Bayesian isotopic mixing models. Isotopic niche space using Bayesian standard ellipses will also be calculated. Mixing model results isolating samples from whales taken more recent to our study period suggest skates, clubhook squid, rockfish, and sablefish make up the largest proportion of sperm whale diets (31%, 18%, 25%, 12% respectively) in this region, though estimates have high uncertainty. When focusing on more frequently depredating whales, top prey items were reduced to skates and clubhook squid (42% and 23% respectively). This is the first known study to provide a complete isotopic and niche space analysis of these adult groundfish and squid species, as well as of adult male sperm whales in this region. Additionally, it is the first study to attempt to assign proportional contribution of prey species to sperm whale diets, thereby providing information to commercial fishermen and fisheries managers to better understand trophic connections of important commercial species.

Revelations from an Aerial Perspective: How Hungry Whales Work Smarter Not Harder

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During feeding events, humpback whales make calculated and even inventive movements to maximize efficiency in prey aggregation and capture. Their exceptionally long flippers also allow for effective navigation in shallow waters, rapid acceleration, and increased maneuverability. Together, these qualities provide humpback whales with considerable flexibility in terms of their foraging techniques. This flexibility (i.e., behavioral plasticity) is especially important in the Gulf of Alaska, where intraspecific competition may have intensified as a result of increased densities since the end of commercial whaling. Over the past decade, hatchery managers in Southeast Alaska have reported humpback whale predation on newly released juvenile salmon. Multi-year observations at Hidden Falls Hatchery in Chatham Strait suggest that a few individuals have learned how to exploit this unique prey source by regularly incorporating hatchery releases into their suite of foraging tactics. We documented novel feeding behaviors employed by two whales feeding at hatchery release sites and surrounding areas (2016 to 2018). Specifically, we analyzed video footage and photographic sequences to assess the use of humpback whale flippers during foraging events. Innovative technology has enabled aerial perspectives that greatly enhance our understanding about how these dynamic animals aggregate, capture, and manipulate prey. From aerial footage, we found two previously undocumented techniques regarding the use of humpback whale flippers during a bubble net feeding event. We defined this technique as “pectoral herding” with two methods of execution during a lunge: horizontal herding and vertical herding. We believe that the whales we observed used a bubble net to corral hatchery-released salmon, followed by directed movements of their flippers to establish a secondary boundary that further condenses the prey field, increasing foraging efficiency. These observations demonstrate that prey aggregation and capture is not limited to movements of the head, caudal peduncle, and tail flukes. Our results also provide evidence of behavioral plasticity and suggest considerable variation among individual humpback whale foraging strategies. Further investigation would enhance our understanding about whether or not the pectoral herding technique is used as a principle foraging tool across the species as well as the conditions that promote its use.

Assessing Cetacean Populations Using Integrated Population Models: An Example with Cook Inlet Beluga Whales

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Effective conservation and management of animal populations requires knowledge of abundance and trends. For many species, these quantities are estimated using systematic visual surveys. For some animals, additional individual-level data are often collected. Integrated population modelling (IPM) offers a mechanism for leveraging diverse datasets into a single estimation framework. IPMs that incorporate both population- and individual-level data have previously been developed for birds, but have rarely been applied to cetaceans. Here, we demonstrate how IPMs can be used to improve the assessment of cetacean populations. We combined three types of data that are frequently available for cetaceans of conservation concern: population-level visual survey data, individual-level mark-recapture data, and data on anthropogenic mortality. We used the Cook Inlet population of beluga whales (CIBW; *Delphinapterus leucas*) as a case study to demonstrate this approach. Our IPM included: 1) a state-space population process model to describe group size estimates from aerial survey data; 2) a state-space mark-recapture model to describe individual photographic mark-recapture data; and 3) a state-space Poisson regression model to describe historical hunting data. We estimated the current and historical population dynamics of CIBW. The model accounts for groups of animals missed by aerial surveys and, therefore, produces estimates of abundance that are higher than those from a model based on aerial survey data alone. The model points to underreporting of anthropogenic mortality in years when CIBW were hunted, and estimates a lower juvenile/adult survival rate than expected based on comparisons to other cetacean populations. These findings are useful for understanding the demographic sensitivities of the population, and can be used to generate potential future population trajectories. This work demonstrates the value of integrating various data sources to assess cetacean populations and will serve as an example of how multiple, imperfect datasets can be combined to improve our understanding of a population of interest. Our model is broadly applicable to cetaceans and other taxa for which similar data types are available.

Top-Level Carnivores Linked Across the Marine / Terrestrial Interface: Sea Otter Haulouts Offer a Unique Foraging Opportunity to Brown Bears

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Commercial exploitation in the 18th and 19th centuries eliminated sea otters from most of their range including the coastline of what is now Katmai National Park and Preserve (KATM). However, a remnant sea otter population remained north of Cape Douglas, and by the early 1990's sea otters had expanded their range into KATM with the area supporting ~1000 animals. Sea otter abundance has increased approximately seven-fold since the early 1990's and now appears to be approaching carrying capacity. Sea otters along the KATM coast utilize offshore islands as haul out sites where brown bears are also commonly found. Since 2006, we have collected sea otter carcasses from the offshore islands along the KATM coast with most carcasses showing signs of being consumed by brown bears. Population models using the carcass collections as representative sea otter age-at-death data suggest the population should be declining, which contrasts with sea otter surveys that do not suggest a decline over a similar time frame. We deployed remote cameras on two offshore islands and documented brown bears actively preying on both sea otters and harbor seals. We conclude that 1) brown bears occupy offshore islands along the KATM coast to hunt marine mammals, not just to scavenge carcasses, and 2) brown bear predation causes more prime age otter mortality than expected in a typical otter age-at-death distribution, confusing interpretation of population models based on such data. This study highlights a previously under recognized interaction between a top-level marine and terrestrial predator. Future work will focus on the direct and indirect effects these top-level predators have on each other and the intertidal community that connects them.

Ecosystem Implications for the Decline in Reproductive Success in Humpback Whales in the Gulf of Alaska

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Since the marine heat wave in the North Pacific (2014-2016), humpback whales from two feeding areas in the Gulf of Alaska have returned from their winter breeding grounds with significantly fewer calves when compared to the previous decade. In northern Southeast Alaska, the percentage of calves (number of calves/total # of whales identified) seen in 1986, 2004, and 2016 was 7.4%, 7.9% and 2.1%, respectively. In Prince William Sound, humpback whales were monitored in the fall and early winter for 7 years across an 11 year time span, 2007 to 2017. The percentage of calves was highest in 2008 at 10.1%, then dropped to 2.9% in 2011, and 2.4% in 2012. In 2013, the percentage of calves increased to 7.1% followed by a decrease to 0.09% in 2014. In 2017 no calves were seen and a 90% decline in the number of whales was documented relative to the average number of whales identified in the previous 6 surveys. Declines in calving rates could be an indicator of a population not meeting its energetic needs on the feeding grounds. Intraspecific competition for resources and reduced prey availability may necessitate these whales spending more time foraging to meet the energetic demands needed for reproduction. Humpback whales become pregnant during the winter and give birth about a year later. Typically, these whales have a staggered migration with some leaving earlier and some later in winter giving the appearance of whales staying year round. These energetic demands can be met by increasing time on the feeding grounds or skipping a migration altogether. In both of these areas Pacific herring are the preferred prey of humpback whales during the winter months. An increase in the number of whales present during the winter will result in increased pressure on recovering herring populations when whale predation is typically at a minimum. Alternatively, if the Gulf of Alaska fails to recover from the recent ecosystem changes due to 2014-2016 warming event and the abundance of forage species remains low, the humpback whale population may readjust to a new normal with a smaller population.

Managing the Invasive Tunicate, *Didemnum vexillum*, in Sitka, Alaska: Is Eradication Feasible?

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Alaska's relatively pristine coastlines, and the intact marine ecological communities and biological resources within them, are regionally and nationally important. One feature of its largely unspoiled near-shore ecology is that relatively few marine invasions have occurred compared to more southern coastlines. The number of incursions is growing, however, and the detection of *Didemnum vexillum* in Whiting Harbor in 2010 marked an important invasion milestone for the State. *D. vexillum*'s occurrence in Sitka represents a jump of >1000km from its nearest known distribution in British Columbia. It is the only known occurrence of the species in Alaska and is a well-established infiltrator of the hard-bottom community at the site. It is the dominant organism in some locations where it blankets rocky substratum and native sessile organisms, such as seaweeds, polychaetes, bivalves, and native tunicates. These characteristics differentiate *D. vexillum* from other non-native tunicates in the region because it does not rely on artificial structure for high abundance. A collaborative effort has worked to delimit the distribution, remove all infested floating structure from the site, reduce boating interactions with infested areas, and conduct field trials of removal techniques. Experiments in 2015 determined that chlorine was the most effective and practical biocidal agent for benthic treatment. In 2018, we applied biocidal treatments using turbidity curtains to determine removal efficacy over larger areas (tens of square meters). The overall response to this invasion has (i) reduced the opportunity for *D. vexillum* spread into Sitka Sound and its important groundfish habitat, (ii) helped to reduce its prevalence in Whiting Harbor, and (iii) suggests a harbor-wide eradication effort may be feasible.

Boats, Whales, Humans, Dollars: Teasing Apart the Many Dimensions of Juneau's Growing Whale-Watching Industry

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Humpback whales are the primary attraction for Juneau's booming whale-watching industry that has grown to include over 70 commercial vessels and caters to nearly 250,000 tourists each summer. Juneau now boasts the largest whale-watching industry in the State and is among the largest in the world. This industry generates substantial economic revenue for Juneau and provides hundreds of seasonal job opportunities. However, as vessel activity around whales has increased along with passenger traffic in local harbors, so too have concerns for 1) the welfare of whales being exposed to heightened vessel traffic and 2) the community culture and infrastructure having to adapt to accommodate this growing industry. Here, we consider recent and ongoing research to help explain the complicated dynamics at play related to this industry and identify the elements that are problematic and further, which elements can be managed. We discuss options and hurdles in managing this wildlife resource, including impact to wildlife, existing legal protections, human dimensions, and an update on existing programs and efforts to alleviate issues within this industry. Specifically, we highlight the Whale SENSE program, a voluntary stewardship and recognition program for whale-watching operators developed on the East Coast and adapted to Alaska in 2015. Participants in the program agree to: operate vessels responsibly and with precautions above and beyond regulations, encourage ocean stewardship by setting an example for other boaters and by providing educational and conservation material to passengers, and notify appropriate networks of marine mammals in distress. Participants are then recognized for their efforts through branding and local outreach. In Juneau, the program has been adopted by nearly all whale-watching tour outfits and, based on industry feedback, has worked to improve vessel behavior, education, collaboration, and stewardship within the industry. Still additional tools may be necessary to address additional angles of this complex management challenge. By presenting a holistic approach to Juneau's whale-watching industry, which considers biological and human dimensions as well as management obligations and limitations, we hope to provide a case study which includes practical management tools that could be explored for other similar resource management challenges.

The First Ocean Guardian School Program in Alaska: Inspiring Marine Stewardship in Schools

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The Ocean Guardian School Program started in 2010 in California as a joint effort between the National Oceanic and Atmospheric Administration (NOAA), National Marine Sanctuaries (NMS) and NMS Foundation as a commitment to the protection and conservation of local watersheds, the world's ocean, and special ocean areas, like national marine sanctuaries. Schools commit to and implement a school- or community-based conservation project. Schools can take one of five project pathways, which include reducing marine debris, recycling, watershed restoration, creating schoolyard habitats, or reducing energy use. During the 2018-2019 school year, the National Marine Fisheries Service Alaska Region is partnering with NMS and local schools to pilot this program in Juneau. Thunder Mountain High School and Sayiék Gastineau Community School are participating; both will become official Ocean Guardian Schools in May 2019 if they achieve their desired program outcomes. In the process, students will learn about marine conservation, collect measurable data, and communicate their findings to their school and community. Both schools have committed to reducing single-use plastics, conducting waste audits, cleaning up Juneau beaches, and educating students, teachers, and the community about the impacts of marine debris on watersheds, the ocean, and on the wildlife that inhabit these areas. Thunder Mountain High School will coordinate and improve a recycling program, reduce single-use water bottle use, and sell new reusable water bottles and jewelry made from marine debris (proceeds will go toward future Ocean Guardian projects). Sayiék Gastineau Community School will reduce single-use plastic by replacing plastic sporks with reusable silverware donated by students, their families, and the community. These are the first two schools to commit to this program in Alaska; ultimately, the goal is to expand the Ocean Guardian School Program to other parts of the state. If children become marine stewards at a young age, there is a high likelihood they will continue to protect the ocean as they become adults. For more information visit: https://sanctuaries.noaa.gov/education/ocean_guardian/.

Paralytic Shellfish Toxins in Butter Clam Tissues and Effect of Cleaning Methods Used by Kodiak Harvesters (Component of NPRB Project 1616)

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Bivalve shellfish remain a dietary and culturally important food source for many Kodiak Island residents, despite risks of Paralytic Shellfish Poisoning (PSP) from eating untested shellfish. Efforts are underway to develop a safe harvest program through monitoring, development of responsive testing, and effective messaging. This study 1) assesses distribution of saxitoxins in Butter Clam tissues and 2) evaluates cleaning methods derived from traditional knowledge. For objective 1, Butter Clam tissues were dissected into four categories: black siphon tip; neck (lower siphon); gut (with contents); and remaining body (foot, gills, remaining digestive tissues, and adductor muscles). Toxins were analyzed by HPLC, yielding total toxin concentration and quantification of the different saxitoxin congeners. Results showed great variability in toxin distribution among tissues, with seasonal changes in congener distribution. At one site in Chiniak Bay, for instance, highest toxicities were observed in the gut of clams collected in June 2016, a pattern consistent with the surge in *Alexandrium* abundance and shellfish toxicity during the regional warming event impacting the Gulf of Alaska and Aleutians in 2014-2016. Analysis of saxitoxin congeners showed the high toxicity was driven mainly by Gonyautoxins, compounds present in *Alexandrium* cells, that are converted to Saxitoxin and neoSaxitoxin during clam digestion and incorporation. Such conversion was exemplified the following spring, when toxicities were highest in the siphons, with the most prevalent congeners being neoSaxitoxin and Saxitoxin. Similar patterns were seen in other samples. For objective 2, we compared three cleaning methods used by local harvesters, with Butter Clam tissues separated into “edible” and “non-edible” fractions based on traditional knowledge. On average, discarding tissues deemed inedible via the three methods reduced overall clam toxicity by 60.3%, 46.6% and 59.1%, respectively. While all three cleaning methods reduced overall clam toxicity, high toxin levels still remained in edible tissues. Results varied with location and season, anatomical distribution of toxins, individual clam toxicity and precision of cleaning. However, it is demonstrated that removing certain tissues can reduce exposure to PSP toxins in Butter Clams. Work in this direction continues, with the goal of providing guidance to help reduce PSP risk in southwest Alaska.

Pacific Herring Trophodynamics and Fisheries in the Southeastern Gulf of Alaska

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Pacific herring (*Clupea pallasii*) is a common Northeast Pacific forage fish consumed by diverse predators. These include protected seabirds and marine mammals along with numerous commercial fishes. Furthermore, herring supports many Alaskan communities through commercial, subsistence, and aboriginal fisheries. Given the recent poor status of many Gulf of Alaska (GoA) herring stocks, humpback whale recovery, and calls for ecosystem-based forage fisheries management, there is a clear need to evaluate the impacts of herring and its fisheries on Alaskan food webs.

This large study examined herring trophodynamics in the southeastern GoA and its impacts on fisheries management through four lines of inquiry, each yielding specific results and contributing to the overall conclusion. Firstly, we constructed a set of high-resolution, mass-balanced ecosystem models for an area including portions of Southeast Alaska and northern British Columbia. These models indicate strong trophic interactions connect herring to its predators and prey. Secondly, we investigated local whale depletion and recovery trajectories, and the historical and current roles of whales as consumers, in surplus production and ecosystem models, respectively. Dynamic ecosystem simulations suggest whale recovery could exert top-down effects on herring and indirect impacts on dependent predators. Thirdly, we employed management strategy evaluation, combined with ecosystem simulations, to comparatively evaluate potential impacts of herring fisheries management strategies on dependent predators and ecosystem structure. Results indicate sharp tradeoffs between herring and many predator biomasses on one hand and high, stable herring catches on the other, as well as potential compromise solutions. Finally, we investigated potential positive effects of high adult herring energy content on the trophic importance of herring in energy-balanced ecosystem models, reformulated from their current mass-balanced counterpart using a novel methodology. Static and dynamic analyses in these models indicate that elevated energy content increases predator dependence on herring. These lines of inquiry yield the overall conclusion that herring, while part of a diverse forage fish guild, nevertheless exercises a key role in southeastern GoA ecosystems as a food web node channeling energy from zooplankton to higher predators. Many of these depend on herring to maintain healthy populations, creating management tradeoffs for commercial herring fisheries in Alaska.

Physiological and Gene Transcription Assays in Combination: A New Paradigm for Marine Intertidal Assessment

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Coastal regions of Alaska face increasing management concerns due to natural and anthropogenic forces that have the potential to significantly degrade nearshore marine resources. New technologies can be applied to expand our ability to evaluate ecosystem health. We combined physiological biomarker analysis with gene transcription assays and applied the techniques to two coastal bioindicator species, the Pacific razor clam (*Siliqua patula*) and the bay mussel (*Mytilus trossulus*), to evaluate ecosystem vulnerability to multiple, interacting stressors. The objectives of this study were to: (1) acquire baseline biomarker and gene transcription data for the razor clam and bay mussel across sites in the Gulf of Alaska, (2) assess the relationship between biomarker and gene transcription assays, and (3) assess applicability of these techniques to evaluate the physiological status of clams and mussels in different coastal areas. Bivalves were sampled in 2015 and 2016 from 6 intertidal sites in Lake Clark and Katmai National Parks and Preserves in southcentral Alaska. Biomarker and gene transcript reference ranges were determined for use in future assessment efforts. Differences in biomarker assay and gene transcription results were identified between parks, years and sites and indicated both large-scale and local environmental variations. The implementation of this holistic approach to assess bivalves as indicators of ecosystem condition will be advantageous to researchers, because the collective results provided more comprehensive information about bivalve condition than one method alone. We also emphasize the need for controlled studies to examine the range of variability in biomarkers and gene transcripts and how they co-vary in individual bivalves.

Ecological Relationships Between Recovering Sea Otters and Eelgrass Communities in Southeast Alaska

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The reintroduction of sea otters to southeast Alaska in the late 1960s and subsequent population expansion has raised many questions on the impact and role of sea otters in nearshore ecosystems. Sea otters are voracious predators that threaten many commercial, recreational and subsistence fisheries. Alternately, sea otters are known to confer positive ecosystem effects in kelp forests via a trophic cascade. The relationship between sea otters and kelp is well understood, however, sea otters inhabit many other nearshore habitats where their effects are less known. Southeast Alaska contains nearly 10,000 km of seagrass coastline with and more than 25,000 sea otters, providing an opportunity to investigate the role of sea otters in across a fairly common nearshore habitat. Recent studies in California and the Baltic Sea suggest that top predators, including sea otters, may indirectly benefit the seagrass, eelgrass (*Zostera marina*), through a trophic cascade. Building off this research we investigated the relationships among sea otters and eelgrass community constituents in southeast Alaska to assess the generality of trophic cascade patterns seen in other systems. Our observations across a gradient of sea otter abundance followed many of the patterns predicted from other studies. We found that sea otters were associated with greater eelgrass biomass and reduced crab biomass and that greater crab abundance as associated with more eelgrass epiphytes. Greater grazer abundance was associated with greater eelgrass biomass, and increased eelgrass epiphyte load was associated with reduced eelgrass biomass. These results support the trophic cascade patterns seen it other eelgrass systems; however, we found no relationship between crabs or fishes with epiphyte grazers, a critical link in the hypothesized trophic cascade. To date this link is unresolved but given the abundance of crabs and fishes in southeast Alaska eelgrass communities further investigation is needed. Future work will examine these relationships in greater detail through biomarker analysis and manipulative experiments.

Development of Socio-Ecological Conceptual Models as the Basis for an IEA Framework in Southeast Alaska

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Integrated Ecosystem Assessment (IEA) is a framework that organizes and summarizes science to aid in the transition from a traditional single sector towards a holistic management approach known as Ecosystem Based Management (EBM). An essential step of the IEA framework is the development of conceptual models. These models allow the integration of intrinsically linked social, environmental and biological components of marine ecosystems which is pivotal to address unsolved questions in fisheries management. We constructed socio-ecological conceptual models of relevant commercial and subsistence fisheries for Sitka, a fisheries-based community in Southeast Alaska, by collecting and synthesizing available scientific information and local ecological knowledge (LEK). The latter was achieved by conducting focus group workshops with key informants in Sitka who had in-depth knowledge of their community's interactions with local fisheries and the structure and function of the surrounding ecosystem. The resulting models co-produced by scientists and Sitka stakeholders, illustrate the main biological and environmental factors driving the abundance of Pacific halibut (Hippoglossus stenolepis) and Pacific herring (Clupea pallasii) fisheries in Southeast Alaska. Furthermore, these co-produced models elucidate how the interaction between Sitka residents and these fisheries affect community well-being. Our models will serve as the basis to assess EBM objectives for Sitka as part of an IEA place-based framework. This study also highlights the importance of integrating LEK into science and potentially, into the broader Alaska fisheries management structure.

WEDNESDAY, JANUARY 30, 2019

BERING SEA & ALEUTIAN ISLANDS
PLENARY SESSION

PLENARY SESSIONS: WEDNESDAY, JANUARY 30 — BERING SEA & ALEUTIAN ISLANDS

TIME	TITLE	PRESENTER	SECTION
8:00 - 8:15	Impact of local biogeochemical processes and climate variability on ocean acidification in the Bering Sea	Darren Pilcher	Climate & Oceanography
8:15 - 8:30	Coupled tide, storm surge and wave modeling under varying ice coverages along Alaska's Bering, Chukchi and Beaufort coasts	Joannes Westerink	Climate & Oceanography
8:30 - 8:45	Downward organic carbon flux, average particle sinking speed, and the role of particle-associated microbial respiration on the Bering and Chukchi shelf	Stephanie O'Daly	Climate & Oceanography
8:45 - 9:00	Tracking benthic bivalve population shifts: Changes in recruitment and dominant size classes of Macoma calcarea and Nuculana spp. in the Northern Bering Sea from 1998-2015	Christina Goethel	Lower Trophic Levels
9:00 - 9:15	How many krill are there in the eastern Bering Sea and Gulf of Alaska?	Patrick Ressler	Lower Trophic Levels
9:15 - 9:30	Observations of Alaskan juvenile crab (Chionoecetes spp.) energetic condition from the last Bering Sea cold pool: effects of temperature and food quality.	Louise Copeman	Fishes & Fish Habitats
9:30 - 10:00	COFFEE BREAK		
10:00 - 10:15	Effects of ocean acidification on snow crab larvae: Carryover effects from embryogenesis and oogenesis reduce direct effects on larval survival	William Long	Fishes & Fish Habitats
10:15 - 10:30	Forecast skill for predicting distribution shifts: A retrospective experiment for marine fishes in the Eastern Bering Sea	James Thorson	Fishes & Fish Habitats
10:30 - 10:45	Salmon homing in time and space: Factors influencing fine-scale homing in wild Alaskan sockeye salmon (O. nerka)	Samuel May	Fishes & Fish Habitats
10:45 - 11:00	Late stage marine mortality of Chinook salmon helps explain observed changes in age structure of Chinook salmon returns	Kaitlyn Manishin	Fishes & Fish Habitats
11:00 - 11:15	Effects of increased salinity in coastal wetlands on threatened Steller's eider (Polysticta stelleri) and spectacled eider (Somateria fischeri) ducklings	Tuula Hollmen	Seabirds
11:15 - 11:30	Genetic assignment of Northern Fulmar bycatch reveals contributions from major breeding colonies	Jessie Beck	Seabirds
11:30 - 1:00	LUNCH (ON YOUR OWN)		
1:00 - 1:15	Seabird mortality events in the Bering Sea	Timothy Jones	Seabirds
1:15 - 1:30	Observations during a springtime Bering Sea research cruise in a year of record-low sea ice extent.	Michael Cameron	Marine Mammals
1:30 - 1:45	Compound specific nitrogen isotope ratios of amino acids in Steller sea lion whiskers reflect seasonal changes in baseline isotope values in their Alaska marine food webs.	Lorrie Rea	Marine Mammals
1:45 - 2:00	Unmanned surface vehicles map prey landscapes to elucidate northern fur seal behavioral responses to prey availability	Carey Kuhn	Marine Mammals
2:00 - 2:15	Surveying harbor seals in the Pribilof Islands with advanced drone imagery	Josh M. London	Marine Mammals
2:15 - 2:30	Piloting sUAS for harbor seal monitoring in the Pribilof Islands: a collaboration between tribal and federal governments	Lauren Divine	Marine Mammals
2:30 - 3:00	COFFEE BREAK		
3:00 - 3:15	Marine mammal co-Management in Alaska: Recommendations for effective relationships Dual permit operations in the Bristol Bay Pacific salmon drift gillnet fishery	Jennafer Malek	Human Dimensions
3:15 - 3:30	Dual permit operations in the Bristol Bay Pacific salmon drift gillnet fishery	Marcus Gho	Human Dimensions
3:30 - 3:45	Community connections: Bringing place-based science into classrooms to strengthen student understanding	Jessica Cobley	Ecosystem Perspectives
3:45 - 4:00	Communication, collaboration, and transparency: How ecosystem science informs fisheries management in times of change	Stephani Zador	Ecosystem Perspectives
4:00 - 4:15	Reconstructing decades of food web structure in the North Pacific and Bering Sea using bulk and compound-specific stable isotope analyses from archived northern fur seal teeth	Carolyn Kurle	Ecosystem Perspectives
4:15 - 4:30	Innovative tools for ecosystem research	Calvin Mordy	Ecosystem Perspectives
4:30 - 4:45	Ecosystem stress test: what an ice-free winter might mean for the eastern Bering Sea	Janet Duffy-Anderson	Ecosystem Perspectives

Impact of Local Biogeochemical Processes and Climate Variability on Ocean Acidification in the Bering Sea

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The Bering Sea is highly vulnerable to OA due to naturally cold, low carbonate concentration waters. Expected negative impacts of OA to marine organisms therefore pose a significant threat to this highly productive marine ecosystem. However, harsh weather conditions within this rapidly changing environment hamper longterm observational monitoring. Well-validated biogeochemical models are a useful tool to help support observational efforts and provide skillful projections of OA on multiple timeframes. We add carbonate chemistry to a regional biogeochemical model of the Bering Sea to explore the underlying mechanisms driving carbon dynamics over a decadal hindcast (2003-2012). The results illustrate that local processes generate considerable spatial variability in the biogeochemistry and vulnerability to OA of Bering Sea shelf water. Substantial seasonal biological productivity maintains highly supersaturated carbonate saturation states (Ω) on the outer shelf, whereas freshwater runoff from major river systems with relatively corrosive water decrease Ω to values below 1 on the inner shelf. Over the entire model hindcast, annual surface Ω decreases by 0.1-0.3 units due to positive trends in ocean carbon concentration. Variability in this trend is driven by variability in primary productivity occurring during the transition from a relatively warm (2003-2005) to cold (2010-2012) temperature regime. Nonetheless, these trends in seawater chemistry are robust throughout most of the Bering Sea shelf, suggesting that the OA signal may be distinguishable from natural variability on decadal timeframes.

Coupled Tide, Storm Surge and Wave Modeling Under Varying Ice Coverages Along Alaska's Bering, Chukchi and Beaufort Coasts

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Coastal Alaska spans over 54,000 km with highly diverse geography ranging from sharp volcanic relief in the south to low lying deltas and tundra in the west and north. The exceptionally broad Bering Sea shelf, intricate coastal geometry, low lying topography, and large energetic late fall and winter extratropical storms make western Alaska especially vulnerable to storm surge. In the Bering, Chukchi, and Beaufort Seas sea ice is present for a significant portion of the year and there is strong inter and intra annual variability in the ice coverage. The effect of sea ice as it relates to large scale hydrodynamic processes such as tides and storm surges leads to significant uncertainty in coastal water levels during strong storm events which occur during ice covered periods.

We have worked to develop an accurate and robust computational model of the Alaskan coastal hydrodynamics capable of simulating tides and storm surge with particular focus on how varying ice coverages impact storm surge. In order to accurately model these processes throughout the whole region we use the coastal circulation model ADCIRC. ADCIRC is a well validated finite element model which can take advantage of a high resolution unstructured mesh to capture the complexity of the geography and topography of the region as well as the range of important hydrodynamic processes. The inclusion of ice coverage into the model has been investigated using a number of approaches, including a modification of the wind drag coefficient in the presence of ice and using ice drift speeds to directly compute sea ice stresses. This talk will focus on the current state of our tide and storm surge model for Alaska and planned future work such as directly coupling to wave and sea ice models.

Downward Organic Carbon Flux, Average Particle Sinking Speed, and the Role of Particle-Associated Microbial Respiration on the Bering and Chukchi Shelf

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The continental shelf of the Bering and Chukchi seas is an important location for carbon burial globally. Export and remineralization of particulate organic carbon (POC) modulate dissolved inorganic carbon concentrations in the ocean and the fluxes of CO_2 between the ocean and the atmosphere. A drifting sediment trap was deployed to collect and quantify sinking particle fluxes at 30 m depth at seven locations in the Bering and Chukchi seas ranging from 35 to 57 m water depth in June of 2018. Particles collected were either incubated to determine microbial remineralization rates or analyzed for elemental fluxes. Average particle sinking velocity was estimated by relating flux to concentration, collected using a combination of optical instruments. We compared remineralization rates of sinking particles with average particle sinking speed and water column depth to determine the effect of mid-water column remineralization of particles on total organic carbon flux. The intraannual variability of flux was examined at two of these stations using two sequential sediment traps moored, one at N4, at 37 m depth and 49 m water depth, and the other at N6, at 35 m depth and 50 m water depth, from June 2017 to June 2018. Flux estimates from the floating sediment trap range from 172 to 2204 mg POC m^{-2} d^{-1}, and were shown to be greater in Bering Shelf Water compared to Alaska Coastal Water. Annual POC flux at N4 and N6 were 200.1 g POC m^{-2} y^{-1} and 202.1 g POC m^{-2} y^{-1}, respectively. Mid-water column microbial remineralization was not found to substantially affect the amount of POC reaching the benthos in this region. These pieces of marine carbon cycle science will help characterize the fate of organic carbon within the water column in this region.

Tracking Benthic Bivalve Population Shifts: Changes in Recruitment and Dominant Size Classes of *Macoma calcarea* and *Nuculana sp.* in the Northern Bering Sea from 1998-2015

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The northern Bering Sea is experiencing rapid change with declining sea ice extent and warming surface and bottom waters. Biomass declines and northward shifts in benthic macrofaunal biomass hotspots, together with modification of predation patterns are likely influenced by these environmental changes. We examined five time-series stations in the Distributed Biological Observatory (DBO) Region 1 in order to track changes in the dominant size class of bivalves from 1998-2015 as they relate to a suite of environmental indices such as annual days without sea ice cover, bottom water temperature, and sediment parameters including sediment chlorophyll-a and grain size. Decreases in the abundance and biomass of the bivalve, *Macoma calcarea*,in the DBO1 region south of St. Lawrence Island have been identified over the past decade at the most southern time-series stations in the DBO1 region. By contrast, in the 1950s and 1960s, *M. calcarea* was the dominant species in the DBO1 region, but *Nuculana radiata* replaced it in the late 1980s. More recently (early 2000's) *M. calcarea*, has again become dominant over *Nuculana sp.*

These bivalves are prey for upper trophic level predators, such as spectacled eiders (*Somateria fischeri*) and Pacific walrus (*Odobenus rosmarus divergens*). The size of individual bivalves and the abundance of each bivalve size class provides insights about recruitment within the population and the growth and sustainability of the population through time. Additionally, there is typically a size class that these benthivorous predators prefer that allows for optimal foraging and caloric intake. Our results to date (2000-2006) indicate that the larger and more optimal individuals of *M. calcarea* are most abundant at the more northern stations within DBO1, which could represent a shrinking foraging ground. Because of the foraging site fidelity of spectacled eiders, this food supply decrease could impact eider feeding south of St. Lawrence Island where the world's population of this duck (>300,000 individuals) annually forages between October and April. On the other hand, walrus can move north with the sea ice edge as it retreats to feed on other prey patches, so they may be less vulnerable to shifts in benthic macrofaunal food supplies.

How Many Krill Are There in the Eastern Bering Sea and Gulf of Alaska?

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Euphausiids ('krill') are a globally important group of zooplankton and key prey for important fishes in the Bering Sea and Gulf of Alaska. Data collected during acoustic-trawl surveys of walleye pollock (*Gadus chalcogrammus*) can be used to estimate krill (mainly *Thysanoessa* spp.) abundance and distribution, but precisely quantifying the true abundance of krill in these systems remains a challenge. At present, net capture and acoustic-trawl estimates of krill abundance differ widely, and we hypothesized that major factors for this difference include krill avoidance of towed samplers and uncertainty or negative bias in krill target strength (TS, the acoustic backscatter from a single krill) estimated by scattering models. To evaluate these hypotheses, we a) conducted paired trawl experiments with and without flashing strobe lights to assess the magnitude of net avoidance, b) parameterized, modelled, and measured the TS of live krill aboard ship, and c) analyzed intact lipid class content and distribution of the same krill specimens. Preliminary results show that krill catches in trawls (g/m^3) with strobe lights averaged 2x (night) to 4x higher (day), consistent with the effects of net avoidance. TS model estimates compared well with measured TS at some frequencies but were substantially lower at the frequency used for abundance estimates (120 kHz). Total lipid content (mg/g) varied among krill individuals, but lipid classes showed less variation and consisted largely of phospholipids. Adjustments for net avoidance and improvements in krill TS estimates will enhance agreement between net samples, acoustic estimates, and ecosystem model predictions. This will improve our understanding of energy flow from lower trophic levels to fisheries.

Observations of Alaskan Juvenile Crab (*Chionoecetes spp.*) Energetic Condition from the Last Bering Sea Cold Pool: Effects of Temperature and Food Quality

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Over the last three decades, the geographic range of snow crab (*Chionoecetes opilio*) in the Eastern Bering Sea (EBS) has contracted to the north. This change has been related to near-bottom temperatures and contraction of the cold pool (< 2°C bottom water). During years of extensive sea ice formation, the cold pool extends to the southeastern middle shelf (~56°N) while during years of low sea ice formation the cold pool contracts to the northwest (~60°N) and in recent years has been completely absent (>2014). One mechanism postulated to account for some of the northward shift in the snow crab population is juvenile stenothermy. Through both laboratory experiments and field collections, we examined the effect of temperature on juvenile *Chionoecetes sp.* growth rates, condition (lipid content), and trophic fatty acid biomarkers. In lab experiments, Tanner crabs (*Chionoecetes bairdi*) reared at 2°C had slower growth rates but higher lipid content than crabs reared at 9°C. Field collected juvenile crabs had elevated lipid storage during 2012 (cold year) compared to 2014 (warm year), however, this effect was more dramatic in regions with a larger change in bottom temperature. Crab fatty acid biomarkers indicated that elevated condition in juvenile crabs was positively correlated with the proportion of diatom-sourced lipid storage across both years. Crabs had the highest lipid density and diatom-sourced storage in the central cold pool during 2012. In contrast, during 2014 crabs had lower total lipid storage and higher proportions of flagellate-sourced markers in their lipids. We combined these data with measurements of chlorophyll a and plankton cell size to show that shifting temperatures in the EBS may result in the reduction of food quality and thus condition of juvenile *Chionoecetes spp*. The mechanism behind reduced lipid storage in juvenile crabs appears to be a combination of direct thermal stress and co-occurring food web change. Additional data on crab condition in the EBS during cold and warm years could help clarify this relationship.

Effects of Ocean Acidification on Snow Crab Larvae: Carryover Effects from Embryogenesis and Oogenesis Reduce Direct Effects on Larval Survival

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Ocean acidification, a decrease in ocean pH with increasing anthropogenic CO_2 concentrations, is expected to affect many marine animals.We determined the effects of ocean acidification on the economically important snow crab, *Chionoecetes opilio*.By holding females in treatment pH for two brooding cycles (two years) and using the resulting larvae, we assessed carryover effects from oogenesis and embryogenesis. Ovigerous females were held at three pHs: ~8.1 (Ambient), 7.8, and 7.5.When larvae hatched from each treatment, they were exposed to similar pH treatments in a fully crossed experimental design. Starvation-survival, morphology, condition, and calcium/magnesium content were assessed for larvae in both years.In the first year, starvation-survival of larvae reared at ambient pH but hatched from embryos reared at low pH was reduced; however, the negative effect was eliminated when the larvae were reared at reduced pH.In the second year, there was no direct effect of either embryo or larval pH treatment, but larvae reared as embryos at reduced pH survived longer if reared at reduced pH.Larvae hatched from embryos held at pH 7.5 had lower calcium content in the first year but not the second year.There was no effect of larval treatment on calcium content or effect of embryo or larval treatment on magnesium content in either year.Larvae hatched from embryos held at 7.5 had a slightly lower mass in the first year but not the second, and those from pH 7.8 embryos had a slightly lower mass in the second year but not first and there was no effect of larval treatment on mass in either.Carbon and nitrogen content varied among treatments but effect sizes were small and there were no clear patterns. These results suggest both that larvae are highly tolerant of low pH, and that embryos are not only able to acclimate to low pH but that this effect carries over to the larval stage.

Forecast Skill for Predicting Distribution Shifts: A Retrospective Experiment for Marine Fishes in the Eastern Bering Sea

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Forecasting distribution shifts under novel environmental conditions is a major task for ecologists and conservationists. Researchers forecast distribution shifts using many tools:predicting from an empirical relationship between a summary of distribution (population centroid) and annual time-series ("Annual Regression", AR); or fitting a habitat-envelope model to historical distribution and forecasting given predictions of future environmental conditions ("Habitat envelope", HE).However, surprisingly little research has estimated forecast skill for distribution shifts by fitting to historical data, forecasting distribution shifts, and comparing forecasts with subsequent observations of distribution shifts.I demonstrate the role of retrospective skill testing by forecasting poleward movement over 1, 2, or 3-year periods for 20 fish and crab species in the Eastern Bering Sea, and comparing forecasts with observed shifts.I specifically introduce an alternative vector autoregressive spatio-temporal (VAST) forecasting model, which can include species temperature responses, and compare skill for AR, HE, and VAST forecasts.Results show that the HE forecast has 30-43% greater variance than predicting that future distribution is identical to the estimated distribution in the final year (a "persistence" forecast). Meanwhile, the AR explains 2-6% and VAST explains 8-25% of variance in poleward movement, and both have better performance than a persistence forecast.HE and AR both generate forecast intervals that are too narrow, while VAST models with or without temperature have appropriate width for forecast intervals.Retrospective skill testing for more regions and taxa should be used as a test-bed to guide future improvements in methods for forecasting distribution shifts.

Salmon Homing in Time and Space: Factors Influencing Fine-Scale Homing in Wild Alaskan Sockeye Salmon (*O. nerka*)

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The homing ability of salmonids has led to extensive local adaptation within large metapopulations. However, the fine-scale resolution at which homing occurs in both space and time remains largely unknown. Addressing the scale and interactions of geographic and temporal homing has important implications for rates of inbreeding, the extent of local adaptation, and the amount of gene flow within populations. In Sockeye and Chinook salmon, there is limited evidence that individuals return within short distances from where they hatched. There is also evidence that salmon home temporally, returning to spawn at the same time as their parents. Here we examine two populations of sockeye salmon in the upper Wood River System, Bristol Bay, Alaska over several generations to elucidate patterns of fine-scale homing on the scale of tens of meters, using daily measures of in-creek location. We developed a “genotyping by thousands” (GTseq) amplicon panel, and then used this panel to reconstruct a three-generation pedigree of adults returning to two small streams, 1km from each other. This pedigree was then used to examine the spatial and temporal distribution of relatives within a cohort in each stream, using genetic spatial autocorrelation approaches. We then investigated the role of factors such as sex, age, size, population density, return timing, and redd location on homing, using mixed effects generalized linear models. Here, we discuss these results in the context of implications for gene flow, inbreeding, and local adaptation within populations.

Late Stage Marine Mortality of Chinook Salmon Helps Explain Observed Changes in Age Structure of Chinook Salmon Returns

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Populations of Chinook salmon (*Oncorhynchus tshawytscha*)have declined in abundance throughout the Pacific Ocean basin and returning adults have decreased in both size and age. The most pronounced shift in age composition of spawning adults has occurred in Alaska, where the proportion of fish that spend 4 winters in the ocean fish has declined and 2- and 3-ocean fish have become the dominant returning age classes. These changes throughout the range of the species suggest a shared perturbation in the common marine environment. The traditional critical period/critical size hypotheses that focus on the first year in the ocean cannot explain the observed trends, thus suggesting some period later in marine stage may play a role. Here we consider investigate how selective mortality later in the marine stage could produce these changes in age composition. To evaluate this question, we utilized an existing stage-structured population dynamics model to simulate the potential impacts of late marine mortality on the age structure of an indicator Chinook salmon population from the Yukon River watershed. The predation scenarios that most closely mimicked observed shifts in age structure of this population focused intense and selective predation during the third year at sea. This result is supported by observations of wild predation events by killer whales and salmon sharks on this ocean age class. These results demonstrate that marine mortality after that first year in the ocean may influence the age structure of adult spawners, which in turn can affect population productivity. Take as a whole, we hope the results of this work will stimulates a critical reexamination of a longstanding hypothesis in salmon biology, which is that the ocean is a fairly safe place for salmon after their first year at sea, during which the year class strength is set.

Effects of Increased Salinity in Coastal Wetlands on Threatened Steller's Eider (*Polysticta stelleri*) and Spectacled Eider (*Somateria fischeri*) Ducklings

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The Yukon-Kuskokwim Delta (YKD) supports large concentrations of breeding water birds and is an ecologically important area for conservation of migratory bird biodiversity in western Alaska. The YKD is one of two breeding areas in Alaska for threatened spectacled (*Somateria fischeri*) and Steller's eiders (*Polysticta stelleri*). Spectacled eiders were listed due to significant declines in breeding population at the YKD, and the area is of critical importance to recovery. Steller's eiders were listed due to reduction in nesting range, and the species has nearly disappeared from the YKD.

Increase in frequency and magnitudeof periodic storm surges on the coastal fringe of the YKD is depositing increasing amounts of saline water into breeding habitats. Because newly hatched waterfowl lack functional salt glands to process saline water, increases in salinity levels may negatively impact growth and survival of ducklings. We investigated potential demographic impacts of wetland salinization on eiders by conducting controlled experiments to determine consequences of saline water exposure to newly hatched spectacled and Steller's eider ducklings. We exposed ducklings to realistic concentrations of salinity and determined clinical responses, effects on growth, tolerance thresholds, and developmental age of salt gland functionality.

We observed no clinical abnormalities in ducklings exposed to 3ppt salinity, but discovered physiological and behavioral pathologies at exposure levels of 6ppt. We did not allow ducklings to die before intervening, but our observations suggest that young ducklings cannot survive on 6ppt salinity water. Even after intervention and return to salinity, ducklings reared on salt water were lighter than controls (although differences were not significant). Salt glands became functional at < 1 week of age when ducklings were exposed to low concentrations of salinity but we suggest that they could not compensate for salinity >3ppt and the lower growth rate suggest an energetic consequence of living in saline conditions. The tolerance thresholds are directly applicable to analysis of habitat suitability using existing maps of wetland salinity and known eider breeding distribution. These data in combination with salinity measurements taken across the YKD suggest that some portion of the breeding range may be unsuitable for rearing ducklings in some years.

Genetic Assignment of Northern Fulmar Bycatch Reveals Contributions from Major Breeding Colonies

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Pacific Northern Fulmars (*Fulmarus glacialis rodgersii*) overlap with U.S. North Pacific groundfish fisheries while foraging, resulting in incidental take of thousands of fulmars annually. The majority of these birds breed at four major colonies in the Bering Sea (Pribilofs, St Matthew, Hall Is.), western Aleutians (Chagulak Is.) and Gulf of Alaska (Semidi Is.). Previously, it was demonstrated that, despite low levels of genetic differentiation, a set of 141 genetic markers can be used to link individual fulmars back to their natal colonies (Baetscher et al. unpublished data). We used these genetic markers to generate reference data from the four breeding colonies for genetic stock identification to evaluate the colony of origin for 1,536 Northern Fulmars caught as bycatch between 2006 and 2016. After quality filtering genotype data, 1,501 bycatch samples remained in the dataset and 47% of birds were assigned to one of the four colonies at a 90% likelihood (high confidence) threshold. Of these birds, 35% originated from the Semidi Islands, 20% from the Pribilof Islands, 25% from St. Matthew and Hall Islands, and 20% from Chagulak Island. Using a 50% likelihood (medium confidence) threshold, we were able to assign 91% of the bycatch birds. With this threshold, 35% were linked to the Semidi Islands, 22% from the Pribilof Islands, 25% from St. Matthew and Hall Islands, and 18% from Chagulak Island. These results suggest that among the samples tested, bycatch is not equally distributed among breeding colonies and is not proportional to colony size. This is particularly true for the Pribilof Islands, which comprise less than 10% of the overall breeding population of the species but make up about a fifth of the bycatch specimens sampled. Spatial and temporal collection information paired with genetic stock identification can help elucidate potential impacts of bycatch to individual colonies and the overall population of Pacific Northern Fulmars.

Seabird Mortality Events in the Bering Sea

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Recent research has highlighted that the frequency and magnitude of animal mass mortality events have increased over the last half a century, and that mortality events are likely to become more frequent with an increasingly variable climate and increases to both anthropogenic and natural (i.e. disease) forcing factors. Since 2014 the north Pacific has experienced multiple seabird mass mortality events, of which the Bering Sea has been particularly affected, with die-offs in 2015 (Common murres), 2016 (Tufted puffins), 2017 (Shearwaters and Northern Fulmars) and 2018 (Murres). These events were coincident with the transition from predominantly cool to warm ocean conditions in the Bering Sea, indicated by reductions in sea ice extent, alterations to the extent of the cold pool, and overall warmer sea surface temperatures compared to climatological averages. While the recent succession of seabird die-offs were coincident with the transition to warmer conditions in the Bering Sea, the link between elevated sea temperatures and the observed effects on seabirds is currently poorly understood. In this presentation, we use data from a citizen science program focused on beached birds (COASST), as well as information from coastal communities and the U.S. fish and wildlife service to provide an overview of seabird mortality events affecting the Bering Sea over the last five years, and draw comparisons with other recent events in the north Pacific, as well as historically documented events that have affected the Bering Sea. Our aim is to instigate discussion on potential mechanisms that may have caused recent events, and to solicit for/identify opportunities for collaborative cross-disciplinary research into these events. We feel that it is critical to develop a network of communication and collaborative research, inclusive of seabird, marine mammal, and fisheries biologists as well as biological/physical oceanographers and ecosystem modellers to provide a more comprehensive examination of current patterns and critical knowledge gaps, so that we are better prepared to investigate, address and respond to these events in the future.

Observations During a Springtime Bering Sea Research Cruise in a Year of Record-Low Sea Ice Extent

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A warming climate is predicted to reduce the volume, extent and duration of Arctic sea ice. Ribbon, bearded, ringed and spotted seals ('ice seals') use sea ice in the spring as a platform for giving birth and nursing young. Hauling out also helps seals to raise their skin temperature, facilitating the molting process. In April 2014, 2016 and 2018, we conducted research surveys at the Bering Sea ice edge. Our primary objectives were to collect samples and measurements from ice seals and to deploy seal-borne satellite-tags to record the seals' movements. In April 2018, the southern ice edge was nearly 375 km farther north than in previous years, approximating conditions predicted by climate models after 2050. 2018 might therefore prove useful as a case-study for a future Bering Sea.

In 2014 and 2016, most of our sightings in the marginal ice zone were of ribbon seals, so we were surprised to observe almost no ribbon seals hauled out on floes at the more northerly ice edge in 2018. There were no reports of ribbon seals hauling out on shore in numbers that would explain their very low abundance at the ice edge, so it seems possible that ribbon seals moved west to occupy sea ice remaining in Russian waters. April is the peak of pupping for ribbon seals and they are not known to give birth or nurse pups in the water. If they instead opted to remain in their typical breeding areas near the shelf break, they would likely have suffered a significant pup production failure due to lack of ice in that region.

Despite low sample sizes, there is evidence for a decline in the body condition (mass/length; n = 32) and blubber thickness (n = 30) of spotted seal pups over the period 2014-2018 ($p<0.05$). The reasons for these declines are not yet known, but a more northerly ice edge would require nursing mothers to occupy areas farther away from their usual foraging zones near the shelf-break. A reduced access to preferred prey could in turn, induce spotted seal mothers to produce less milk of sufficient quality, affecting the condition of their pups.

Compound Specific Nitrogen Isotope Ratios of Amino Acids in Steller Sea Lion Whiskers Reflect Seasonal Changes in Baseline Isotope Values in Their Alaska Marine Food Webs

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Several studies document oscillating patterns in bulk (total organic) $\delta^{15}N$ and $\delta^{13}C$ values along the whiskers of both seals and sea lions. It has been postulated these predictable isotopic cycles result from seasonal feeding ecology changes with multiple, sometimes competing, interpretations attempting to account for these bulk oscillations including seasonal migration, changes in baseline isotope values of the local food web and/or seasonal changes of trophic position. To further examine these interpretations we analyzed the $\delta^{15}N$ values of the essential amino acids phenylalanine and glutamic acid in whisker segments from 8 adult female Steller sea lions (*Eumetopias jubatus*). Glutamic acid has been shown to exhibit a systematic increase in $\delta^{15}N$ values with increasing trophic position, while phenylalanine shows very little increase in $\delta^{15}N$ values during trophic transfer and thus is used as a tracer for isotope values at the base of the food chain. We initially conducted bulk isotope analyses along the length of each whisker to determine the pattern of $\delta^{15}N$ and $\delta^{13}C$ oscillations. We then selected a pair of sub-samples, one at a peak in the $\delta^{15}N$ bulk values (reflecting winter foraging) and one from an adjacent trough (summer foraging) for amino acid compound specific nitrogen isotope analyses. The $\delta^{15}N$ values of phenylalanine were more variable between individuals in the Aleutian Islands than in southeast Alaska with very little seasonal change in these baseline isotope values for most individuals. Exceptionally, one adult female sea lion from the western Aleutian Islands had a difference of 6.5 ‰ between the summer and winter $\delta^{15}N$ values of phenylalanine suggesting that baseline isotope values of the local food web changed seasonally, or that she changed foraging location seasonally. We found that despite some differences in isotopic baselines between individuals there was no trophic level difference between peaks and troughs when paired compound specific $\delta^{15}N$ values from each individual were used to estimate trophic level. This indicates the seasonal oscillations in bulk $\delta^{15}N$ values found in SSL whiskers cannot be predominantly attributed to shifts in trophic position.

Unmanned Surface Vehicles Map Prey Landscapes to Elucidate Northern Fur Seal Behavioral Responses to Prey Availability

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Understanding predator-prey relationships for the depleted northern fur seal (*Callorhinus ursinus*) is critical to help identify potential causes for the recent unexplained decline, which has resulted in a historic low for the largest U.S. colony. However, measuring prey availability for wide-ranging marine predators, such as northern fur seals, can be a costly undertaking. As a result, temporal or spatial mismatches often occur between prey availability data and foraging data, limiting our understanding of fundamental predator-prey relationships. Between July and September of 2016 and 2017, unmanned solar- and wind-powered Saildrone surface vehicles equipped with fisheries echosounders were used to map the abundance and depth distribution of walleye pollock (*Gadus chalcogrammus*), the primary prey of fur seals feeding on the Bering Sea shelf. During the same period (July-October), the at-sea behavior of 46 fur seals from St. Paul Island, Alaska was recorded using GPS- or satellite-linked dive recorders. In 2017, 5 fur seals were also equipped with video cameras to quantify prey captures, and prey species and size. Acoustic backscatter was classified into two age-classes: aggregations of age-0 pollock and adult pollock, based on observed aggregation characteristics, depth distributions, and trawl sampling conducted in July (2016). Fur seal foraging metrics, summarized within 10x10 km grids, were examined in relation to multiple prey indices, including backscatter by age-class and depth distribution. Fur seal dive depths were negatively related to age-0 backscatter but positively related to adult backscatter, reflecting changes in foraging strategies relative to the availability of the pollock age-classes. The areas most used by fur seals generally overlapped with regions of abundant age-0 pollock and residence time in a grid cell was positively related to age-0 backscatter. Finally, we tested the feasibility of using Saildrones to conduct remote focal-follow studies of tracked fur seals. Using transmitted at-sea locations, 6 fur seals were followed by a Saildrone in near-real time for ~2 days. The results of this study will be used to fill significant gaps in our understanding of how northern fur seals respond to variation in prey resources, which is essential to develop ecosystem-based approaches for northern fur seal conservation and fisheries management.

Surveying Harbor Seals in the Pribilof Islands with Advanced Drone Imagery

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Harbor seals (*Phoca vitulina*) are found throughout much of Alaska's coastal marine habitat and have long been significant subsistence and cultural resources of Alaska Native communities. Harbor seals are upper-trophic predators, non-migratory, and relatively local in their habitat use. Thus, they are uniquely positioned to provide insight about nearshore marine ecosystem health. The Pribilof Islands stock of harbor seals is a very small, isolated population which has been historically under-surveyed. Records from previous, opportunistic counts show isuĝin present on St. Paul, St. George, and Otter islands with the majority of seals at Otter and St. George islands. Counts ranged between 150-300 seals, but no effort was made to conduct surveys at all three islands in the same time period. In Aug/Sept 2018, the Aleut Community of St. Paul Island Tribal Government, the Duke University Marine Robotics and Remote Sensing Laboratory, and the NOAA Fisheries Alaska Fisheries Science Center began a collaborative research project focussed on isuĝin. The two main objectives were to conduct the first ever comprehensive survey of harbor seals in the Pribilof Islands and to explore the use of advanced technology drone (sUAS) platforms for future, community-led monitoring. Two senseFly eBee+ fixed-wing drones were used to map harbor seal haul-out habitats on St. Paul and Otter islands. The eBee+ aircraft were flown simultaneously on the same flight track with 25 meters altitude separation. The higher altitude aircraft collected high resolution visual imagery, while the other aircraft collected thermal IR data. This unique application of advanced drone platforms allowed creation of georeferenced high resolution orthomosaics for identification of harbor seals in both visual and thermal imagery. Counts from these surveys along with additional drone (DJI Phantom 4) surveys on St. George Island summed to 239 harbor seals ashore. Using an approximate correction for seals likely in the water, the abundance estimate for the Pribilof Islands is 478 seals. This project provides a solid foundation for implementation of a long-term, community-led monitoring effort that can serve as a model for the use of drone platforms and collaborations between local constituents and management agencies.

Piloting sUAS for Harbor Seal Monitoring in the Pribilof Islands: A Collaboration Between Tribal and Federal Governments

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The Aleut Community of St. Paul Island Tribal Government has recently invested in training and equipment for the use of small unmanned aircraft systems (sUAS) in a variety of research and monitoring projects in the remote Pribilof Islands, Alaska. In January 2018, we began a collaboration with NOAA Alaska Fisheries Science Center and Duke Marine Robotics and Remote Sensing Laboratory to investigate implementing sUAS surveys for the historically understudied Pribilofs stock of isuĝin or harbor seals (Phoca vitulina). Isuĝin have been an important subsistence resource for seal oil and an unknown level of harvest has been sustained since the islands were permanently settled in the late 1700s. The collaboration involved flight planning and field testing of sUAS harbor seal surveys at St. Paul, St. George, and Otter Islands. Areas of interest on these islands were chosen based on historical waypoints and traditional knowledge from hunters and residents of St. Paul and St. George. Land- and boat-based sUAS surveys were conducted at all three islands in August-September 2018. Advanced flight planning software enabled customized transect capabilities and experimenting with photographic settings to maximize data quality and output. We combined local and traditional knowledge with advanced technologies to inform and develop monitoring protocols. This collaborative effort resulted in high quality, reproducible products and a standardized but responsive program that the ACSPI has the capacity to implement into the future. This project provided a positive experience and resulted in increased local support for long-term monitoring and management of isuĝin in the Pribilof Islands.

PRESENTATION WITHDRAWN
Enhancing Decision Support Services for Coastal Flooding in Alaska

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Coastal flooding in Alaska is a major hazard for many remote coastal communities. As Arctic sea ice declines and the length of the open water season increases, these communities are increasingly vulnerable to the impacts of storms. Several communities including Kivalina and Shishmaref are considering relocating entirely due to eroding shorelines and the increasing threat of serious inundation. Forecasts and decision support for these events must be accurate and issued with significant lead time for communities to take actions and evacuate by air if necessary.

In collaboration with the Alaska Division of Geological and Geophysical Surveys (DGGS), the National Weather Service Alaska Region has developed a Coastal Flood Guidance (CFG) tool to equip meteorologists with more robust guidance and procedures to forecast and disseminate flood threat information to many impacted communities. The CFG tool allows for a conversion from model output storm surge levels into real world impacts that are easily understood by forecasters, emergency managers, community members, and other stakeholders. Configurable components include maps indicating areas and structures that may be impacted by high water, current observations, forecasts, and auto-generated decision support slides for partners all within one base interface. Built in ArcGIS online as an Alaska region group project using common data formats, flood mapping for additional communities and updates to current maps can easily be made when new elevation data becomes available from the DGGS. This presentation will demonstrate the many functions of the CFG tool. The tool optimizes coastal flood event management and allows meteorologists to provide NWS partners and stakeholders with improved forecasts and decision support services, helping to build a Weather-Ready Nation by making Alaska communities better prepared and more resilient to coastal storms.

Marine Mammal Co-Management in Alaska: Recommendations for Effective Relationships

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Co-management of subsistence use of Alaska marine mammals is a key provision of the Marine Mammal Protection Act (MMPA). Under authority of Section 119 of the MMPA, the U.S. Fish and Wildlife Service and the National Marine Fisheries Service can enter into agreements with Alaska Native organizations (ANOs) to cooperatively manage the use of marine mammals by Alaska Natives for subsistence and cultural purposes. The objectives of those agreements are to conserve marine mammals and provide for co-management of subsistence using a cooperative approach. Of the cooperative agreements currently established under Section 119, some have been more effective than others, and there is general agreement that co-management partnerships can be improved. The goal of this study was to review current marine mammal co-management agreements and, using data from a series of interviews and focus groups, develop a set of recommendations to help increase the effectiveness of co-management relationships in Alaska. With the help of a Steering Committee comprised of Alaska Natives with co-management experiences and federal resource managers, the Marine Mammal Commission selected three case study agreements: the Aleut Marine Mammal Commission, the Aleut Community of St Paul Island, and the Eskimo Walrus Commission. We conducted interviews with federal agency staff and ANO members involved in each agreement, and also held focus groups with hunters and subsistence users in seven coastal communities that have members from one or more of the selected case study agreements. Findings grouped into three overarching themes: partner roles and expectations, communication, and organization and structure. Based on these findings we recommend that partners: 1) clearly define and mutually agree upon roles and responsibilities and mechanisms to ensure greater accountability; 2) work cooperatively to strengthen communications within and between co-management partners; and, 3) engage and mentor the next generation of Alaska Native leaders and provide additional opportunities for them to participate in co-management activities. The Marine Mammal Commission is committed to working with the project Steering Committee, ANOs, federal agency partners, and Alaska Native communities over the next several years to put the recommendations into practice.

Dual Permit Operations in the Bristol Bay Pacific Salmon Drift Gillnet Fishery

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The Alaska Board of Fisheries passed regulations allowing for dual permit operations in the Bristol Bay Pacific salmon drift gillnet fishery starting in 2004. These regulations allow two permit holders to fish from a single vessel with additional gear. Policymakers anticipated that the dual permit regulations would encourage young fishermen to enter the fishery and reduce the number of limited entry permits transferred from local fishermen to nonlocal fishermen and nonresidents. Statistical analyses reported herein indicate that the opportunity to enter the fishery as part of a dual-permit operation partially offsets the adverse influence of increases in the market value of permits on the number of new entrants. Separate analyses indicate that, after controlling for overall changes in the average age of the Alaskan workforce, implementation of dual-permit regulations was followed by a reduction in the median age of new entrants, particularly among nonresidents. Implementation of dual-permit regulation has not staunched the outflow of limited entry permits even with highly subsidized programs to help local permit holders acquire permits.

Community Connections: Bringing Place-Based Science into Classrooms to Strengthen Student Understanding

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A community partnership in Juneau, Alaska (SouthEast Exchange) is connecting local STEM professionals/scientists with teachers to exchange ideas and facilitate place-based science experiences in classrooms. Through this innovative approach to science education, we are helping students see that what they learn in school can prepare them for meaningful scientific careers. We have developed a database of local experts, searchable by keywords and areas of expertise, willing to enhance student learning through real-life examples. This model can be replicated in communities and school districts across Alaska to increase place-based and culturally relevant teaching and learning. As a result of the connections made through SouthEast Exchange, a month-long Ecosystems unit was created to teach children about Ecosystem Based Fisheries Management in Alaska. The unit began in Spring 2018, when 105 7th grade students at Floyd Dryden Middle School learned about and researched the Bering Sea ecosystem. The curriculum centered on ecosystem responses to high or low amounts of sea ice with small groups focused on 6 components: oceanography, zooplankton, juvenile pollock, seabirds, fur seals, and humans. The unit culminated in a mock fisheries management process where students presented quota recommendations for 2019 eastern Bering Sea pollock to a panel of experts including Plan Team, Scientific and Statistical Committee, Advisory Panel, and Council members. This talk will include audio and video clips of student presentations and explanations of Ecosystem Based Fisheries Management in Alaska from young stakeholders. Additionally, the curriculum was adapted and implemented during the 2018 Bering Sea Days on St. Paul Island and we plan to develop a Gulf of Alaska unit in Spring 2019. Our goal is to continue facilitating educational opportunities like this for students so they can gain experience with, and an understanding of, the science that is taking place in the communities around them.

Communication, Collaboration, and Transparency: How Ecosystem Science Informs Fisheries Management in Times of Change

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A composite of unusual weather events during the winter of 2017/2018 resulted in an unprecedented lack of sea ice in the northern Bering Sea (NBS). Residual heat in the system delayed sea ice formation in the Chukchi Sea, and a persistent high-pressure system brought warm air from the southwest over the Bering Sea shelf through winter and spring, largely preventing the formation of sea ice in the NBS. Given these events, the Alaska Fisheries Science Center convened experts across NOAA line offices, other agencies, academia, and community stakeholders together with relevant stock assessment authors to compile and synthesize real-time data and observations of the NBS to inform the North Pacific Fisheries Management Council. The expert group reviewed findings from survey results, reports from coastal community members, and climate models. There was evidence of unusual distributions, poor condition, and strandings of marine mammals as well as poor reproduction and die-offs of seabirds primarily due to starvation. Bottom trawls, surface trawls and acoustic surveys documented the presence of Pacific cod and pollock in the NBS, and analysis of their stomach contents showed prey similar to Pacific cod and pollock diets from the inner shelf of the southeastern Bering Sea (SEBS). Participants reviewed evidence for Pacific cod and pollock in the NBS in earlier years and evidence for ecosystem connectivity between the NBS and the SEBS under likely short-term and future climate scenarios. With half of Pacific cod biomass in 2018 located in the NBS survey area, stock assessment models included NBS data for the first time, further demonstrating the need for timely ecosystem synthesis to inform current fisheries management. Whether the climate and weather events of 2018 were anomalous or portend a “future normal”, proactive communication, collaboration, and transparency are key ingredients to conducting sound science in support of sustainable fisheries.

Reconstructing Decades of Food Web Structure in the North Pacific and Bering Sea Using Bulk and Compound-Specific Stable Isotope Analyses from Archived Northern Fur Seal Teeth

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Physical and biological conditions in the North Pacific (NP) and Bering Sea (BS) vary on different multi-year scales due to natural climate variations from El Niño Southern Oscillation (ENSO), Pacific Decadal Oscillation (PDO), and North Pacific Gyre Oscillation (NPGO) events. These, combined with ongoing human-caused climate change and continued lack of recovery of multiple top trophic-level consumers in the system, indicate potential effects of climate on the productivity and other processes contributing to the function and composition of NP and BS food webs. We analyzed the bulk stable isotope values from annual growth layers drilled from archived juvenile male northern fur seal teeth along with compound-specific isotope analysis (CSIA) of individual amino acids (AA) from the same layers from a subset of seals to examine variability in their trophic position (TP), the food chain length (FCL), and other parameters in the NP and BS from 1946 to 2014. We targeted CSIA-AA of tooth layers grown in years with known climate variations and we related oceanographic and isotope data to better understand how environmental conditions contribute to variation in ocean biogeochemistry and animal foraging patterns. Preliminary analyses of a subset of our CSIA-AA data indicate some variation in TP and FCL among years, but no changes in mean seal TP (range: 3.4 to 4.4; 3.9±0.04) or FCL (as measured by Δ^{15}N; range: 13.9 to 15.8‰; 14.4±0.48‰) over time. Variations in TP could be associated with BS ice cover which directly influences walleye pollock recruitment, a primary seal food source, as high ice cover years are associated with lower TP and greater 0-age pollock recruitment into the food web. The longest estimated FCL (15.8±0.71‰) corresponded to anomalously high ENSO and NPGO events in 1998, which is expected as food chain length becomes longer with warmer sea surface temperatures due to reduced nutrient availability and resulting dominance of smaller phytoplankton at the food web base. This also coincided with notable reductions in seal pup counts. Our data demonstrate the unique ability of bulk SIA and CSIA-AA analyzed from biologically inert tissues to recreate food web patterns in marine systems over time.

Innovative Technology for Arctic Exploration

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Extreme physical changes are underway in the marine Arctic, including a transition from multi-year to seasonal sea ice, an increase in open water, and changes in water chemistry, all of which impact Arctic ecosystems. Traditional ship- and mooring-based observations are limited in time and/or space, and there is a paucity of data from under the ice, from the marginal ice-edge zone, and during seasonal transitions. Important goals for effective ecosystem assessment include reducing data limitations and expanding temporal and spatial scales of key measurements. New autonomous technologies directly address those goals. NOAA's Innovative Technology for Arctic Exploration (ITAE) program focuses on the development of new autonomous platforms and high-resolution sensors— many of which were developed through public-private partnerships— tailored to the challenging environmental and logistical conditions found in the Arctic. These innovations include the Saildrone, which incorporates over a dozen sensors sampling the atmosphere and ocean over months-long missions across thousands of kilometers. The Prawler is a profiling line crawler that exponentially increases the depth resolution of moored water-column observations. Pop-up floats are released in winter to profile the water column and sample directly underneath the ice. The Oculus coastal glider operates in shallower waters than traditional wave gliders, allowing adaptive missions in the key ecological coastal regions of the Arctic. ALAMO (Air Launched Autonomous Micro Observer) floats can be efficiently deployed from the air in hard-to-access waters. The RAS *in-situ* incubation system measures nitrate replenishment through the winter. Results from the 2017 and 2018 field campaigns are presented, along with new insights on ecosystem and seasonal dynamics derived from high-resolution sampling and some considerations for future developments. Results include the discovery of fine-scale eddies near from St. Matthew Island, seasonal and interannual variability in bloom dynamics, freeze-up projections, and the influence of prey distributions on the foraging behavior of fur seals. Autonomous platforms in conjunction with high resolution sensing technologies allow researchers to fill data gaps and expand observations in marginal, transitory, or limited-access areas, improving our understanding of Arctic ecosystems and empowering our ability to cost-effectively monitor and predict Arctic marine ecosystem change.

Ecosystem Stress Test: What an Ice-free Winter Might Mean for the Eastern Bering Sea

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During the winter of 2017-2018, the Bering Sea experienced the lowest recorded sea ice extent in the satellite era (1978-present). This drastic decline in ice extent resulted in a complete lack of ice melt over the southern shelf and the potential for minimal sea ice-mediated productivity. Our mechanistic understanding of recruitment controls for juvenile fish indicate bottom-up forces drive cohort success (or failure) in years with above-average water temperatures. We provide real-time ecosystem observations of the influence of an ice-free winter, the progression of ocean heating, and impacts to system-wide productivity. Spring surveys in April and May of 2018 documented reduced stratification, a month-long delay in the timing of the spring bloom, and low abundance and quality of crustacean zooplankton. However, the production of larval walleye pollock (*Gadus chalcogrammus*) remained high, indicating a potential temporal mismatch with lower trophic level productivity. A reduction in trophic transfer could subsequently impact adult fish, bird, and marine mammal species. Late-summer surveys in August and September of 2018 will provide information on survival and condition of key zooplankton prey taxa and forage fish species. In the near-term, these ecosystem observations and indicators enable climate-informed stock assessments; in the long-term, this research elucidates mechanisms linking climate with recruitment dynamics and provides a glimpse of the Bering Sea ecosystem under future projections of limited sea ice.

THURSDAY, JANUARY 31, 2019

ARCTIC OCEAN
PLENARY SESSION

PLENARY SESSIONS: THURSDAY, JANUARY 31 — ARCTIC

TIME	TITLE	PRESENTER	SECTION
8:00 - 8:15	Variability in the Chukchi Sea: A decade of observation	Carol Ladd	Climate & Oceanography
8:15 - 8:30	Recent surface heat fluxes and thermal and sea ice conditions of the Bering-Chukchi Continental Shelf	Seth Danielson	Climate & Oceanography
8:30 - 8:45	The changing Chukchi Sea: Anomalous sea-ice and environmental conditions in 2017 and 2018	Phyllis Stabeno	Climate & Oceanography
8:45 - 9:00	Optical properties and hydrography associated with the spring freshet of the Kuparuk and Sagavanirktok Rivers in nearshore Beaufort Shelf waters	Samuel Laney	Climate & Oceanography
9:00 - 9:15	A comparison in functional diversity of two Alaskan Arctic shelf systems	Lauren Sutton	Lower Trophic Levels
9:15 - 9:30	A visual tour of the macrozooplankton over the Arctic's Chukchi Borderlands	Russell Hopcroft	Lower Trophic Levels
9:30 - 10:00	COFFEE BREAK		
10:00 - 10:15	Digging deep: Depth distribution and utilization of carbon sources in Chukchi Sea sediments	Ann-Christine Zinkann	Lower Trophic Levels
10:15 - 10:30	Benthic respiration rates across the northern Bering and southern Chukchi Sea shelf	Brittany Jones	Lower Trophic Levels
10:30 - 10:45	Mustering records or Arctic exploration: Alaskan bivalve distributions in the Chukchi and Bering Seas over the last 150 years	Caitlin Meadows	Lower Trophic Levels
10:45 - 11:00	Modeling growth and transport of Arctic cod and saffron cod early life stages in the Pacific Arctic under variable climate forcing	Cathleen Vestfals	Fishes & Fish Habitat
11:00 - 11:15	Spatial patterns, environmental drivers, and potential seasonal differences of Arctic Cod (Boreogadus saida) distribution in the Chukchi Sea	Caitlin Forster	Fishes & Fish Habitat
11:15 - 11:30	Acute and latent bioenergetic impacts of oil on a keystone Arctic forage fish (Boreogadus saida)	Benjamin Laurel	Fishes & Fish Habitat
11:30 - 1:00	LUNCH PROVIDED		
1:00 - 1:15	The effects of rapid destabilization of coastal marine ecosystems	Douglas Causey	Seabirds
1:15 - 1:30	Sea ice loss and the post-breeding migration of planktivorous Arctic seabirds.	Alexis Will	Seabirds
1:30 - 1:45	Declining winter sea ice is associated with a northward shift of bowhead whale winter range	John Citta	Marine Mammals
1:45 - 2:00	Zinc concentrations in teeth of female Pacific walruses reflect onset of reproductive maturity	Casey Clark	Marine Mammals
2:00 - 2:15	Migratory culture, philopatry and kinship in beluga whales (Delphinapterus leucas)	Greg O'Corry-Crowe	Marine Mammals
2:15 - 2:30	Vulnerability of Arctic marine mammals to vessel traffic in the increasingly ice-free Northwest Passage and Northern Sea Route	Donna Hauser	Marine Mammals
2:30 - 3:00	COFFEE BREAK		
3:00 - 3:15	Alaska Eskimo bowhead whale subsistence sharing practices	Stephen Braund	Human Dimensions
3:15 - 3:30	Climate change impacts on access to coastal resources by subsistence harvesters in Arctic National Parks: Implications for NPS management	Kristen Green	Human Dimensions
3:30 - 3:45	An assessment of ecological value and vulnerability in the Bering, Chukchi, and Beaufort Seas	Max Goldman	Ecosystem Perspectives
3:45 - 4:00	The impact of shelf break upwelling on Beaufort Shelf distributions of zooplankton and fish	Carin Ashjian	Ecosystem Perspectives
4:00 - 4:15	Pelagic-Benthic coupling in the Chukchi Sea ecosystem: A key part of the Arctic Marine Biodiversity Observing Network (AMBON)	Jacqueline Grebmeier	Ecosystem Perspectives
4:15 - 4:45	The Arctic Integrated Ecosystem Research Program: Observations of 2017-2018 conditions and consequences	Seth Danielson	Ecosystem Perspectives

Variability in the Chukchi Sea: A Decade of Observation

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The Chukchi Sea is undergoing rapid change— sea-ice cover is decreasing, ocean temperatures are increasing, and seasonal timing of a range of physical and biological parameters are shifting. Even in the context of these rapid changes, 2017/2018 was surprisingly anomalous, with very late ice advance and early ice retreat; warm water temperatures; and previously unobserved levels of ocean transport at Icy Cape. Given the high productivity of the Chukchi Sea and its importance to a range of local and regional stakeholders, the surprising conditions observed in 2017/2018 reinforces our aim to better understand the increasing variability of the Chukchi. The past decade has seen substantial increases in *in situ* data collection, including expanded seasonal and spatial coverage via research ships and autonomous vessels, and continuation of biophysical moorings that have provided nearly decade-long time series of temperature, currents, transport, chlorophyll fluorescence, and ice keel depth. With these time series, we examine seasonal and interannual variability; trends in sea-ice cover and timing; ocean circulation; and consequences for the ecosystem. Ice draft data from moorings are used in combination with satellite data to examine the timing of ice advance and retreat, and the duration of transition periods that are critical for primary production. Local winds are integrated with current profile and drifter data to examine variability in patterns of flow and total transports. Chlorophyll fluorescence data are used to investigate bloom timing, which appear related to timing of ice arrival. These long-term observations are used to place the anomalies of the past few years in a longer-term context, and we provide suggestions for future research priorities to continue our efforts to leverage ocean observation into understanding ocean and sea-ice dynamics in the Chukchi Sea and improving our ability to predict future conditions. This has broad societal and ecological value, considering the reliance of local communities on the sea for food and culture; commercial activity in fisheries, oil and gas extraction, and transport; and highly productive regional ecosystems with strong connections to the Bering Sea and to surrounding waters in the Arctic Ocean.

Recent Surface Heat Fluxes and Thermal and Sea Ice Conditions of the Bering-Chukchi Continental Shelf

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This presentation provides an overview of the Arctic Integrated Ecosystem Research Program IERP (Arctic IERP) effort and highlights results and study implications from the first two field seasons. As a changing climate and sea-ice retreat progressively expose the northern Bering and Chukchi seas to longer open water seasons, society will confront new resource management issues. These include the future of the cultures and subsistence lifestyles of local indigenous communities, potential impacts of industrial activities (e.g. commercial fishing, oil and gas extraction), potential changes to regional ocean carrying capacity, and resilience of the arctic marine ecosystem. To address these issues, the North Pacific Research Board in cooperation with other organizations has funded the Arctic IERP, with the goal to better understand the mechanisms and processes that structure the ecosystem and influence the distribution, life history, and interactions of biological communities in the Chukchi Sea. The Arctic IERP is addressing the overarching question: How will reductions in Arctic sea ice and the associated changes in the physical environmental influence the flow of energy through the ecosystem? With observations from year-round moorings and vessel-based research expeditions in late spring and late summer, the Arctic IERP is contributing to a more comprehensive understanding of Bering-Chukchi ecosystem dynamics. Results reflect the transport, seasonal composition, distribution, and production of phytoplankton, particulate matter, zooplankton, fishes, benthic invertebrates, seabirds, and marine mammals; the timing, magnitude and fate of the primary and secondary productivity; the partitioning/flux of energy between pelagic and benthic realms; and fundamental physical, geochemical, and biological rates. These are interpreted in the context of human use of, and interaction with, the marine environment. Anomalous environmental conditions during 2017 and 2018 — including a dramatic lack of sea ice well into winter and early spring— were a marked change even from recent unusually warm years. Such conditions may come to be considered normal in future years. These results suggest the potential for permeating future transformations of the regional food web (e.g., altered distributions of keystone species such as Arctic Cod) and associated human impacts.

The Changing Chukchi Sea: Anomalous Sea-Ice and Environmental Conditions in 2017 and 2018

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Understanding the mechanisms driving seasonal sea ice in the Pacific Arctic strengthens research on northern marine ecosystems and informs local and regional stakeholders prepare. Using a variety of *in situ* data sets together with satellite observations, we evaluate sea-ice drivers in the Chukchi Sea in 2017 and 2018, review next-year prediction made in 2017, and present a prediction for 2019. The Chukchi shelf in summer 2017 was particularly warm; it was predicted that the northern Chukchi Sea shelf would begin freezing in late November— more than 30 days later than the 1981-2016 mean. This prediction proved correct – by mid-November 2017, the Chukchi had the lowest sea-ice extent in four decades, and ice was relatively thin and mobile. Our late freeze-up prediction was largely derived from observations of high heat content on the shelf. In addition, unusually strong southerly winds in fall 2017 forced the largest monthly-mean northward transport (2 Sv) at Icy Cape observed in a decade. These currents shifted the mobile sea ice and transported warmer water northward, reinforcing the thermodynamically delayed onset. Similar strong winds in February 2018 also supported strong northward currents in the Chukchi, resulting in anomalous midwinter open water in Bering Strait and the southern Chukchi Sea. Late ice arrival was then followed by early ice retreat in spring 2018, with the northwest coast of Alaska largely ice free by mid-May.Chukchi temperatures in late summer 2018 are comparable to those in 2017. This, together with the particularly warm (5-6°C) water residing below the fresher surface water north of the Chukchi slope, are setting up a repeat of the anomalously late freeze-up that occurred in 2017-2018. We also compare the timing and duration of sea ice in the Chukchi during the last two years (2017, 2018) to the decadal projections of the ice-ocean state in Chukchi Sea from ensemble simulation of the Community Earth System Model. Changes in ice arrival and duration have broad societal and ecological implications, ranging from coastal community storm surge vulnerability to changes in the behavior of marine mammals, emphasizing the need to continue sea-ice related research in the region.

Optical Properties and Hydrography Associated with the Spring Freshet of the Kuparuk and Sagavanirktok Rivers in Nearshore Beaufort Shelf Waters

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The majority of riverine freshwater input into the coastal Arctic Ocean is provided by the spring freshet, an ephemeral annual event that occurs during a narrow window of one to several weeks. The freshet also carries a substantial pulse of dissolved and particulate organic carbon (DOC and POC) into coastal Arctic Ocean ecosystems, and the relative distributions and content of these carbon inputs can be expected to differ among rivers that drain different types of watersheds. The Sagavanirktok and Kuparuk rivers, near Prudhoe Bay in northern Alaska, respectively drain the coastal plain/Brooks Range and tundra, and their contributions of DOC and POC to the coastal ocean can be presumed to differ also. Measuring the organic contributions of these spring freshets and assessing their impact on coastal Arctic ecosystems is extremely challenging however, due to logistical and observational challenges. We present observational data from a spring-summer 2018 field study in and around Prudhoe Bay that involved the deployment of custom-designed ice buoys that were outfitted with sensors to measure optical proxies for DOC and POC. We deployed five such buoys inshore of the barrier islands surrounding Prudhoe Bay and Foggy Island Bay in mid-April while sea ice conditions were still safe for access. Four buoys survived the spring freshet event and ultimately ice out, providing novel time series of optical and hydrographic variables throughout the course of the Kuparuk and Sagavanirktok freshets. Unexpectedly, three of these buoys were recovered, allowing us to assess influences of biofouling and other factors on the quality of these optical proxies. Differences were observed in the optical signatures of the freshets from each river, suggesting that such simple optical approaches may be valuable in characterizing the duration, DOC &POC contribution, and spatial extents of freshet influences by river systems that feed the Arctic Ocean while annual sea ice cover still exists.

A Comparison in Functional Diversity of Two Alaskan Arctic Shelf Systems

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Increased interest in Arctic resource development and climate warming may trigger disturbances in benthic-dominated shelf systems such as the Beaufort and Chukchi seas. We used functional diversity based on biological traits analysis to compare epibenthic invertebrate community function of the Beaufort and Chukchi Sea shelves. We hypothesized that epibenthic shelf communities in the Chukchi Sea would have a higher functional diversity than in the Beaufort Sea, driven by the wider shelf area and nutrient-rich waters in the Chukchi Sea versus the narrow Beaufort shelf influenced by the oligotrophic Beaufort Gyre and strong freshwater inputs. Eleven biological traits for 356 taxa were used to describe and compare community function among and between shelf systems. Community function was evaluated using fuzzy correspondence analysis (FCA) and four functional diversity metrics: community-weighted functional diversity (FDw), functional richness (FRic), functional evenness (FEve), and functional dispersion (FDis). Contrary to our hypothesis, Beaufort Sea epibenthic communities had a statistically higher FDw and FDis than Chukchi Sea epibenthic communities when spatial autocorrelation was considered. There were no significant differences in FRic or FEve between the two shelves. Biological traits that drove most differences between shelf communities were larval development, body form, and adult movement. The Chukchi Sea communities were dominated by individuals with planktotrophic larval development, dorso-ventrally compressed, and crawlers while the Beaufort Sea communities had in general, a more evenly distributed proportion of modalities within biological traits. In our study, functional redundancy was expressed by the wider spread of expressed biological traits and statistically significant higher functional dispersion in the Beaufort than the Chukchi Sea. Therefore, Beaufort Sea shelf epibenthic invertebrate communities may have a higher resilience to disturbances due to climate warming based on higher functional diversity (FDw) and functional redundancy.

A Visual Tour of the Macrozooplankton Over the Arctic's Chukchi Borderlands

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The largest zooplankton of the Arctic Ocean are virtually unknown due to the logistical challenges imposed by sea-ice cover. During the summer of 2016, we used an ROV equipped with an Ultra-high Definition video camera to explore and quantify the macrozooplankton communities occurring over the bathymetrically complex Chukchi Borderlands region. Gelatinous macrozooplankton were prominent throughout the water column, with both distinct vertical zonation of species and striking differences between stations resolvable due to the image resolution provided by UHD.Ctenophores were the most prominent larger predators, for which we documented and collected as many as 6 undescribed species, several which had been first glimpsed during the last Hidden Ocean expedition.Siphonophores were also prominent throughout the water column, as were jellies in proximity to the seafloor.Chaetognaths and larvaceans were abundant in specific zones.We present a detailed look at the patterns observed and a video inventory of the poorly known species we encountered.We highlight the advantages of adaptive, interactive ROV exploration of the water column as a supplement to traditional sampling, and to explore the benthopelagic zone where plankton nets fear to tread.

Digging Deep: Depth Distribution and Utilization of Carbon Sources in Chukchi Sea Sediments

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The Chukchi Sea is a highly productive region of the Arctic Ocean with strong pelagic-benthic coupling and an associated rich benthic community. Impacts of climate-induced alterations of carbon flow to the benthos and potential shifts in the Arctic marine food web are still poorly understood and necessitate a better understanding of the primary production sources of organic matter to lower trophic levels. The isotopic composition of essential amino acids (EAA) is useful in distinguishing various carbon sources such as from terrestrial plants, phytoplankton, red and brown algae, and bacteria. EAA from these different biosynthetic sources have distinct patterns of $\delta^{13}C_{EAA}$ values (= fingerprints) that are conserved in consumer tissues. We used $\delta^{13}C_{EAA}$ values as a proxy to determine the proportional contributions of these carbon sources in depth-stratified sediments (0 - 5 cm) across the Chukchi Sea shelf and benthic invertebrates of different feeding types. Across sediment depth strata, the majority of carbon in sediments originated from terrestrial sources (average contribution ~76%). Carbon sources showed no significant differences in proportional contributions with depth except phytoplankton, which decreased with increasing sediment depth. There also was no relationship between various environmental variables and the proportional contribution of carbon sources at sampling sites across the Chukchi shelf. These patterns indicate a well-mixed upper sediment horizon, possibly from bioturbation activities of the abundant benthos. Also, the large estimated proportional contribution of terrestrial carbon to the sediments may be indicative of accumulation over time due to slow degradation processes of this source by bacteria. However, benthic invertebrates were able to utilize this terrestrial source as it made up the highest proportion (average ~30%) of their diet. We also were particularly interested in the contributions of bacterial carbon as bacterial processes are expected to increase rapidly with warming water temperatures, thus influencing bacterial turnover of organic material and possible effects on subsequent trophic levels. Although proportional estimates of bacterial-derived carbon were relatively homogeneous in sediments, bacterial carbon to benthic invertebrate diets differed significantly among species, even within the same general feeding type, suggesting highly species-specific feeding habits.

Benthic Respiration Rates Across the Northern Bering and Southern Chukchi Sea Shelf

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Flows of energy and organic material through food webs is central to our understanding of Arctic marine ecosystem function. Much of this organic material must pass through the benthos before reaching upper trophic levels. Oxygen consumption rates are often used as a proxy for organic matter consumption, representing energy flow through the food web. Benthic oxygen consumption rates must be quantified to better constrain and evaluate ecosystem models, particularly in the Arctic. Closed-system respirometry was conducted using non-invasive oxygen optodes onboard the *R/V Sikuliaq* in June 2017 and 2018 as part of the Arctic Shelf Growth, Advection, Respiration, and Deposition (ASGARD) project. Oxygen consumption was measured for sediment cores at 0ºC (i.e., approximating ambient temperature) and 5ºC (i.e., projected future temperature). Sediment community oxygen consumption was 1.4 and 1.3 times higher at 5ºC compared to 0ºC in 2017 and 2018, respectively. These data indicate that an increase in temperature results in an increase in sediment community oxygen demand, which has important implications for organic matter processing under future climate conditions. We also selected dominant infaunal taxa for incubation in individual respirometry chambers at 0ºC. In 2017, respiration rates for *Macoma sp.* and *Serripes groenlandicus* ranged from 0.07 to 1.6 µmol O_2 h^{-1} for organisms that ranged from 0.008 to 0.9 g AFDM (ash free dry mass). The mass specific respiration rate was higher for *S. groenlandicus* compared to *Macoma sp*., demonstrating the importance of measuring taxon-specific respiration rates, particularly for different functional groups. Respirometry data of additional *Macoma sp.* and *S. groenlandicus* from 2018 are currently being analyzed for interannual comparisons,and include new data for 3 other clams, *Astarte mantagui*, *Hiatella arctica*, and *Nuculana sp.*; ampeliscid amphipods; and the deposit-feeding polychaete *Pectinaria*. Respiration rates of individual macrofauna and whole sediment communities can be used to inform ecosystem models to better understand carbon flow through the current benthic food web and potential future alterations due to a changing climate.

Mustering Records or Arctic Exploration: Alaskan Bivalve Distributions in the Chukchi and Bering Seas over the Last 150 Years

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Immense interest in the Alaskan Arctic and its resources have stimulated many large scientific and military missions, with semi-quantitative periodic benthic surveys starting in 1865. Data, voucher specimens, and in some instances untouched bulk samples from these surveys are archived in museums, libraries, and online databases, and provide a rich basis for reconstructing how benthic systems have changed. By extracting and integrating insights from these diverse and scattered sources, I have been able to reconstruct a 150-year history of benthic community change in the N Bering and Chukchi Seas. The principal sources were the taxonomic identification of live- and dead-collected bivalves in museum lots; information from museum labels and intake ledgers; cruise reports and personal journals of mission participants; and NOAA, NASA, and NSF data repositories. From 1865 to 1900, taxa that are most dominant today in Subarctic and Arctic waters were concentrated in the Chukchi Sea, with very few occurrences south of the Bering Strait. This previously unrecognized but remarkable geographic offset pervades all bivalve functional groups and is evident in both rare and common taxa. Only two families of bivalve were consistently found in the N Bering Sea in the late 19th century – the mixed-feeding Tellinidae and the suspension-feeding Veneridae. After 1950, peak populations of many taxa shifted southward into the N Bering Sea to match what is considered the “ecologic baseline” of the 1970’s. Bivalve distributions in the late 19th century are more concentrated in the Chukchi Sea than they are today; however, recent northward shifts in Subarctic taxa detected within the last 20 years seem to indicate that the Subarctic taxa are returning to the Chukchi Sea. Historic observations on bivalve family distributions thus indicate that the ecologic baseline based on modern surveys is the result of a benthic community reorganization in the 1960’s, coincident with a sudden increase in the variability of sea ice concentration across the region and the onset of sea ice retreat related to secular warming and climate change.

Modeling Growth and Transport of Arctic Cod and Saffron Cod Early Life Stages in the Pacific Arctic Under Variable Climate Forcing

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Arctic cod (*Boreogadus saida*) and saffron cod (*Eleginus gracilis*) are key fishes in the Arctic marine ecosystem, serving as important trophic links between plankton and apex predators, yet our understanding of their life histories in Alaska's Arctic is extremely limited, particularly with regard to spawning and early life stages. In order to fill some of these critical knowledge gaps, we developed species-specific, individual-based, biophysical transport models (TRACMASS) coupled to a high-resolution ocean circulation model (PAROMS) to simulate the growth and transport of larvae and early juveniles from several hypothesized spawning and hatching locations in the northern Bering Sea and Chukchi Sea. Larvae were released at bi-weekly intervals from January 1st to May 15th and tracked daily until the end of the simulation on September 1st, after which their simulated distributions were compared to summer distributions of age-0 Arctic cod and saffron cod from acoustic-trawl (AT) surveys conducted in 2012 and 2013 as part of the Arctic Ecosystem Integrated Survey (Arctic Eis). Simulated larvae that were released from more southerly hatching locations achieved the sizes and spatial distributions observed during the AT surveys, while those that hatched from more northerly locations did not, which suggests that source populations may originate in the northern Bering and southern Chukchi seas. In addition, larval growth and transport appear to be sensitive to environmental forcing, as the number of simulated larvae matching the sizes and spatial distributions of those observed in the field varied between hatch dates and between years. This research provides new insight into potential spawning and hatching locations of Arctic cod and saffron cod and the subsequent transport of their early life stages in the Pacific Arctic, which helps to improve our understanding of how their growth and dispersal may be affected by variable climate forcing.

Spatial Patterns, Environmental Drivers, and Potential Seasonal Differences of Arctic Cod (*Boreogadus saida*) Distribution in the Chukchi Sea

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Arctic Cod (*Boreogadus saida*) is a key forage fish species in the Arctic marine ecosystem and provides a critical energetic link between lower and upper trophic levels. Despite its ecological importance, spatially explicit studies synthesizing Arctic Cod distribution across a multitude of research efforts previously have not been conducted in the western portion of its range. We used spatial generalized additive models (GAM) to map the distribution of Arctic Cod by size class and relative to environmental variables. We compiled demersal trawl data from 16 research cruises conducted from 2004 to 2017 in the Chukchi Sea, and investigated size-specific patterns in distribution to infer movement ecology of Arctic Cod as it develops from juvenile to adult life stages. High abundance of small (≤ 60 mm total length) Arctic Cod was found in the northeastern Chukchi Sea. Large Arctic Cod (>100 mm) was found offshore and spatially segregated from small (≤ 60 mm) and medium (61 – 100 mm) Arctic Cod, indicating an ontogenetic offshore movement of Arctic Cod as it matures. Analysis of environmental drivers demonstrated that temperature and salinity impacted juvenile distribution patterns, while depth was the primary driver of adult Arctic Cod distribution. Furthermore, a comparison of spring and summer 2017 catches of Arctic Cod in the southern Chukchi Sea, from the Bering Strait to Cape Lisburne, found low abundance in the spring when compared to the summer. Seasonal differences in Arctic Cod catch suggest that Arctic Cod migrate seasonally, potentially following patterns of biological production in the Chukchi Sea. Considering the differences between spring and summer abundance, we hypothesize that Arctic Cod movement in the Chukchi Sea may follow a classic migration triangle pattern. An increasing human presence in the Arctic prompted the creation of the Arctic Fisheries Management Plan (FMP) in 2009, which listed Arctic Cod as one of two potential commercial fish species. The analysis presented here is necessary to address the research requirements therein, as well as to gain better general understanding of the role of Arctic Cod in the Pacific Arctic.

Acute and Latent Bioenergetic Impacts of Oil on a Keystone Arctic Forage Fish (*Boreogadus saida*)

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In the Arctic, future oil spills associated with increasing fishing, shipping, and offshore oil production pose largely unknown risks to keystone species and the marine ecosystems they support. This includes the Arctic cod *Boreogadus saida*, an energy-rich forage fish and primary prey species for marine mammals, seabirds, and other fish. The cardiotoxic impacts of oil on marine fish embryos and larvae are well known, and there is growing evidence from transcriptomic studies for altered bioenergetics in oil-exposed gadids. To address this, we exposed embryos to physically dispersed microdroplets of Alaskan North Slope crude oil for 3 days during heart morphogenesis. We then monitored morphological and functional indicators of toxicity, as well as lipid composition, in larvae and juveniles for ~5 months post-exposure under clean seawater conditions. Total polycyclic aromatic hydrocarbon dose concentrations in sea water were 0.9 ± 0.3, 3.3 ± 0.4, and 15 ± 5 µg/L and 63 ± 11, 505 ± 105, and 1170 ± 170 ng/g wet weight in embryos, respectively. Embryos were assessed for oil-induced cardiotoxicity immediately after exposure (28 dpf) and at hatch (42 dpf). For the 15 µg/L and 3.3 µg/L exposure concentrations, either all or most of the hatched larvae had severe defects including craniofacial malformations that impair first-feeding success. Large numbers of larvae with a normal morphology from the 0.9 µg/L exposure showed significant long-term growth impairment. There was a dose-dependent increase in triacylglycerols (TAG) and free fatty acids (FFA) in yolk sac larvae that was not present in the egg-phase but that persisted through first feeding. However, in older surviving exposed juveniles (0.9 µg/L exposure), TAG levels were lower than in

non-exposed individuals. Collectively, these data suggest that storage and fuel lipids (TAG and FFA) are underutilized or inappropriately synthesized (or both) in exposed first-feeding larvae, while these lipids are burned excessively in juveniles rather than accumulating for the critical overwintering period. This supports an exposure and injury model in which embryonic contact with oil leads to irreversible lipid-bioenergetic deficits that in turn could impact ecosystems by way of reduced survival and fat content of an Arctic keystone forage fish.

The Effects of Rapid Destabilization of Coastal Marine Ecosystems

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Understanding the complex dynamics of environmental change in northern latitudes is particularly critical for Arctic coastal communities, which are at the interface between land and sea. Coastal marine foodwebs are more complex and interconnected—even in the High Arctic—by comparison to those found in adjacent terrestrial and offshore marine ecosystems. Quantitative assessment of marine foodweb structure and dynamics is challenging given the difficulty in direct sampling of organisms in the water column, particularly so in Arctic regions. We utilize instead indirect methods that allow reconstruction of foodweb structure and entropic stability within a broad range of spatial and temporal scales using birds as proxy indicators of change. Avian communities of marine and terrestrial Arctic environments represent a broad spectrum of trophic levels, from herbivores, planktivores, insectivores, nearshore and offshore fish, even other bird species.

We have been reconstructing the foodweb ecology using stable isotopes ($d^{13}C$, $d^{15}N$, $d^{34}S$), parasites, and diet reconstruction of contemporaneous coastal bird communities in High Arctic (Northwest Greenland) and Low Arctic (Aleutian and Bering Sea islands, AK). Initial findings indicate that in the past decade Arctic coastal foodwebs are increasingly less predictable with higher structural variance, less complex, simpler trophic structure, and possibly with different species composition. Analysis of archival specimens collected over 150 years show that these patterns appear to be similar throughout the Arctic, but with the effect gradient increasing with latitude and time. We discuss the potential fine-scale implications of change on High Arctic coastal ecosystems and the effect on seasonal breeding populations of marine and terrestrial animals.

Sea Ice Loss and the Post-Breeding Migration of Planktivorous Arctic Seabirds

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In the Pacific Arctic, planktivorous seabirds have been observed to forage in the Chukchi Sea prior to departing for their lower latitude wintering grounds. It is not clear what triggers their decision to head south. One possibility is that sea ice acts as a physical barrier to their access to food and the advancing of winter sea ice forces these specialized foragers out of the Arctic. An alternative hypothesis is that the timing of the southward migration is independent of ice extent, in which case the cue may be set, such as day length, or flexible, such as following oceanographic features that concentrate their prey into dense patches. We deployed geolocators on and collected throat feathers from least (*Aethia pusilla*) and crested (*A. cristatella*) auklets during the 2016 and 2017 breeding seasons. Here we compare post-breeding movements of least and crested auklets in a year with extremely low sea ice cover (2017), to those in a more normal year (2016). We also measured the loss of telomeres, a molecular marker of stress, in tracked individuals to infer the cost of migration in 2017 compared to 2016. We discuss the possible mechanisms triggering the southward migration for these species and what effect sea ice loss may have on their ecology.

Declining Winter Sea Ice Is Associated with a Northward Shift of Bowhead Whale Winter Range

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Since 2006, satellite-linked transmitters (tags) have been attached to bowhead whales (*Balaena mysticetus*) of the Bering-Chukchi-Beaufort (BCB) stock. During 2006-2016, tagged whales never travelled south of the ice margin in winter (January-March) and the primary wintering area was located east of Anadyr Gulf in the Bering Sea. This wintering area was ice-free during 2017 and 2018 and it was unknown if whales would travel south of the ice margin to return to this area or if they would remain under sea ice and shift their distribution northwards. No tags were transmitting in 2017, however, four tags transmitted during the winter (January-March) of 2018, allowing us to compare the distribution and behavior of whales in two time periods, 2006-2016 and 2018. In 2018, tagged whales remained under sea ice and shifted their distribution northwards. During 2006-2016, less than 6% of all tag locations (*n*=4,793) were in the Chukchi Sea in winter. In contrast, during 2018, 86% of all tag locations (*n*=576) were in the Chukchi Sea. The proportion of square- and U-shaped dives, dives where ≥50% time is spent at a specific depth and are thought to be associated with feeding behavior, did not change between the two time periods (~90% of all dives). The average percentage of time spent at or near the seafloor was less during the winter of 2018 (21%) than during 2006-2016 (30%), but within the range of variation observed in individual whales. These dive data suggest whales were feeding during both time periods. Why bowhead whales do not venture south of the ice margin in winter, when they are only weakly associated with ice concentration in summer, is unknown. Bowhead whales may remain north of the ice margin to avoid killer whales which are known to frequent the ice edge in winter but are rarely observed in BCB bowhead summer ranges. The fall and early winter of 2017-18 were also characterized by southerly winds that are inferred to have promoted northward transport of krill through Bering Strait, possibly improving feeding conditions in the Chukchi Sea.

Zinc Concentrations in Teeth of Female Pacific Walruses Reflect Onset of Reproductive Maturity

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Organic structures containing incremental growth layers act as biological archives, recording information throughout an organism's life. Pacific walrus (*Odobenus rosmarus divergens*) tooth cementum grows continuously, incorporating trace elements into seasonal layers as they develop. Analysis of cementum using laser ablation inductively coupled plasma mass spectrometry can reconstruct a lifetime record of trace element concentrations. This study measured concentrations of zinc (Zn), an important metal for growth and reproduction, in teeth of female walruses (n = 93) collected between 1932 and 2016. Zn concentrations exhibited a characteristic "hockey stick" shape, with an inflection point marking the beginning of a linear increase in tooth Zn. Due to Zn's critical role in growth and reproduction, we hypothesize that this inflection point reflects the onset of reproductive maturity. Cementum growth layers were counted to estimate the age at which the Zn inflection occurred (age_{inf}). These estimates closely match literature values of timing of first ovulation in female walruses. A validation was conducted using 16 paired walrus tooth and ovary specimens. Total number of ovulations (estimated from ovary corpora counts) is strongly correlated with reproductive lifespan (total lifespan - age_{inf} ; $R^2 = 0.75$). Decadal averages of age_{inf} estimates track changes in Pacific walrus population size, with age_{inf} decreasing when the population was depleted by commercial hunting and increasing when it reached carrying capacity. The relationship between population size, resource availability, and age at reproductive maturity is a well-established ecological paradigm. Our findings support the hypothesis that the Zn inflection marks age_{inf}, thus providing an important and novel tool for reconstructing past changes in walrus populations and monitoring population health. These results may be applicable to other species, and would have substantial implications for wildlife research and management.

Migratory Culture, Philopatry and Kinship in Beluga Whales (*Delphinapterus leucas*)

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The annual return of beluga whales, *Delphinapterus leucas*, to traditional seasonal locations across the Arctic may involve migratory culture, while the convergence of discrete summering aggregations on common wintering grounds may facilitate outbreeding. Associations among closely related animals has been postulated as a core driver of social structure in belugas, while the presence of close kin in resident populations may help estimate fitness. Natal philopatry, cultural inheritance and the role of kinship in group structure, however, has been difficult to assess as earlier studies. Using a much expanded sample and genetic marker set comprising over 2,000 whales, spanning more than two decades and encompassing all major coastal summering aggregations in the Pacific Ocean, we found likely demographic independence of ($F_{st\text{-}mtDNA}$=0.02-0.66), and in many cases limited gene flow ($F_{st\text{-}nDNA}$=0.0-0.02; *K*=5-6) among, summering groups within regions. Assignment tests identified few immigrants within summering aggregations, linked migrating groups to specific summering areas, and found that some migratory corridors comprise whales from multiple subpopulations (P_{BAYES}=0.31:0.69). Further, dispersal is male-biased and substantial numbers of closely related whales congregate together at coastal summering areas. Stable patterns of heterogeneity between areas and consistently high proportions (~20%) of close kin (including parent-offspring) sampled up to 20 years apart within areas (*G*=0.2 – 2.9, *p*>0.5) is the first direct evidence of natal philopatry to migration destinations in belugas. Using recent satellite telemetry findings on belugas we found that the spatial proximity of winter ranges has a greater influence on the degree of both individual and genetic exchange than summer ranges (r_{winter}-$F_{st\text{-}mtDNA}$=0.9, r_{summer}-$F_{st\text{-}nDNA}$=0.1). These findings indicate widespread natal philopatry to summering aggregation and entire migratory circuits, and provide compelling evidence that migratory culture and kinship helps maintain demographically discrete beluga stocks that can overlap in time and space. Finally, the identification of close kin in resident populations as well as in distinct groupings offers new opportunities to understand social organization and fitness in beluga whales.

Vulnerability of Arctic Marine Mammals to Vessel Traffic in the Increasingly Ice-Free Northwest Passage and Northern Sea Route

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Vessel transits are expanding into the increasingly ice-free Northwest Passage and Northern Sea Route, yet potential impacts on endemic Arctic marine mammal (AMM) species are unknown. We developed a vulnerability assessment of 80 subpopulations of seven AMM species to vessel traffic. Vulnerability scores were based on the combined influence of spatially-explicit exposure to the sea routes and a suite of sensitivity variables. Over half of AMM subpopulations are exposed to open-water vessel transits in the Arctic sea routes. Overall, narwhals (*Monodon Monoceros*) were most vulnerable to vessel impacts given their high exposure and sensitivity, and polar bears (*Ursus maritimus*) least vulnerable due primarily to low exposure. Among Alaskan AMM populations, Bering-Chukchi-Beaufort bowhead whales (*Balaena mysticetus*) scored the highest vulnerability, although beluga whale (*Delphinapterus leucas*) and walrus (*Odobenus rosmarus*) populations in Alaska also had relatively high vulnerability. Vulnerability was considered intermediate-low for ice-dependent seal species. Regions with geographic bottlenecks, such as the Bering Strait, were characterized by 2-3 times higher vulnerability than more remote regions such as northwest Greenland. These pinch points are obligatory pathways for both vessels and migratory AMMs, so represent potentially high conflict areas but also opportunities for conservation planning. Uncertainty was greatest in the most remote regions but also for data-limited species and populations, such as bearded seals (*Erignathus barbatus*) in the Beaufort Sea, underscoring the need for additional knowledge. Our quantification of the heterogeneity of risk across AMM species provides a necessary first step towards developing best practices for maritime industries poised to advance into Arctic sea routes.

Alaska Eskimo Bowhead Whale Subsistence Sharing Practices

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Stephen R. Braund & Associates (SRB&A), under contract to the Alaska Eskimo Whaling Commission (AEWC), conducted research on the sharing of bowhead whales by Alaska Eskimo whaling communities (Iñupiaq and Siberian Yup'ik) to non-whaling communities and explored whether the current quota system allowed for adequate harvesting opportunities for Alaska Eskimo whaling communities, given information related to bowhead whale sharing practices. SRB&A's research included a review and analysis of existing literature related to bowhead sharing outside of whaling communities, in addition to interviews and workshops with whaling captains and crew members in seven of the 11 Alaska Eskimo whaling communities.

AEWC members have expressed concerns that current and past methods for quantifying the need of Alaska Eskimo whaling communities for bowhead whale do not adequately take into account sharing, because quantification methods are based solely on Alaska Eskimo populations living in whaling communities. There have been substantial changes in demographics, communication, and access to transportation in the years since the current method for quantifying Alaskan Eskimo need for bowhead whales was adopted by the International Whaling Commission (IWC) in 1986. Social science research has begun to reveal the long-standing subsistence sharing networks that form the backbone of the northern Alaskan mixed subsistence-cash economy. Through these interlocking village networks, food items, including bowhead whale, are shared among northern Alaskan communities and with relatives living in other areas.

This study identified that the methods used to quantify need for bowhead whales by Alaska Eskimo whaling communities were developed in the 1980s, were based on sometimes limited historic data from 1910 to 1969, were based on a time when both Alaska Eskimo and bowhead whale populations were at a reduced level associated with Yankee whaling, and did not consider the subsistence sharing of bowhead whales, a central aspect of whaling culture.

Climate Change Impacts on Access to Coastal Resources by Subsistence Harvesters in Arctic National Parks: Implications for NPS Management

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Human access routes to coastal subsistence resources are being altered in the Northwest Arctic Alaska as temperatures warm. Many studies have shown in recent years that coastal habitats where subsistence resources are traditionally gathered and processed are eroding with sea level rise while sea ice retreat reduces the availability of marine mammals for hunters. The National Park Service (NPS) is responsible for sustainable management of subsistence resources in National Parklands as well as access to those resources; however, a lack of information on factors affecting subsistence access, including climate change, limits management planning. Here we, collaborate with NPS and the communities of Kotzebue and Kivalina, Alaska to better understand the factors that affect subsistence access to marine resources in Western Arctic Parklands. Our study employs a combination of (1) a synthesis of pre-existing harvest and environmental time series data, (2) key respondent interviews, and (3) participant observation of NPS Subsistence Resource Commission meetings. Our research seeks to understand the perceptions of agency staff in addition to a diverse community of subsistence users to gather information on ways to improve communication between NPS and subsistence users. To date, we have conducted 11 interviews with regional and local NPS staff and 53 coastal subsistence users in the Northwest Arctic regarding access to coastal resources in Cape Krusenstern National Monument and Kotzebue Sound, environmental changes to subsistence resources, and how local knowledge is incorporated into management. Study results will provide data on key access and subsistence harvest challenges that can be used to improve NPS management of resources and communication with local stakeholders.

An Assessment of Ecological Value and Vulnerability in the Bering, Chukchi, and Beaufort Seas

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Tasked with the responsibility of ensuring the resilience of Arctic ecosystems in the face of natural and human-caused changes, managers and decision-makers must often prioritize their efforts. An integrative analysis of extensive ecological spatial data can serve to identify areas of disproportionate value to an ecosystem's health, ensuring that the best available science is considered when decisions are made. Our assessment of ecological value and vulnerability had two primary objectives: 1) use publicly available scientific mapping of species patterns in the *Ecological Atlas of the Bering, Chukchi, and Beaufort Seas* to identify areas of especially high importance to the function, health, productivity, biodiversity, and resilience of this ecosystem; and 2) to apply a spatial representation of ecosystem stressors to evaluate the vulnerability of these areas to anthropogenic impacts, namely: vessel traffic, commercial fishing, energy exploration and extraction, and climate change.

Spatial patterns in these data were analyzed using the Important Ecological Area methodology, which has previously been applied to spatial ecological information in Alaska's Arctic waters. We modified the method to measure value relative to a regional neighborhood, which balanced differences in species diversity across the study area and resulted in more well-distributed and geographically diverse set of important areas. We assessed ecological value across hexagonal bins and ecological units for four taxa groups: lower trophic organisms, fishes, birds, and marine mammals, as well as a combined ecosystem assessment. We then combined relative measures of stressor impact with the ecological values to produce a prioritized index of the most vulnerable and valuable areas, offering insight into the interface between ecosystems and human activity. For instance, Unimak Pass and Smith and Harrison Bays were the top-ranked ecological units for birds across the entire project area, while also ranking highest in vessel traffic (Unimak Pass; 1st), oil spill impact probability (Smith and Harrison Bays; 1st), and commercial fishing (Unimak Pass; 2nd). This analysis quantifies the relationship between ecological value and anthropogenic stressor, which can be applied to a variety of management questions.

The Impact of Shelf Break Upwelling on Beaufort Shelf Distributions of Zooplankton and Fish

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The Beaufort Sea experiences frequent upwelling of deep, nutrient rich basin water onto the shelf.Such upwelling transports plankton between shelf and basin, potentially modifying the availability of zooplankton as prey to upper trophic level consumers such as arctic cod, seabirds, and bowhead whales.Two cruises were conducted during late summer 2018 and early fall 2017 from the *R/V Sikuliaq* on the Beaufort Shelf to investigate broad-scale atmospheric forcing, the ocean physical response, and the resulting changes in zooplankton distributions.During early fall 2017, no sea ice was present and two multiple day periods of east winds occurred.Upwelling of deeper water from the basin onto the slope and ultimately the shelf was observed during these periods, with associated reversals in the shelf-break current.Offshore zooplankton including the large copepod *Calanus glacialis* were found further inshore during upwelling where they would be available to bowhead whales.By contrast, during late summer 2018 extensive sea ice cover was present and downwelling west and north winds occurred over most of the cruise. Sentinel isopycnals were deeper during the downwelling of 2018 than during 2017, even during periods of relaxation in 2017.A period of upwelling winds at the end of the 2018 cruise produced a muted, only slightly discernible shallowing of the sentinel isopycnals.Qualitative assessment of zooplankton distributions did not reveal substantial differences between different wind conditions in 2018.Acoustic detection of euphausiids and fish using the *Sikuliaq's* EK60 from 2017 revealed substantial patches of both along the shelf-break and slope that were not spatially coincident, supporting observations that arctic cod were not utilizing euphausiids as prey.

Pelagic-Benthic Coupling in the Chukchi Sea Ecosystem: A Key Part of the Arctic Marine Biodiversity Observing Network (AMBON)

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In recent years, reduction of seasonal sea ice in the Chukchi Sea has accelerated as has seawater warming. In 2015, the Arctic Marine Biodiversity Observing Network (AMBON) project was initiated in the U.S. Chukchi Sea as a prototype network to document status and trends in biological systems undergoing these environmental changes. The AMBON project had two field seasons (2015, 2017) and used an interdisciplinary ecosystem approach. A benthic-oriented component collected water column, sediment, and macrofaunal samples at all stations, which included two of the Distributed Biological Observatory (DBO) transect lines: DBO3 in the SE Chukchi Sea and DBO4 in the NE Chukchi Sea. We present results from both field seasons, including: (1) water column chlorophyll (chl) *a*, macronutrients, and stable isotopes of oxygen, which trace melted sea ice in surface waters, (2) surface sediment total organic carbon, nitrogen and isotopic content, and grain size, and (3) macrofaunal community composition, abundance, and biomass. Results indicate higher inventories of water column chl *a* offshore at the DBO3 stations and some other offshore locations. Surface sediment chl *a* inventories reflect higher deposition offshore compared to areas with higher current flow inshore. The summer phytoplankton bloom occurred earlier in 2017, giving phytodetritus more time to settle to the benthos as indicated by higher sediment chl *a* values. The highest benthic biomass was observed at stations dominated by bivalves, a common prey source for Pacific walrus in the Chukchi Sea. High bivalve biomass occurred in both the DBO offshore stations in the SE Chukchi Sea and areas S and SE of Hanna Shoal and the central portions of the northern DBO4 line. Astartid bivalves were dominant in the NE Chukchi Sea, along with maldanid polychaetes, whereas tellinid bivalves dominated the offshore SE Chukchi Sea DBO3 hotspot. Sand dollars dominated a band of coarse sand on the nearest alongshore transect under faster current regimes in the Alaska Coastal Water. We use these data to relate pelagic-benthic coupling processes to the determinants of macrofaunal biodiversity and biomass and to evaluate status and trends in this productive marine ecosystem.

The Arctic Integrated Ecosystem Research Program: Observations of 2017-2018 Conditions and Consequences

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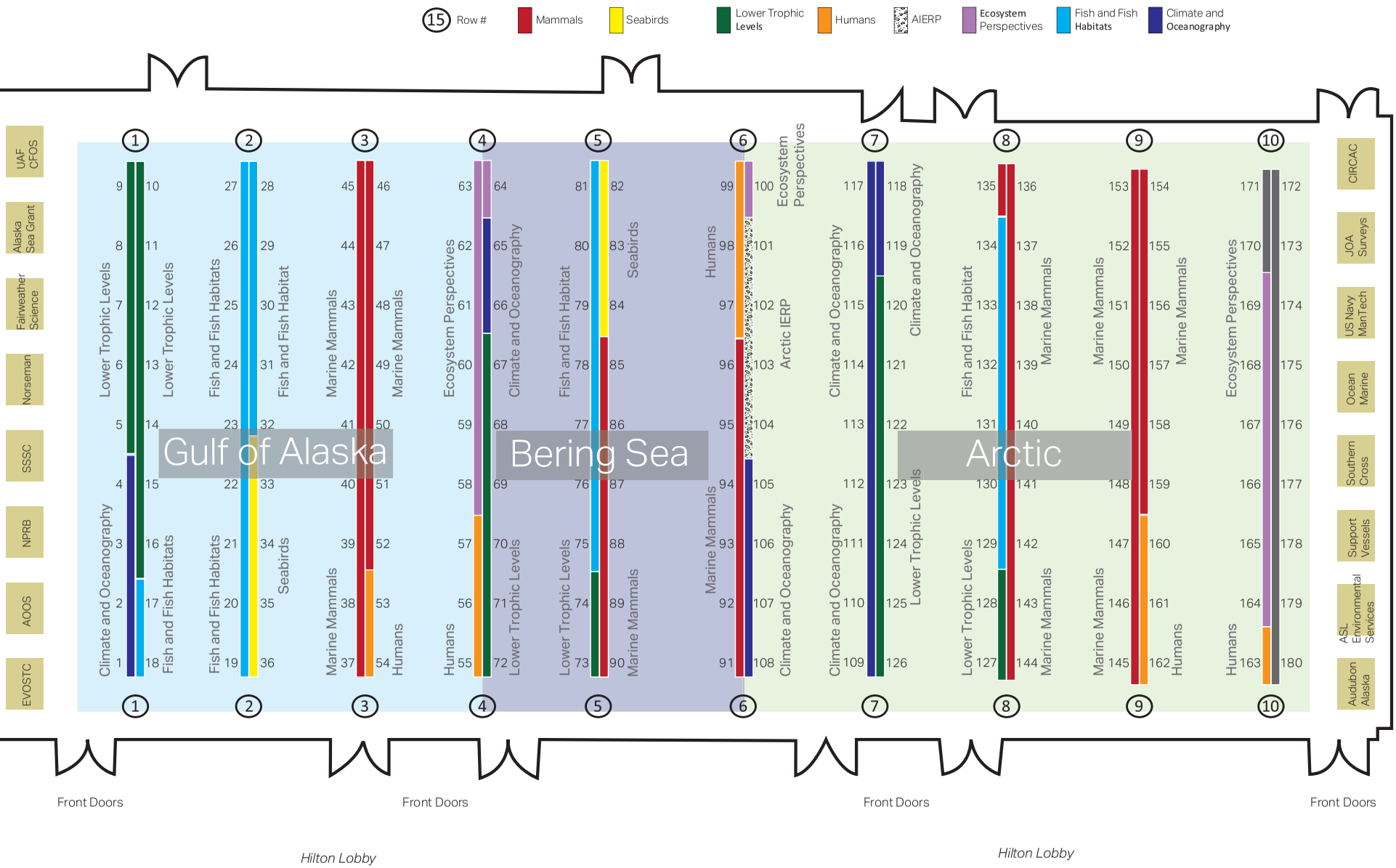
This presentation provides an overview of the Arctic Integrated Ecosystem Research Program IERP (Arctic IERP) effort and highlights results and study implications from the first two field seasons. As a changing climate and sea-ice retreat progressively expose the northern Bering and Chukchi seas to longer open water seasons, society will confront new resource management issues. These include the future of the cultures and subsistence lifestyles of local indigenous communities, potential impacts of industrial activities (e.g. commercial fishing, oil and gas extraction), potential changes to regional ocean carrying capacity, and resilience of the arctic marine ecosystem. To address these issues, the North Pacific Research Board in cooperation with other organizations has funded the Arctic IERP, with the goal to better understand the mechanisms and processes that structure the ecosystem and influence the distribution, life history, and interactions of biological communities in the Chukchi Sea. The Arctic IERP is addressing the overarching question: How will reductions in Arctic sea ice and the associated changes in the physical environmental influence the flow of energy through the ecosystem? With observations from year-round moorings and vessel-based research expeditions in late spring and late summer, the Arctic IERP is contributing to a more comprehensive understanding of Bering-Chukchi ecosystem dynamics. Results reflect the transport, seasonal composition, distribution, and production of phytoplankton, particulate matter, zooplankton, fishes, benthic invertebrates, seabirds, and marine mammals; the timing, magnitude and fate of the primary and secondary productivity; the partitioning/flux of energy between pelagic and benthic realms; and fundamental physical, geochemical, and biological rates. These are interpreted in the context of human use of, and interaction with, the marine environment. Anomalous environmental conditions during 2017 and 2018 — including a dramatic lack of sea ice well into winter and early spring— were a marked change even from recent unusually warm years. Such conditions may come to be considered normal in future years. These results suggest the potential for permeating future transformations of the regional food web (e.g., altered distributions of keystone species such as Arctic Cod) and associated human impacts.

POSTER PRESENTATIONS


15 Row #
Mammals
Seabirds
Lower Trophic Levels
Humans
AIERP
Ecosystem Perspectives
Fish and Fish Habitats
Climate and Oceanography
UAF CFOS
Alaska Sea Grant
Fairweather Science
Norseman
SSSC
NPRB
AOOS
EVOSTC
CIRCAC
JOA Surveys
US Navy ManTech
Ocean Marine
Southern Cross
Support Vessels
ASL Environmental Services
Audubon Alaska
Gulf of Alaska
Bering Sea
Arctic
Front Doors
Front Doors
Front Doors
Front Doors
Hilton Lobby
Hilton Lobby

MONDAY, JANUARY 28, 2019

WAVE 1
GULF OF ALASKA/BERING SEA

(6:00 PM TO 7:30 PM)

POSTER PRESENTATIONS: MONDAY, WAVE 1 6:30PM - 7:45PM
GULF OF ALASKA & BERING SEA/ALEUTIANS

TITLE	PRESENTER	SECTION	LOCATION (row & poster)
Coastal surface ocean CO2 dynamics revealed by an Alaskan ferry	Wiley Evans, Geoffrey Lebon, Christen Harrington, Allison Bidlack	Climate and Oceanography	R1 , P1
Seasonal and spatial variability in ocean acidification conditions in Kachemak Bay and Cook Inlet Alaska	Kristine Holderied, James Schloemer, Kimberly Schuster, Steve Baird, Dominic Hondolero	Climate and Oceanography	
Yakutat Wave Energy Study	Manuel Castellote, Jeremy Kasper, Andrew Seitz, Kathleen Stafford	Climate and Oceanography	R1 , P4
Monitoring Ocean Acidification in Southeast Alaskan Communities	Esther Kennedy, Aidan Crawford, Kari Lanphier, Wiley Evans	Climate and Oceanography	
Comparing intertidal food web and community structure across two regions of lower Cook Inlet	Danielle Siegert, Katrin Iken, Susan Saupe, Mandy Lindeberg	Lower Trophic Levels	R1 , P6
Variability of zooplankton abundance and community structure in Kachemak Bay and lower Cook Inlet from 2012 to 2017	Kimberly Powell Schuster, James Schloemer, Kristine Holderied, Dominic Hondolero	Lower Trophic Levels	
After the Pacific warm event: Phytoplankton monitoring in Kachemak Bay, Alaska	Dominic Hondolero, Kristine Holderied, Kim Schuster, James Schloemer, Steve Kibler, Mark Vandersea	Lower Trophic Levels	
Innovating kelp aquaculture methods by studying the life cycle of Saccharina latissima	Annie Raymond, Michael Stekoll	Lower Trophic Levels	R1 , P9
Morphologies of Alaria marginata within the City and Bureau of Juneau, Alaska	Trevor McLean, Annie Raymond, Michael Stekoll	Lower Trophic Levels	R1 , P11
The PWS Plankton Cam: an in situ look into the zooplankton ecosystem of Prince William Sound	Robert Campbell, Jules Jaffe, Paul Roberts	Lower Trophic Levels	R1 , P13
Environmental heterogeneity in the northern Gulf of Alaska impacts physiological status in the copepod Neocalanus flemingeri	Vittoria Roncalli, Matthew Cieslak, Russell Hopcroft, Petra Lenz	Lower Trophic Levels	R1 , P15
Zooplankton abundance trends and patterns in the Shelikof Strait, western Gulf of Alaska 1990-2016	David Kimmel, Janet Duffy-Anderson	Lower Trophic Levels	
Estimates of productivity for Northeast Pacific herring (Clupea pallasii) stocks using Bayesian inference	Jessica Gill, Sean Cox	Fishes and Fish Habitats	R1 , P17
Fish community structure related to water flow at river mouths in southcentral Alaska.	Chris Guo	Fishes and Fish Habitats	R2 , P19
A Case Study of Biological and Social Effects of Climate Change and Earlier Salmon Migration.	Ana Christine Tafoya	Fishes and Fish Habitats	R2 , P21
Evaluation of productivity and escapement quality trends in Cook Inlet and Yukon River Chinook salmon (Oncorhynchus tshawytscha) stocks	Holly Smith, Brad Harris, Curry Cunningham	Fishes and Fish Habitats	R2 , P23
A quantitative histological index to differentiate between endemic and epidemic ichtyophoniasis in Pacific herring	Maya Groner, Eliana Bravo, Carla Conway, Jacob Gregg, Paul Hershberger	Fishes and Fish Habitats	R2 , P25
Evaluating the effects of a changing ecosystem on juvenile and adult survival of Pacific herring (Clupea pallasii) in Prince William Sound, Alaska	JohnTrochta, TrevorBranch	Fishes and Fish Habitats	R2 , P27
Fatty acid profiles in muscle of Alaska Pacific Halibut: Associations with region, age-class and mercury content	Christoff Furin, Robert Gerlach, Birgit Hagedorn, Claude Dykstra, Todd O'Hara	Fishes and Fish Habitats	R2 , P28
Juvenile Pacific cod abundance and condition in the western Gulf of Alaska	Alisa Abookire, Michael Litzow, Benjamin Laurel	Fishes and Fish Habitats	R2 , P29

TITLE	PRESENTER	SECTION	LOCATION (row & poster)
Long term shedding of viral hemorrhagic septicemia virus from Pacific herring	Paul Hershberger, Ashley MacKenzie, Jake Gregg, Rachel Powers, Maureen Purcell	Fishes and Fish Habitats	
One Size Fits All? Development and evaluation of a life stage specific bioenergetics model for young-of-the-year Sablefish (Anoplopoma fimbria).	Joseph Krieger, Anne Beaudreau, Ron Heintz	Fishes and Fish Habitats	
Long-lived marine fish employing broadcast spawning may be resilient to environmental variability: a selective sieve hypothesis	Jacek Maselko	Fishes and Fish Habitats	
Seabird studies during the Northern Gulf of Alaska Long Term Ecological Research Program	Daniel Cushing, Kathy Kuletz, Elizabeth Labunski, Russell Hopcroft	Seabirds	R2 , P33
Development of new tufted puffin monitoring protocol	Aaron Christ, Brie Drummond	Seabirds	
Seabird breeding failures following the marine heat wave of 2014-2016	Sarah Schoen, Mayumi Arimitsu, John Piatt, Brielle Heflin, Caitlin Marsteller	Seabirds	
Kamishak Bay Rhythms: Seasonal Changes in the Community Structure and Distribution of Marine Mammals, 2004–2018	Adrian Gall, Robert Day, Alex Prichard	Mammals	R3 , P37
Spatial distribution of fin (Balaenoptera physalus) and humpback (Megaptera noveangeliae) whales in relation to acoustically-sensed prey distribution and environment.	Abigail McCarthy	Mammals	
Capturing, disentangling, and tracking the movements of sub-adult and adult male Steller sea lions in Southeast Alaska	Lauri Jemison, Kim Raum-Suryan, Michael Rehberg, Kate Savage	Mammals	R3 , P39
Reproductive Status of Female Beluga Whales in the Endangered Cook Inlet Population	Kim Shelden, John Burns, Kathleen Burek-Huntington, Tamara McGuire, Dan Vos, Barbara Mahoney	Mammals	
Cook Inlet beluga whale (Delphinapterus leucas) intra-annual presence, sighting trends, and habitat use near Beluga, Alaska	Sioned Sitkiewicz, Willow Hetrick, Kathleen Leonard, Maile Branson, Sheyna Wisdom	Mammals	R3 , P42
Biomarkers for Reproduction and Metabolism in Large Whales from the North Pacific	Valentina Melica, Shannon Atkinson DeMaster, John Calambokidis, Diane Gendron	Mammals	R3 , P44
Characterizing the likelihood of juvenile Steller sea lion mortality from behavioral and space use patterns	Amanda Bishop, Alexandra Dubel, Renae Sattler, Casey Brown, Markus Horning	Mammals	R3 , P46
Fatty acid signature analysis of harbor seals in Alaska, 1997-2010	Victoria Neises, Ryan King, Mandy Keogh, Shawna Karpovich, Stephen Trumble	Mammals	R3 , P48
Where are they now? Use of long-term photo-identification records to monitor individual Cook Inlet belugas following acute disturbance events and chronic disease.	Tamara McGuire, Amber Stephens, John McClung	Mammals	R3 , P49
Serology and Parasitology of Stranded Marine Mammals in Alaska 2013-2018	Kathleen Woodie, Natalie Rouse, Jane Belovarac, Sarah McMillen, Caroline E.C.Goertz	Mammals	R3 , P50
An Unfortunate Legacy: Continuing Effects of the Exxon Valdez Oil Spill on Killer Whales	Craig Matkin, Dan Olsen, Graeme Ellis	Mammals	R3 , P52
The first successful Steller sea lion satellite flipper tag deployment: New application yields promising results	Kimberly Raum-Suryan, Lauri Jemison, Kate Savage, Michael Rehberg	Mammals	
Timelapse photography to assess bear and visitor activity patterns on coastal sedge meadows in Katmai National Park	Kelsey Griffin	Mammals	
Microplastics in Tribal Subsistence Foods in Southeast Alaska	Helen Dangel, Naomi Bargmann	Humans	
Bridging local ecological knowledge and survey data to improve assessment and management of rockfishes in Alaska	Jesse Gordon, Anne Beaudreau, Scott Meyer, Benjamin Williams	Humans	R3 , P54

TITLE	PRESENTER	SECTION	LOCATION (row & poster)
NPRB 1801: Prevalence of Paralytic Shellfish Toxins in the Marine Food Webs of Prince William Sound and Kachemak Bay, Alaska.	Steve Kibler, Xiuning Du, Rob Campbell, Kris Holderied, Dominic Hondolero, Kimberly Powell Schuster, Rose Robinson, Mayumi Arimitsu, John Piatt	Humans	
Community-Based Mitigation of Harmful Algal Blooms and Shellfish Poisonings in Southeast Alaska	Esther Kennedy, Kari Lanphier, Chris Whitehead	Humans	
Communicating management practice with videogames	Milo Adkison	Humans	R4 , P57
Where carnivores clash: Evidence of competition - Prey-shifting by brown bears during a period of sea otter recovery	Heather Coletti, Grant Hilderbrand, Daniel Monson, Joy Erlenbach, Brenda Ballachey, Benjamin Pister, Buck Mangipane	Ecosystem Perspectives	
Patterns of Ichthyophonus sp. infection in age zero Pacific herring	Catrin Wendt, Paul Hershberger, Chelsea Wood	Ecosystem Perspectives	R4 , P60
Three Decades Later: Volunteers Continue to Photograph Inter-annual Variability of Rocky Shoreline Marine Life in Prince William Sound	Alan Mearns, David Janka, Scott Pegau	Ecosystem Perspectives	
Using Circulation Mapping and Long-term Water Quality Data to Aid Community Monitoring Programs in Kachemak Bay, Alaska	James Schloemer, Steve Baird, Rosie Masui, Syverine Bentz, Mark Johnson	Ecosystem Perspectives	R4 , P62
Clam Predation Patterns as a Way of Understanding Sea Star Wasting Disease's Impacts in Kachemak Bay	Tibor Dorsaz, Brenda Konar	Ecosystem Perspectives	R4 , P64
Improving Communication of Coastal Flood Warnings to Western Alaska Communities	Edward Plumb	Climate and Oceanography	
Accounting for shifting distributions and changing productivity in the development and use of scientific advice for fisheries management: from detection to management action	Melissa Karp, Jay Peterson, Patrick Lynch, Roger Griffis, Jane DiCosimo	Climate and Oceanography	
Mercury concentrations and speciation in seawater and zooplankton of the southeastern Bering Sea	Zofia Baumann, Wesley Huffman, Mary Beth Decker, Brian DiMento, Patricia Myer, Robert Mason, Hans Dam	Lower Trophic Levels	R4 , P67
An improved Target Strength model for Bering Sea and Gulf of Alaska krill validated by ship-board backscatter and material property measurements from individual animals.	Brandyn Lucca, Joseph Warren, Patrick Ressler, H. Rodger Harvey, Georgina Gibson	Lower Trophic Levels	R4 , P69
Target Strength Calibration through Parallel Measures of Intact Lipid Classes and Acoustic Profiles of Individual Euphausiids	H. Rodger Harvey, Joseph D. Warren, Patrick H. Ressler, Brandyn Lucca, Rachel McMahon, Rachel Pleuthner	Lower Trophic Levels	R4 , P71
Coccolithophore population dynamics in the Eastern Bering Sea	Tanika Ladd, Debora Iglesias-Rodriguez	Lower Trophic Levels	R5 , P73
Variation in the subsurface optical environment of the eastern Bering Sea: A novel approach to estimating apparent optical properties during bottom-trawl surveys	Sean Rohan, Stan Kotwicki, Edward Laman, Lyle Britt, David Beauchamp, Kerim Aydin, Stephani Zador	Fishes and Fish Habitats	R5 , P75
Reexamining an assumption about marine mortality of Chinook salmon	Andrew Seitz, Michael Courtney, Kaitlyn Manishin, Peter Westley	Fishes and Fish Habitats	R5 , P76
An assessment of biennial spawning in Chionoecetes opilio in relation to temperatures in the Eastern Bering Sea'	Jennifer Gardner, Robert Foy, Katherine Swiney	Fishes and Fish Habitats	
Catch Accounting and Vitality Metrics for Trawl-Bycaught Red King Crab in the Bering Sea	Bradley Harris, Noelle Yochum, Cory Lescher	Fishes and Fish Habitats	R5 , P78
Preliminary observations of walleye pollock response to survey bottom trawls.	Stan Kotwicki, Liz Dawson, Alex De Robertis, Kresimir Williams, Lyle Britt, Shawn Russell	Fishes and Fish Habitats	
Distribution, life history, and reproductive biology of spawning Capelin Mallotus villosus in Norton Sound, Alaska	Kirsten Ressel, Beth Mikow, Jenefer Bell, Trent Sutton	Fishes and Fish Habitats	R5 , P79

Coastal Surface Ocean CO2 Dynamics Revealed by an Alaskan ferry

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From October 2017 to October 2018, the Alaska Marine Highway System M/V Columbia has served as a key platform for oceanographic data collection while conducting ~800-nm transits between Bellingham WA and Skagway AK each week. Data collected while the vessel was underway included sea surface temperature, salinity, dissolved oxygen content, seawater carbon dioxide partial pressure (pCO_2), and atmospheric pCO_2. Water-side measurements were made on seawater drawn into the vessel through an intake located on the haul 2 m below the waterline. Seawater was circulated past a Sea-Bird Electronics SBE 38 Digital Oceanographic Thermometer located at the intake to a General Oceanics 8050 pCO_2 Measuring System coupled with a Sea-Bird Electronics SBE 45 Thermosalinograph and an Aanderaa 4330F oxygen optode located on the car-deck before exiting the vessel. Seawater measurements were made every ~2.5 minutes. Air-side measurements were made every ~2 hours on marine air drawn to the 8050 via a sample line mounted to a mast on the foredeck. Discrete seawater samples were collected during two cruises aboard the M/V Columbia, in November and August, were analyzed for pCO_2 and total dissolved inorganic carbon content, and then used to validate a previously-published total alkalinity-salinity relationship. This relationship was subsequently used with the direct seawater measurements to determine the full marine CO_2 system. Results from the M/V Columbia dataset revealed dynamics that had been previously undocumented in many areas of the coastal margin between British Columbia and southeast Alaska. Specifically, contrasting regions that exhibited diverging seasonal dynamic ranges of CO_2 system parameters related to patterns in freshwater input, high summer primary productivity, and vertical mixing. Using these data, surface water anthropogenic CO_2 content was estimated and showed a large gradient coincident with the gradient in observed dynamic ranges. A hindcast and forecast of surface marine CO_2 parameters was subsequently calculated using our estimation of anthropogenic CO_2 and the high emissions (business as usual) Representative Concentration Pathway (RCP 8.5). These data and calculations point to a dynamic seascape of shifting surface water CO_2 system parameters with potential implications for species vulnerable to carbonate mineral instability and low-pH conditions.

Seasonal and Spatial Variability in Ocean Acidification Conditions in Kachemak Bay and Cook Inlet Alaska

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Poster Presenter: Kristine Holderied

Coastal marine species and mariculture operations in the northern Gulf of Alaska have the potential to be adversely affected in the near-term by ocean acidification, due to the presence of waters with low pH and low aragonite saturation at deeper depths on the shelf. Estuary waters in this region experience changes in pH and carbonate chemistry from upwelling of shelf waters, from freshwater input associated with precipitation, glaciers and snowpack melt and from phytoplankton blooms. Seasonal, interannual and spatial variability in ocean acidification are being assessed in Kachemak Bay and lower Cook Inlet Alaska with routine monitoring from small boat oceanographic surveys and near-shore water quality stations. On shipboard surveys, near surface and near-bottom water samples were collected with a Niskin bottle, preserved and analyzed for carbonate chemistry parameters at the Aluutiq Pride shellfish hatchery laboratory. Coincident vertical profiles of oceanographic data were made with a SeaBird Electronics SEACAT 19plus conductivity-temperature-depth (CTD) profiler. Results from water column sampling showed a consistent seasonal cycle in mid-Kachemak Bay, with lower aragonite saturation in the fall than in spring or summer. Less seasonal variability was observed in outer Kachemak Bay and southeast Cook Inlet. The pH measurements from continuous sampling at Kachemak Bay National Estuarine Research Reserve stations in Seldovia and Homer harbors showed similar seasonal variability, but also captured higher-frequency changes within the seasonal cycle. Marine species in estuaries are exposed to variability in ocean acidification on daily to seasonal time scales. Characterizing the variability in ocean acidification in coastal waters will help assess both the resilience and vulnerability of near-shore species to long-term changes in carbonate chemistry associated with climate change.

Yakutat Wave Energy Study

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The development and implementation of ocean wave energy technology is advancing rapidly and has the potential to provide long-term renewable energy to remote Alaska villages with access to the ocean, in areas with favorable wave conditions. Yakutat, Alaska, is a village on the outer coast of the Gulf of Alaska that currently relies on barged-in fuel oil for heat and electricity. It is also a region with good access to the ocean and high potential for wave energy projects. The project aims to understand the potential for environmental changes that may be induced by the installation of wave energy converters for generating electricity for the community of Yakutat. In May and June 2018, trawl, hydrographic, beach elevation and photogrammetric surveys were conducted in the shallow waters of- and along- the beach face of the Gulf of Alaska adjacent to Yakutat. In addition, three oceanographic moorings were deployed offshore of the community to document presence of marine mammals, ambient noise baseline, and the physical forces responsible for driving sediment transport and coastal morphology in the region. Some initial findings are presented here including from the fisheries and topo-bathy surveys: mid-water trawling captured very few fishes while bottom trawling produced substantially more fishes, consisting mostly of flatfishes. Only small changes were found in beach elevation between 2018 and the last time such elevation transects were measured, in 2014, with the exception of one transect adjacent to the nearby Situk River which was submerged between 2014 and 2018 due to changes induced by the river.

Monitoring Ocean Acidification in Southeast Alaskan Communities

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Alaskan coastal communities are especially vulnerable to the effects of ocean acidification (OA) due to their reliance on intact marine ecosystems. While much ocean acidification research focuses on long-term trends in the open ocean, there has been increasing interest in collecting nearshore baseline data to better assess the impacts OA will have on access to subsistence resources. The Sitka Tribe of Alaska and Southeast Alaska Tribal Ocean Research (SEATOR) partnership, with the support of Hakai Institute and Alaska Ocean Acidification Network, have begun collecting weekly discrete water samples at important subsistence harvesting locations in six communities in Southeast Alaska: Yakutat, Hoonah, Juneau, Sitka, Petersburg, and Wrangell. This weekly collection documents each community's baseline water conditions using protocols developed by the Hakai Institute and Alutiiq Pride Shellfish Hatchery, and will allow for the development of long-term vulnerability assessments. Discrete samples are collected in sterilized glass bottles, preserved with mercuric chloride, and capped with an airtight seal. Samples are shipped to the Sitka Tribe of Alaska Ocean Chemistry Lab for analysis on the Sitka Tribe's Burke-o-Lator. Sample collection started spring of 2018 and will continue indefinitely. In contrast with other community-based discrete sampling programs, all water samples for this project are collected in parallel with a phytoplankton sample, providing an opportunity to better understand how water chemistry and harmful algal blooms interact. Preliminary data is now available for all six communities, showing interesting seasonal and geographic variability in OA samples and phytoplankton assemblages. As the program continues, this emerging dataset will prove important to validating and expanding on the OA information provided by the Columbia Ferry Burke-o-Lator and other nearshore OA monitoring programs, as well as to developing OA adaptation plans for Southeast Alaskans.

Comparing Intertidal Food Web and Community Structure Across Two Regions of Lower Cook Inlet

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Increased glacial melt, ocean acidification, and ocean temperatures are predicted to affect the functioning of high-latitude marine ecosystems. Some of the more noticeable impacts will likely be in the nearshore environment, particularly in the composition and trophic linkages of nearshore communities. Here we studied community composition and food web structure in Kamishak and Kachemak bays, two regions of lower Cook Inlet with differing environmental conditions. While the regions share many common species, they differ in allochthonous carbon inputs and hydrology, resulting in possible differences in community and trophic structure. Systems like these may be affected differently by potential future climate changes. Specifically, systems with a higher number of species and higher trophic diversity are typically considered more resilient against environmental or anthropogenic perturbations. We hypothesized that taxonomic and trophic diversity would be higher in the more oceanic-influenced Kachemak Bay. Intertidal invertebrate and macroalgal samples and community composition data were collected in summer 2017 and 2018. Trophic diversity metrics, such as trophic niche space, trophic redundancy, and trophic evenness, were calculated from stable carbon and nitrogen isotope values. Intertidal community composition was dominated by different species in the two regions, but about the same number of species made up approximately 90% of the macroalgae and sessile invertebrates. However, there were about twice as many mobile invertebrate species found in Kachemak Bay compared with Kamishak Bay intertidal communities, possibly indicating different trophic linkages. Contrary to our expectation, Kamishak Bay had higher values of trophic niche space, while Kachemak Bay had higher trophic redundancy and a more even trophic distribution of species. Results indicate that intertidal invertebrates in Kamishak Bay are able to capitalize on the more diverse carbon sources (e.g., terrestrial influx from rivers and glaciers) and, thus, increase trophic niche space, possibly representing a stabilizing mechanism on intertidal food webs. However, the higher redundancy of food webs in Kachemak Bay may present a different mechanism to increase trophic resilience in an intertidal system. Going forward, this increased understanding of community function will allow us to better define expectations on how vulnerable or resilient nearshore communities will be to environmental stressors.

Variability of Zooplankton Abundance and Community Structure in Kachemak Bay and Lower Cook Inlet from 2012 to 2017

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Kachemak Bay and lower Cook Inlet, located within the northern Gulf of Alaska, are highly productive marine ecosystems with a diverse zooplankton community that supports higher tropic level species such as commercially important salmon and halibut populations. As a part of the Gulf Watch Alaska program, funded by the Exxon Valdez Oil Spill Trustee Council, we have intensely monitored zooplankton communities and environmental variables in Kachemak Bay and lower Cook Inlet since 2012. The zooplankton community was sampled monthly in Kachemak Bay and quarterly in lower Cook Inlet via 50 meter vertical tows of a 0.333 µm mesh bongo net. Resulting data were analyzed to compare abundance and community structure spatially, between Kachemak Bay and lower Cook Inlet, and temporally, across seasons and across years from 2012 to 2017. Copepods were the dominant zooplankton species throughout the study area; however, it was the rarer species that contributed most to variability in community structure. Within seasons, spatial variability in dominant species was greater than interannual variability. Continuing to characterize the detailed patterns in the zooplankton community, as well as comparing these data to coincident phytoplankton and oceanographic data, will help to assess the response of the base of the food web to changing marine conditions, between relatively cool conditions in 2012 and anomalously warm conditions of the 2014 to 2016 large Pacific marine heat wave. Having intensive sampling data through the Pacific warm anomaly event will give us insight into the implications warmer ocean conditions could have on higher-level consumers such as commercially important fish species and marine mammals and seabirds.

After the Pacific Warm Event: Phytoplankton Monitoring in Kachemak Bay, Alaska

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As part of the Gulf Watch program, funded by the Exxon Valdez Oil Spill Trustee Council, the NOAA Kasitsna Bay Laboratory, working with the Kachemak Bay Research Reserve and other partners, has been conducting research and monitoring of phytoplankton and phytoplankton bloom events in Kachemak Bay and lower Cook Inlet since 2012. In 2014 the Pacific marine heat wave event brought warmer than usual sea surface temperatures that persisted through 2017. Coincident with the warmer sea surface temperatures we observed blooms of Alexandrium, a dinoflagellate which can produce toxins that cause paralytic shellfish poisoning (PSP), that occurred in late summer, resulting in temporary closures for commercial shellfish harvesting and public warnings to recreational harvesters. In 2018, we have seen a return to normal sea surface temperatures in the study area and while the diatom dominated spring phytoplankton was normal, there were changes in later summer patterns from the previous three years. We did not observe a late summer bloom of dinoflagellates, which can include Alexandrium, but this year we saw a second bloom of diatoms that has continued through September. Sea surface temperatures, while cooler than the last 3 years, were well within the temperature range for Alexandrium to persist and bloom. Weather, oceanographic, and nutrient conditions were assessed to help understand seasonal and interannual changes in phytoplankton community composition and abundance of Alexandrium species. Seabird mortality events and declines in cod and salmon populations occurred during the 2014-2016 Pacific heat wave and, as part of an effort to understand the role of toxic algae in these events, in 2018 we also collected samples of zooplankton, forage fish, and predator fish tissues to examine possible transfer of PSP toxins through the marine food web. In the future, we will be examining other factors such as ocean circulation and nutrient availability might have affected phytoplankton bloom dynamics this summer in Kachemak Bay.

Innovating Kelp Aquaculture Methods by Studying the Life Cycle of *Saccharina latissima*

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Poster Presenter: Annie Raymond

Kelp farming has the potential to economically diversify coastal communities while offering potential ecosystem services including carbon sequestration and mitigating the effects of eutrophication. Our research is focused on identifying methods to control life stages of *Saccharina latissima* to optimize kelp aquaculture. First, we investigated the natural fertility patterns of sporophytes, providing insights into when the commercial kelp seeding process can be implemented. Preliminary observations from sporophyte fertility surveys show that *S. latissima* sporophytes arefound in protected sandy habitats attached to shells of bivalves, small cobbles or rocks. There also appears to be site specific variation in population abundance and whether the plants exist as annuals or perennials. Furthermore, observations from sporophyte fertility surveys suggest that *S. latissima* fertility patterns vary between different regions in Alaska. Second, we investigated how growth and development of gametophytes and juvenile sporophytes can be controlled by varying temperature, nutrients, light quality and light intensity. The ability to control the life cycle at these stages will give more flexibility to kelp hatchery operators and farmers. So far we have evaluated a variety of different techniques of halting or delaying gametogenesis. Methods include withholding iron from the gametophyte culture medium and filtering out blue light while gametophytes are in culture, changing light intensity and temperature in which gametophytes are grown. Our preliminary results suggest withholding iron from the gametophytes nutrient medium is a reliable method of halting gametogenesis of *S. latissima* from Juneau. However, filtering out blue light does not appear effective in halting gametogenesis. We have also observed that kelp gametophytes and juvenile sporophytes grow optimally at a moderate light intensity and sporophytes are more sensitive to changes in light intensity then gametophytes. Current experiments are examining how gametophyte and juvenile sporophyte growth can be slowed by varying temperature and light intensity. Preliminary results suggest gametophytes grown under low temperatures (4°C) grow slower and produce less eggs and sporophytes then gametophytes grown at optimal temperatures (12°C). Results from current and upcoming experiments will help inform kelp aquaculture practices and give insight to the ecological life cycle strategy of *S. latissima*.

Morphologies of *Alaria marginata* Within the City and Bureau of Juneau, Alaska

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Alaria marginata (winged kelp) is a low intertidal to high subtidal species of brown algae found throughout Alaska. Sporophytes of *A. marginata* begin growing in late winter/early spring and die back toward the end of summer. Kelp are widely known to demonstrate a wide variety of morphologies within the same species over varying geographic ranges. These differences in morphologies may be due to environmental conditions which promote phenotypic plasticity of kelps or due to genetic differences within populations. Previous work has shown that there is a localized and distinct morphological variant of *A. marginata* near Juneau, AK. This study was initiated to look more closely at *A. marginata* morphology variation at six sites near Juneau. Data on sixteen morphological characteristics including stipe length, rachis width/length, sporophyll number, sporophyll length/width/thickness, holdfast diameter and volume were collected. Preliminary results from Principle Component Analysis (PCA) suggest that rachis width, sporophyll length, thickness and width explain the majority of the variation and may be important features for understanding differences among local populations. Data visualization using PCA suggest there morphological variation between sites and slight variation by depth. Further data analysis is in progress. These data can be useful for both resource managers and phycologists who are trying to decipher the genetic structure of kelp species as the morphological variation may reflect genetic structure. These data also have ecological significance and may give insight as to how foundational species such as kelp are affected by differences in environmental stressors experienced across the local environment.

The PWS Plankton Cam: An *In-situ* Look Into the Zooplankton Ecosystem of Prince William Sound

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As part of the Gulf Watch Alaska program, a profiling mooring has been deployed annually in central Prince William Sound since 2013. The profiler measures temperature, salinity, chlorophyll-a fluorescence, turbidity, and oxygen and nitrate concentrations at approximately 5 cm resolution and does twice-daily casts from ~60 m to the surface during the solar minimum and maximum.

An *in situ* plankton imager for the profiler was designed and built in 2016. The system, based on the Scripps Plankton Camera, was designed to image mesozooplankton and features a 0.137x telecentric lens and a 12 MP color digital camera. It has an imaged volume of ~400 ml per frame at full resolution, with a pixel size of ~20 µm. Operating at 4 Hz, the imager samples approximately 300 liters per cast.

The camera images hundreds to thousands of individual plankters during each profile, totaling several hundred thousand images per year, far more than can be identified manually. A convolutional neural network (CNN) classifier was developed to identify the images. Using a training set of >10000 images identified to 37 taxa based classes, the CNN had ~90% accuracy, although there was some confusion between taxa with similar appearances.

Results from the identifications made with the CNN classifier clearly show the annual transition from large *Neocalanus* copepods in spring, to smaller *Pseudocalanus* and *Metridia* copepods in summer/autumn. Copepods with full guts were often imaged in phytoplankton patches. Diel migratory behavior was noted in several taxa, particularly *Metrida* spp. The camera and profiler will continue to be deployed into the future, giving an unprecedented view into the plankton ecosystem of Prince William Sound.

Environmental Heterogeneity in the Northern Gulf of Alaska Impacts Physiological Status in the Copepod, *Neocalanus flemingeri*

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The northern Gulf of Alaska is characterized by steep environmental gradients that extend from fjordal habitats to offshore oceanic regions with corresponding gradients in the pelagic biological communities, as well as differences in productivity. The copepod *Neocalanus flemingeri* occurs in surface water throughout the region during the spring (March to May). The life cycle of this species is highly synchronized to the seasonal cycle capitalizing upon the spring phytoplankton bloom. Energy stores built during this growth period sustain first deep-water dormancy and then recruitment of the next year's population. The combination of a heterogenous environment and a narrowly-timed growth period raises the question of how existing resource gradients affect development in this species. Here, we investigated organism-environment interactions in *N. flemingeri* pre-adult individuals collected between Prince William Sound and off-shelf waters in the northern Gulf of Alaska. Physiological status was investigated in this copepod species using a new molecular tool, transcriptomics, which can simultaneously assess phenotypic and genotypic divergence among individuals. Copepod collections and concurrent environmental monitoring occurred over a five-day period in May 2015 as part of the Seward Line Long-term Observation Program. Genetic differentiation was low among stations, but gene expression divergence indicated regional differences in development, metabolism and response to stress. Specifically, individuals in Prince William Sound were developmentally more mature and actively accummulating lipids. In contrast, gene expression in individuals from the most offshore stations in the Gulf of Alaska indicated nutritional deficits. Individuals with signature responses to stress were obtained from two stations located in a transition zone between the Alaska Coastal Current and the offshore Alaska Stream. Gene expression divergence in *N. flemingeri* in the Gulf of Alaska suggests physiological acclimation to local conditions: expression profiling of actively swimming individuals collected at six locations indicate large differences in the nutritional environment they were experiencing, including evidence for the presence of localized exogenous stressors. Furthermore, this analysis raised the question whether in 2015 offshore individuals, which physically appeared to be healthy, had sufficient resources to complete their life cycle.

Zooplankton Abundance Trends and Patterns in the Shelikof Strait, Western Gulf of Alaska, 1990-2016

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Poster Presenter: David Kimmel

The objective of this study was to determine if trends and patterns in zooplankton abundance could be detected at a long-term monitoring line in the Shelikof Strait. Consistent zooplankton sampling has occurred in the Shelikof Strait in May since 1990. Dynamic Factor Analysis was used to estimate if common trends were present in multivariate environmental and zooplankton time-series. If trends were present, a non-linear approach, generalized additive models (GAM) was used to relate environmental factors to zooplankton abundance. We detected two common trends in the environmental time-series, the first trend corresponded to phases of the Pacific Decadal Oscillation (PDO) while the second trend corresponded to the phases of the North Pacific Index. One common trend was detected in the zooplankton time series and GAMs found significant relationships between selected environmental variables and specific zooplankton species life-history stages. Specifically, positive PDO periods were characterized by increases in the abundance of multiple species, including *Calanus marshallae* C5 and euphausiid furcilia, and declines in the C4 stages of *Neocalanus cristatus* and *Neocalanus* spp. (*N. plumchrus/N. flemingeri*). The primary environmental factors related to changes in zooplankton abundance were temperature, intensity of upwelling, and wind speed and direction. Long-term increases in the abundance of *C. pacificus* C5 and long-term declines in the abundances of *N. cristatus*C4 and *Neocalanus* spp. C4 were detected. Other species and stages did not show long-term trends. Results suggest that the zooplankton community in Shelikof Strait responds most strongly to interannual trends in regional oceanography, but also appears to be responding to longer term trends in warming.

Estimates of Productivity for Northeast Pacific Herring (*Clupea pallasii*) Stocks Using Bayesian Inference

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Poster Presenter: Jessica Gill

The population dynamics of marine fishes are thought to be affected by their physical environment and intrinsic stock productivity. The productivity of many fishes, such as salmon and some species of forage fish, have been linked to large- and small-scale environmental variability. For another forage fish species, Pacific herring (*Clupea pallasii*), results of studies attempting to establish a link between stock productivity and environmental variability have been inconsistent. In this study, I estimate productivity of 25 Pacific herring stocks along the Northeast Pacific coast, using a Bayesian surplus production model fit to spawning stock biomass estimates. My results show that environmental variability likely does not drive population dynamics for most spawning stocks.

Fish Community Structure Related to Water Flow at River Mouths in Southcentral Alaska

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Poster Presenter: Chris Guo

As future climate scenarios unfold, biological responses to shifts in habitat will be a valuable data source for coastal communities that are seeking ecological information. The Gulf of Alaska's estuarine systems are strongly shaped by hydrology, and proposed climate effects will alter the physical structure and seasonal timing of these habitats. Estuaries are known to be critical nursery grounds for many fish species in Alaska, such as salmonids, forage fish, gadids, and other ecological role-players. Thus, the environmental conditions that estuarine fish are exposed to are very likely contributing to the structure of the community. I hypothesized that fish communities inhabiting river mouths would be structured differently in high and low water flow conditions. During the summer and fall of 2018, flow measurements were collected at six river mouth sites in Kachemak Bay located in lower Cook Inlet, AK, using continuous acceleration and magnetic bearing loggers. These sites were chosen based on differences in exposure to the prevailing ocean circulation patterns. During the same time period, river mouth fish were sampled about every two weeks via beach seine to measure community structure (i.e., species frequency, abundance, and size). In addition to water flow, various habitat conditions (i.e., temperature, salinity, dissolved oxygen, turbidity, and substrate) were collected to account for other possible drivers of site variability. All sites exhibited temporal trends in species occurrence and water conditions. The direction of water flow differed among the sites. The major groups of fish caught were salmonids, flatfish, gaddids, cottids, and forage fish. Salmonids were caught more frequently in the early sampling period, whereas forage fish became more abundant as the season progressed. A few species were typically more abundant than others within a single seining effort, but the same species were not always dominant in replicate seines. The results can be used to update and fortify the broader ecological understanding of estuaries, particularly in relation to water flow conditions. These findings can help inform coastal communities and managers of the role of estuaries as habitat for nearshore fish communities in southcentral Alaska.

A Case Study of Biological and Social Effects of Climate Change and Earlier Salmon Migration

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Poster Presenter: Ana Christine Tafoya

I developed an interrupted case study teaching module to help high school students explore the biological and social effects of shifts in the timing of salmon migration. The case study incorporates figures and results from a published, peer-reviewed scientific article describing earlier migration timing of Auke Creek salmon. High school students were given the case study, which includes fictional characters used to introduce scientific content, and then assigned to small discussion groups to deepen their understanding of the biological and social implications of changes in salmon migration. After the small group discussions, a whole class discussion was used to synthesize small group insights and to facilitate better understanding of the concepts by all students. Students were given a questionnaire before and after the case study to assess their knowledge. Results and student feedback, along with subsequent efforts to improve the case study, will be presented.

Evaluation of Productivity and Escapement Quality Trends in Cook Inlet and Yukon River Chinook Salmon (*Oncorhynchus tshawytscha*) Stocks

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Cook Inlet and Yukon River Chinook salmon (*Oncorhynchus tshawytscha*) stocks have recently exhibited below average productivity (recruits per spawner), coinciding with fluctuations in escapement quality (age, sex, and length compositions). Reductions in run size have led to emergency restrictions and fisheries closures, and have strained already difficult allocation issues between sport, commercial, and subsistence users of this economically and culturally valuable fish. The fluctuations in escapement quality, including a transition toward younger ocean age at return, smaller average size, and male-biased sex ratios, highlight the need to evaluate the factors that may be influencing Chinook salmon survival and maturation schedules. The similarity in the declines in productivity and escapement quality between these geographically-disparate spawning stocks suggests common causes in the shared ocean environment may be responsible, rather than specific freshwater environments. This project will combine previously-completed productivity analysis with new analysis of the quality of returns by brood year to provide a more complete picture on biological trends amongst regions. Multivariate regression analysis will be used to investigate potential relationships between basin-wide and localized ocean condition variables and the quality of returns. Results from these analyses will provide managers and researchers with increased understanding of escapement quality trends that may affect potential future productivity of Chinook salmon stocks across Alaska, as well as the relationships between variable ocean conditions and these trends.

A Quantitative Histological Index to Differentiate Between Endemic and Epidemic Ichtyhophoniasis in Pacific Herring

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Poster Presenter: Maya Groner

Epidemics of marine diseases can cause substantial mortality in host populations, while endemic diseases may have only mild impacts. In fisheries, differentiating between these two disease states is critical for management, yet extremely difficult to deduce. A recent decline in Pacific herring abundance from Sitka Sound, Alaska was associated with changes in the infection prevalence of *Ichthyophonus* sp., a parasite that typically occurs in a low level endemic state throughout the NE Pacific. Qualitative assessments of fish health during this period indicated that the population changes may have occurred concomitantly with increases in infection severity. Because there is no evidence to indicate that Pacific herring recover from ichthyophoniasis, the disease caused by infection with *Ichthyophonus* sp., the most parsimonious explanation for these observations involves an increase in disease mortality resulting from higher infection loads during recent years. Here we describe the results of current efforts to confirm these qualitative observations by establishing a quantitative disease severity index. The disease severity index consists of establishing a histological threshold of infection intensity, above which herring are predisposed to mortality from the disease. Once established, this threshold will be applied to a time series of histological samples that were collected before, during, and after the recent population changes in Sitka Sound and a reference location (Prince William Sound). These results will inform a new mathematical model intended to assess the possible role(s) of ichthyohoniasis in the recent population changes.

Evaluating the Effects of a Changing Ecosystem on Juvenile and Adult Survival of Pacific Herring (*Clupea pallasii*) in Prince William Sound, Alaska

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Poster Presenter: John Trochta

We investigate how a changing ecosystem may impact Pacific herring (*Clupea pallasii*) population dynamics in Prince William Sound (PWS), Alaska. The PWS herring collapsed in the early 1990's and have yet to recover from low abundance that has remained below the lower regulatory threshold (i.e. below which the fishery is closed) of 20,000 metric tons. The collapse and failed recovery continue to motivate research into improving the model of herring population dynamics for fisheries management. We aim to specifically improve the predictability of herring recruitment and spawning stock biomass by including physical and ecological data in a Bayesian age-structured assessment model. Effects from the physical environment (e.g. sea surface temperature, air temperature, freshwater discharge, and sea level) and interspecific interactions (e.g. pink salmon, humpback whales, and pollock) are modeled as covariates on either adult or juvenile survival in the assessment model. This effort builds upon previous hypothesis tests and reviews that examined the potential causes of both herring collapse and recovery failure, synthesizing past and more recent hypotheses with updated data and new data sets altogether in a new modeling framework. With a suite of Bayesian model selection methods, our results reveal which effects best improve the model while further extending the utility of the herring stock assessment to project biomass dynamics under different environmental conditions.

Fatty Acid Profiles in Muscle of Alaska Pacific Halibut: Associations with Region, Age-Class and Mercury Content

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Poster Presenter: Christoff Furin

Fatty acid (FA) profiles were obtained for 103 muscle tissue samples collected from Pacific halibut during the International Pacific Halibut Commission's annual setline surveys in Alaskan waters (2002-2011). Fish were from 7 regions across Alaskan waters. FA profiles were examined in light of trophic status based on N stable isotopes, location, and total mercury content (THg). Lipid profiles varied by region and age/length, with region being the most important factor predicting halibut FA profiles. In general, halibut collected in Prince William Sound and the Eastern Aleutian Islands stood out from those collected in the Gulf of Alaska. Prince William Sound halibut had the highest proportion of omega-3 polyunsaturated fatty acids (PUFAs), on average, but contained the least amount by mass due to lower total lipid content. Smaller, younger fish tended to have more omega-3 PUFAs than larger, older fish. Combining multiple ecological chemical tracers can be an effective method to distinguish geographical trophic, and population patterns and dynamics.

Juvenile Pacific Cod Abundance and Condition in the Western Gulf of Alaska

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Poster Presenter: Alisa Abookire

Poor juvenile survival during the 2014-2016 marine heatwave appears to have been a leading cause of the collapse of the Gulf of Alaska Pacific cod (*Gadus macrocephalus*) stock. In 2018, a Cooperative Research project between the Alaska Fisheries Science Center (AFSC) and University of Alaska Fairbanks (UAF) was established to address factors regulating post-settlement survival and condition for juvenile Pacific cod across the western Gulf of Alaska, from Kodiak to the Shumagin Islands, in order to better understand the factors regulating stock recovery, and to provide managers with early information on recruitment strength. During July and August 2018, we sampled shallow nearshore habitat utilized by age-0 cod with 130 beach seine sets in 14 bays. Most sites were sampled on both the outbound leg from Kodiak to the Shumagins, and on the return leg, in order to resolve seasonal patterns in abundance, growth, condition, and diet. For each set, habitat information, temperature, and salinity were recorded. Pacific cod were the most abundant species in beach seines, and juveniles of several other commercially important species were also well sampled. We captured approximately 18,600 juvenile cod, measured 4,337 cod, retained 2,156 cod for laboratory analysis, and retained fin clips from 345 cod for genetics analysis. Other gadid species captured and measured were walleye pollock (*Gadus chalcogrammus*) and saffron cod (*Eleginus gracilis*). Laboratory analysis of juvenile cod condition and diets is currently under way. With continued sampling in coming years, this joint research project will monitor changes in juvenile Pacific cod abundance and provide information on the mechanisms that regulate demographic variability of age-0 Pacific cod in the GOA.

Long Term Shedding of Viral Hemorrhagic Septicemia Virus from Pacific Herring

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Processes that allow viral hemorrhagic septicemia (VHS) virus to persist in the marine environment remain enigmatic, owing largely to the occurrence of extremely low host infection prevalence during typical sub-epizootic periods. Traditionally, the involvement of Pacific herring as an effective long term reservoir has been dismissed as unlikely because naïve individuals are considered super-susceptible to the disease, and survivors of the resulting epizootic apparently clear the infection within several weeks. Here we demonstrate that Pacific herring continue to shed VHS virus at extremely low levels for extended periods after surviving a VHS epizootic. Further, these low waterborne VHS virus levels are capable of establishing new infections in naïve Pacific herring for at least 6 months after cessation of the epizootic. This transmission mechanism was not necessarily dependent on the intensity of the initial epizootic, as prolonged transmission was demonstrated from two groups of donor herring that experienced cumulative mortalities of 4% and 30%. These studies provide support for a new VHS virus perpetuation paradigm in the marine environment, whereby herring that survive an epizootic represent effective host reservoirs and are capable of cycling the virus to sympatric cohorts.

One Size Fits All? Development and Evaluation of a Life Stage Specific Bioenergetics Model for Young-Of-The-Year Sablefish (*Anoplopoma fimbria*)

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We measured the effects of temperature on growth, consumption, and respiration rates of wild caught young-of-the-year (YOY) Sablefish (218 – 289 mm TL; *Anoplopoma fimbria*) in laboratory trials. Fish were held over 4 temperature treatments and maintained on *ad libitum* ration for 7 weeks. Physiological response functions were used to outfit a novel, life stage specific bioenergetics model. Average daily growth rates ranged from 46.7 to 122 J $g^{-1}d^{-1}$ (0.82 to 3.42 g d^{-1})with optimum growth occurring at 12°C-16°C, and declining substantially outside of this range. A second growth study was used to corroborate the performance capabilities of our model. Observed growth rates matched well with model estimates. We then demonstrated the importance of including life stage specific physiological response functions by comparing growth estimates from our model to a previous model parameterized with life stage indiscriminate information. Our YOY life-stage specific bioenergetics models was very accurate in forecasting growth of fish in both the first and second experiment. We noted disparities in overall model performance between our model and that of the life-stage indiscriminate model; wherein our model performed better when estimating growth of fish used in our study. A Monte Carlo sensitivity analysis indicated that consumption-related parameters exert the greatest influence on model output; so much so, that we suggest life-stage specific consumption parameters alone may provide sufficient information to describe growth response of YOY Sablefish in the GOA. Our study contributes to ongoing collaborative efforts by management agencies and university researchers to develop a comprehensive mechanistic model describing relationships between Sablefish and habitat conditions through early ontogeny that will provide valuable insight into potential survival bottlenecks and shifts in Sablefish production under future climate scenarios.

Long-Lived Marine Fish Employing Broadcast Spawning May Be Resilient to Environmental Variability: A Selective Sieve Hypothesis

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Poster Presenter: Jacek Maselko

Pacific Ocean Perch (POP) support a prominent commercial fishery in the Gulf of Alaska. They are a long-lived species characterized by widespread larval dispersal in their first year and lifespan of over 100 years. In order to understand how early marine dispersal affects the POP survival and population structure, I used Restriction Site Associated DNA sequencing (RADseq) technique to obtain 11,146 single nucleotide polymorphic (SNPs) sites from 401 Pacific Ocean perch (POP) young of the year (YOY) collected during the 2014 (19 stations) and 2015 (4 stations) NOAA led surveys in the Eastern Gulf of Alaska. Maximum likelihood based clustering (STRUCTURE) analysis showed that the POP samples represented four distinct ancestral populations. These larvae are most likely from various, distinct parturition locations mixing during their pelagic dispersal life stage. Latent factor mixed models were used for genome-wide association study and revealed that POP are facing significant selection forces during their first year at sea as indicated by the gene variants associated with spatial and physiological heterogeneities. These findings support the idea of a *Selective Sieve Hypothesis* where the strongest selection occurs during this critical life stage in response to environmental conditions, food availability, predator abundances, and other external factors. Each adult cohort's DNA sequences are the result of the environmental conditions experienced during their first year at sea. Long-lived species relying on broadcast spawning strategies, may therefore be uniquely resilient to environmental variability by maintaining a portfolio of cohort specific adaptive genotypes.

Seabird Studies During the Northern Gulf of Alaska Long Term Ecological Research Program

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The Northern Gulf of Alaska (NGA) is characterized by high productivity and intense environmental variability, which is hypothesized to drive species responses (and adaptations) towards high resilience. In 2018, a new Long-Term Ecological Research (LTER) site was established in the NGA, building on two decades of multidisciplinary observations along the Seward Line. The NGA-LTER utilizes spatially and temporally expanded series of observations, as well as experimental and modeling components, to evaluate processes that drive productivity, species, and community responses to environmental variability. Vessel-based seabird surveys have been a component of Seward Line research cruises, annually from 1998 - 2003 and 2006 - 2018, with shifts in cross-shelf distribution of seabirds evident under different temperature regimes during the latter period. Seabird surveys continued during NGA-LTER cruises during April-May, July, and September 2018. The NGA-LTER provides a platform for addressing hypotheses about the response of seabirds to the spatial, seasonal, interannual, and regime variabilities of the NGA. The LTER program also provides a framework for cross-system comparisons of seabird community properties and responses with the California Current Ecosystem LTER.

Development of New Tufted Puffin Monitoring Protocol

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Poster Presenter: Aaron Christ

Monitoring burrow nesting birds like tufted puffins (*Fratercula cirrhata*) is particularly onerous because of the difficulty in directly observing nests. The current method used at the Alaska Maritime National Wildlife Refuge, monitoring burrow occupancy on permanently defined plots, can be highly disruptive in delicate environments. We created an alternative protocol to provide similar information with less disruption using transects rather than defined plots. Becasue it is not based on a pre-defined plot, these methods can also be used in areas that are not regularly visited, and results can be compared through time. We present results from our trial sampling on both regularly monitored and unmonitored islands in the Aleutians and western Gulf of Alaska, and we discuss issues for further refinement of this methodology.

Seabird Breeding Failures Following the Marine Heat Wave of 2014-2016

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A prolonged and extreme marine heat wave in the North Pacific Ocean during 2014-2016 precipitated the largest die-off of Common Murres (*Uria aalge*) ever recorded in the North Pacific in 2015-2016. Rates of death were particularly high in the Gulf of Alaska. The evident cause of mortality was starvation, presumably due to insufficient forage availability. In an effort to detect population level effects following the die-off, we studied the demographics of Common Murres and Black-legged Kittiwakes (*Rissa tridactyla*) at two breeding colonies in Cook Inlet (Chisik Island) and Kachemak Bay (Gull Island) during summers 2016-2018 and compared our findings with earlier (1995-1999) demographic studies. We censused whole colony populations and estimated productivity (# chicks fledged/eggs laid). Census counts for murres at Gull steadily declined from a high of 7636 birds in 2016, when they were slightly lower than historic levels (mean 8937 SD 1852), to the lowest ever count of 3147 birds in 2018. In contrast, kittiwake counts at Gull increased from a low of 5141 birds in 2016 to a high of 7479 birds in 2018, similar to historic levels (mean 6988 SD 1179). At Chisik, counts for both species were below historic estimates in all years. For the first time on record, murres at both colonies completely failed to fledge chicks in both 2016 and 2017, and preliminary results indicate they also failed in 2018. Similarly, kittiwake productivity was at or near zero at both colonies in 2016 and 2018, and at Chisik in 2017. In 2017, kittiwakes at Gull produced above average numbers of chicks. In addition to these metrics, we also observed very emaciated murres attending colonies in 2018, which is unprecedented in our experience. Additionally, predators (eagles, falcons, gulls) were observed to cause unusually frequent disruptions of birds attempting to attend nest sites, which also contributed to breeding failures. Overall, seabird populations in Cook Inlet and Kachemak Bay have not recovered following the North Pacific marine heat wave, and continued breeding failures suggest a chronic scarcity of forage fish. Preliminary evidence from concurrent studies of forage fish in lower Cook Inlet support that hypothesis.

Kamishak Bay Rhythms: Seasonal Changes in the Community Structure and Distribution of Marine Mammals, 2004–2018

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Lower Cook Inlet, Alaska is used by marine mammals year-round and contains federally designated critical habitat for two marine mammal species protected under the Endangered Species Act (ESA). We conducted over 170 aerial and boat-based surveys in all months of the year during 2004–2018 to determine the seasonal distribution and patterns of use by marine mammals. Surveys focused on Iliamna and Iniskin bays and the islets and reefs nearby, with some coverage south to Nordyke Island. The community is composed primarily of 2 species: harbor seals, which dominate numerically from the spring through the fall, and sea otters, which dominate numerically from late fall through late winter. Six of the marine mammal species recorded in the study area are classified as being of conservation concern. Of these species, one (sea otter) is protected as a threatened species and two (Steller's sea lion and beluga) are protected as endangered species under the ESA. The highest species richness was recorded in the late winter/spring, when the mammal community was transitioning from a wintering community to a summering one. In winter, most mammals concentrated in the nearshore zone near the mouths of the bays, with small aggregations of sea otters also seen throughout the offshore zone. Sea otters congregated within the bays at times during winter, hauling out on offshore islets and landfast ice shelves. In summer, sea otters were dispersed in singles and pairs and primarily outside of bays whereas harbor seals continued using mudflats and intertidal areas within bays and along the coast as haulouts. Steller's sea lions had two peaks of abundance, one from late March through mid-May and one from late October through mid- or late November. Belugas were recorded during surveys for this study only twice in 9 years of surveys, indicating that they rarely occur in this area. These surveys are unique in providing systematically collected data on monthly changes in distribution of marine mammals in Kamishak Bay.

Spatial Distribution of Fin (*Balaenoptera physalus*) and Humpback (*Megaptera noveangeliae*) Whales in Relation to Acoustically-Sensed Prey Distribution and Environment

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Poster Presenter: Abigail McCarthy

Visual cetacean surveys and simultaneous acoustic-trawl surveys of their potential prey were conducted in two canyons off Kodiak Island in 2004 and 2006. A combination of univariate and multivariate statistical models are used to examine the associations between sightings of fin and humpback whales and measures of their potential prey and environment. Together, these observations and models indicate that Fin whales were disproportionately abundant in areas with the highest observed euphausiid concentrations, while humpback whales were abundant at lower euphausiid concentrations and also in areas where juvenile pollock were abundant. Fin whales were disproportionately abundant in both the areas where krill biomass was deepest and in the deepest areas surveyed (>150 m depth), and humpback whales were primarily found in shallower areas and near shallower krill biomass. The different depth and prey affinities of fin and humpback whales suggest niche and habitat partitioning between these two co-occurring species. Abundance models built using these acoustically sensed data are a useful tool for further understanding of distribution, abundance, and behavior of these animals, and may be useful for future conservation efforts.

Capturing, Disentangling, and Tracking the Movements of Sub-Adult nd Adult Male Steller Sea Lions in Southeast Alaska

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Poster Presenter: Lauri Jemison

The once unfeasible goal of safely capturing and handling sub-adult and adult male Steller sea lions (*Eumetopias jubatus*) is now possible due to development of a drug combination of midazolam, butorphanol, and medetomidine, which provides sedation without respiratory compromise. Since 2013, the Alaska Department of Fish and Game and National Marine Fisheries Service have collaborated to remotely dart and immobilize Steller sea lions entangled in marine debris and fishing gear. During this work we have developed tools and methods for handling and sampling animals that enter the water or remain on shore. Over the past six years, we have immobilized 13 sub-adult and adult male sea lions and disentangled 10 of these individuals. To track animal movements and survival post-disentanglement, we used epoxy to attach SPLASH-F location- and dive-reporting satellite transmitters to the fur of six animals. Because captures are conducted during summer months, these fur-mounted transmitters detach from sea lions during the annual late-summer/fall molt. To overcome this, in 2018 we attached flipper-tag mounted SPOT-6 location-only satellite transmitters to the posterior edge of the foreflipper of three males. This type of attachment is new to otariid work. Here we provide a preliminary summary of the movements of the satellite-tagged males. We compare detailed GPS movement data from the fur-mounted SPLASH transmitters with the Argos location data provided by flipper-mounted SPOT-6 transmitters. The ability to capture and attach satellite tags to sub-adult and adult male Steller sea lions is providing exciting new movement and dive information on this less-studied segment of the population.

Reproductive Status of Female Beluga Whales in the Endangered Cook Inlet Population

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Beluga whales (*Delphinapterus leucas*) of Cook Inlet are a genetically unique and critically endangered population for which adequate life history data are lacking. Here we determined reproductive seasonality and status by examining female reproductive tracts. Our sample of 51 females necropsied between March and November (1995-2014) included hunted (pre-2006), live-stranded (that later died), and beachcast whales. Sexually mature females (n=20) ranged from age-14 to 41 (growth layer groups (GLGs)), immature whales were younger than age-3 (n=7), reproductive status could not be determined for the remainder of the sample. Of mature females, 6 were non-gravid, 10 were pregnant, and 4 were recently post-partum. Ovary weights and/or internal ovarian structures of 14 paired and 4 single ovaries were recorded. Corpora counts (corpora luteum (CL)/albicans (CA)) between paired ovaries did not indicate left-ovary dominance, which has been reported in other cetacean species. Support of a single fetus sometimes involves more than one CL. For example, both ovaries from a pregnant age-23 whale contained two luteinized bodies, one large and one small. We found no evidence of reproductive senility; the oldest whale at age-41 was pregnant. Reproductive tracts from younger (<14 GLGs) and older (>41 GLGs) females are not present in the current dataset and will be necessary to determine age of first reproduction and onset of menopause. For example, a female appeared to be post-partum at age-47. The necropsy report described the uterus as enlarged, measuring 50cm by 45cm. However, the ovaries were not collected, therefore, reproductive status was not confirmed. Photo-ID matches (2005-2014) provided additional insights and suggested age at first birth (~10-13) is similar to other beluga populations. Of the 10 pregnant whales, 2 had early-stage fetuses (<50cm), 2 mid-stage (<70cm), and 6 late-stage (>90cm). Stranded calves-of-the-year first occurred in July, corroborated by photo-ID documentation of neonates July-October. We applied the fetal growth formula per Robeck et al. (2015) to the length data for fetuses, neonates, and calves. Our findings suggest reproductive seasonality with conception (65%) and birth (57%) dates primarily during the periods March-June and July-October, respectively, though conceptions also occurred from late December to mid-February.

Cook Inlet Beluga Whale (*Delphinapterus leucas*) Intra-Annual Presence, Sighting Trends, and Habitat Use Near Beluga, Alaska

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A marine mammal monitoring and mitigation program was implemented from May 9 to September 15, 2018 in the Beluga area on the west side of Cook Inlet, Alaska, as part of Harvest Alaska's Cook Inlet Pipeline extension project. This program provided a unique opportunity to document trends of Cook Inlet beluga whale (*Delphinapterus leucas*) presence and habitat use in the summer period as there are limited data in this area for this species. Observers were stationed at Ladd Landing near Beluga and on the Tyonek Platform to monitor an 8 x 4.5-kilometer zone between the two observation locations during vessel operations and periods of no work. There was a total of 2,067.3 hours of observation time over a period of four months for approximately 12 hours per day during which 143 sightings of approximately 814 individual beluga whales were recorded. The first beluga whale sighting was documented on May 31 and the final sighting occurred on August 28. Most beluga sightings were observed in June (63%, n = 143), followed by July (34%, n = 143), and the majority of these sightings occurred during periods of no vessel work (92%, n = 143). Here we present an overview of observed trends in beluga whale travel trajectory, overall movement patterns, and observed behaviors. Eighty-three percent of all sightings (n = 143) occurred within 3 km of the shoreline, and were generally observed during daytime hours between 0600-1600 (79%). Beluga whales were most commonly present during high flood (21%) and low slack (21%) tides, and least frequently observed during high ebb tide (8%). Most sightings (>50%) were observed heading NNE, and preliminary analyses suggest that beluga whale sighting frequency and heading may correspond with salmon presence in the Little Susitna River. Additionally, these data highlight the importance and potential for industry, regulatory agencies, and the scientific community to collaboratively gather data relevant to areas of biological and environmental concern including; species conservation, marine mammal migration patterns and behavior, fisheries, and future development projects in Cook Inlet.

Biomarkers for Reproduction and Metabolism in Large Whales from the North Pacific

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The goal of this project is to define the interaction among stress response, metabolic status, and reproduction using hormones as biomarkers in two populations of baleen whales from the Eastern North Pacific: the blue whale *(Balaenoptera musculus)* and the gray whale *(Eschrictius robustus).* Both species have been recovering after depletion due to commercial whaling and share their migration routes between the Eastern Tropical and the Eastern North Pacific Ocean. As both species feed on lower trophic levels of the food web, their health status can be significantly affected by changes in oceanographic conditions. Additionally, as the number of whales feeding in the Eastern North Pacific increases, potentially chronic effects of human-whale interactions (e.g., vessel traffic and underwater noise) are of growing concern. Physiological parameters regarding reproduction and metabolic status, used as a proxy for stress-response, are fundamental for assessing long-term effects and can complement photo-identification and behavioral studies as tools to determine population status and well-being. In this study, we propose to develop an interspecies comparison for reproductive and metabolic profiles. Using hormones as biomarkers we aim to evaluate existing relationship among environmental conditions that may become stressors, anthropogenic activities and reproduction. Progesterone, testosterone and cortisol were extracted and validated in blubber samples of blue whales collected from the U.S. West Coast and the Gulf of California. The sample batch included samples from both stranded and live animals. Results indicated that progesterone can be used as indicator of pregnancy, with concentrations being significantly higher (ANOVA $p<0.05$) in pregnant whales compared to lactating, resting and juvenile females. Testosterone concentrations in males were higher in whales sampled off the U.S. West Coast, potentially indicating the onset of breeding behavior. Additionally, testosterone was detected in blubber of pregnant whales and results suggest it might be indicative of gestational stages. Cortisol was higher in stranded individuals and showed variation across reproductive states. This same approach is currently being applied to blubber of gray whales, in order to build an interspecies comparison and fill the gap of knowledge on physiology of large whales.

Characterizing the Likelihood of Juvenile Steller Sea Lion Mortality from Behavioral and Space Use Patterns

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Understanding linkages between behaviors and mortality risk is critical for managing populations. Juveniles often constitute one of the most vulnerable life stages, and there is growing evidence that within life-history stages, individual strategies and behavioral types can also be associated with greater risk of predation and mortality. These forms of predator-prey dynamics are rarely explored in marine environments due to difficulties in confirming vital status of individuals, and the lack of datasets that link known-fate to behavior. We utilized two concurrently collected datasets for juvenile Steller sea lions (SSL; *Eumetopias jubatus*) in the Gulf of Alaska to examine whether mortality due to predation was associated with specific behavioral patterns. We analyzed data from juvenile SSLs captured in the Kenai Fjords-Prince William Sound region (n=38) that were instrumented with external satellite tags and internally implanted vital rate transmitters (LHX tags). As of 2018: 19 juveniles are alive, and 12 animals died with behavioral data that matches the season they died. Using a binomial GLM, we tested whether the probability of mortality for an individual (i.e. alive or dead) was associated with seasonally specific post-release dive patterns (i.e. time wet, dive depth) or horizontal movement patterns (i.e. home range, trip distance). In three cases, external tags were still transmitting up to the time of death. To examine if fine-scale ante-mortem behavioral patterns are linked to predation susceptibility, we present data from a randomization test comparing the dive patterns during both dead and alive animals' last three days of data transmissions to other periods in their tracking data. Results support some evidence that individuals that spent more time dry, had a greater probability of mortality. This may reflect specific foraging tactics of their predators; but with a limited sample size, this pattern is not fully clear and no other dive or behavioral patterns were associated with vital status. This work highlights that further investigation into fine-scale ante-mortem behaviors, linkages between risks and resources, and interactions in a multi-predator system all may provide additional information on the drivers of predator-prey dynamics in marine ecosystems, and will assist future management goals.

Fatty Acid Signature Analysis of Harbor Seals in Alaska, 1997-2010

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The blubber layer of marine mammals is a specialized form of adipose tissue that serves many important functions, including insulation, buoyancy, body streamlining, and fat storage. We examined spatial and temporal trends in the blubber fatty acid composition of Alaskan harbor seals (*Phoca vitulina*). Blubber samples were collected from 760 individuals across 14-years. The five regions sampled included Bristol Bay (n=86), Glacier Bay (n=257), Kodiak (n=72), Prince William Sound (n=255) and Tracy Arms-Fords Terror (n=91). A subset of 16 fatty acids were used in analysis. Distance-based redundancy analysis (db-RDA) using Bray-Curtis distances was used to evaluate the multivariate relationships between predictors (region, season, age class, sex) and response variables (fatty acids). Our results indicate that harbor seal fatty acid profiles vary seasonally within regions and between age classes. In addition, sex differences within those age classes appear to be heavily dependent on the region and season. These data suggest harbor seal fatty acid profiles are seasonally influenced and depend on the energetic needs and foraging strategies of the animals.

Where Are They Now? Use of Long-Term Photo-Identification Records to Monitor Individual Cook Inlet Belugas Following Acute Disturbance Events and Chronic Disease

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Strandings, disease, and human disturbance, including disturbance from research methods, have all been listed as possible threats to the endangered Cook Inlet beluga whale population (CIBW; *Delphinapterus leucas*). While it remains unknown how these threats may affect the population as a whole, longitudinal studies of individuals who have experienced these events may provide insight. The Cook Inlet Beluga Whale Photo-ID Project has identified over 400 individual beluga whales by using natural marks visible in photographs collected from 2005-2018. Photographs have also been provided by the public and by colleagues. Marks used for identification are long-lasting and allow information on individual survival, habitat use, social association, and reproduction (for females) to be collected over time. Although little of a beluga's body is visible in the turbid water of Cook Inlet, photographs also allow for examination of marks resulting from injury and disease on those parts of the body visible above water. Thus, photographic records collected over time following a disturbance event provide a record of wound healing/infection and body condition of affected individuals, while also providing information on survival and reproduction of these individuals. Here we present photographs and post-event sighting histories of identified individual Cook Inlet beluga whales that have experienced live stranding, entanglements, ship strikes, and/or invasive research (tagging, biopsy, flipper banding), and demonstrate the use of long-term photo-id records to monitor individual Cook Inlet belugas following acute disturbance events and chronic disease.

Serology and Parasitology of Stranded Marine Mammals in Alaska 2013-2018

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Since 2013, the Alaska SeaLife Center (ASLC) Wildlife Response program, in cooperation with volunteers and stranding agreement holders across the state, has responded to more than 586 marine mammals representing a vast amount of the Alaskan coastline. These responses represent more than 57% of the ASLC's historical responses since its inception in 1997. When live stranding marine mammals are admitted to the Rehabilitation Program at the ASLC in Seward, Alaska each animal receives a thorough physical exam and biological specimens (blood, urine, feces, mucosal swabs, +/- skin biopsies or hair samples) are collected for routine diagnostics and disease screening. Using samples obtained at admit, all animals are screened for exposure to a variety of diseases known to affect marine mammals and/or humans, which may include: herpesvirus, avian influenza, morbilliviruses, brucellosis, six serovars of leptospirosis, and three types of infectious protozoans. Species screened include: harbor seals, ringed seals, spotted seal, harbor porpoise and Dall's porpoise, beluga, Northern sea otter, and Pacific walrus. Positive antibodies may develop for multiple reasons including exposure, acute disease, or transfer of maternal antibodies. In cases of live stranded animals with positive testing, serial sampling post treatment confirmed resolution of disease. While disease exposure rates in stranded marine mammals are different than the overall population, any positive findings indicate that the disease is active within the wild populations and may be present within a geographical region. These tests not only aid in the diagnosis of ASLC's rehabilitating animals and thus aid their individual treatment, but they also provide a means for disease surveillance among Alaska's scarcely monitored populations of marine wildlife.

An Unfortunate Legacy: Continuing Effects of the *Exxon Valdez* Oil Spill on Killer Whales

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Resident (fish eating) and transient (mammal eating) killer whales have been systematically monitored in Prince William Sound since 1984. Pre-spill data allowed an assessment of damages to both ecotypes of whales. Initial effects included the loss of 13 individuals from AB pod and the loss of 9 individuals from the AT1 transient population (Chugach transients) during the period immediately following the spill. In addition, AB pod split into two parts in the years following the oil spill, and the AB25 group is now associating with the AJ pod. The remaining matrilines in AB pod have not recovered to pre-spill numbers and at last count contained only 21 individuals compared to 26 individuals immediately prior to the spill. In contrast, other resident pods have been increasing at an average rate in excess of 3%. Three AB pod matrilines, AB17, AB14, and AB22, now contain only older adult males and their aging mothers, and in recent years have not been traveling with the pod and have not been photographed. The lack of recovery of AB pod appears strongly influenced by the loss at the time of the spill of newly reproductive females such as AB8 and AB23 as well as important matriarchs such as AB34 and AB 21. The AT1 transient population which numbered 22 individuals prior to the spill and declined to 13 whales in the year following, has contained only 7 individuals since 2008. Since all remaining females appear to be past reproductive age, the group is likely headed for extinction. The members of this population now appear to forage primarily in glacial fjord areas where they are the only transients that hunt seals within the ice zone. Reasons for their lack of recovery may include the small size of the population even prior to the spill and the effects of contaminants on reproduction and survival. The prognosis for both AB pod and the AT1 population is not positive. This continuing long-term monitoring program has been made possible by the Exxon Valdez oil spill Trustee Council and currently continues under their “Gulf Watch” program.

The First Successful Steller Sea Lion Satellite Flipper Tag Deployment: New Application Yields Promising Results

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Advances in satellite technology have yielded valuable information on movements, dive behavior, and foraging range of pinnipeds. However, most satellite tags are secured to the hair of pinnipeds using epoxy, limiting deployment time because tags fall off during the late summer/early fall molting period. To combat this problem and possibly provide longer-term movement data, we (National Marine Fisheries Service and Alaska Department of Fish and Game) deployed "location only" Smart Position and Temperature (SPOT) 6 Model 371B inline satellite tags to the foreflippers of Steller sea lions (*Eumetopias jubatus*). These tags have been used on phocids in recent years, but this was the first attachment to the flipper of an otariid. To prepare for deployment, we attached the SPOT tags to sea lion flipper carcasses to determine best tag placement and orientation, and best tools for attachment. We then tested (in collaboration with Wildlife Computers) the SPOT tags on a flipper carcass lying on the beach in various orientations and at varying distances from the water's edge. We found limited information about otariid flipper vasculature so we dissected a Steller sea lion carcass flipper to locate major and minor vessels to ensure tag placement would not interfere with major blood vessels or nerves. During the summer of 2018 in Southeast Alaska, we successfully deployed three SPOT 6 371B tags to the flippers of Steller sea lions: two on sub-adult males during entanglement responses and one to an adult male stranded because of harassment. All three tags provided data on animal location; two tags are still attached and transmitting (at 30 and 91 days post-deployment) and one tag stopped at 67 days (possible programming issues). Results to date demonstrate that SPOT tags can be used to track Steller sea lions during the summer-fall molt period. We are guardedly optimistic that these tags will be retained by sea lions and function for many months, perhaps >1 year, allowing for longer-term tracking than previously possible. Deploying SPOT tags on otariid flippers not only provides survival data for post-entanglement and stranding response, but allows an opportunity to answer future research questions.

Timelapse Photography to Assess Bear and Visitor Activity Patterns on Coastal Sedge Meadows in Katmai National Park

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Poster Presenter: Kelsey Griffin

Visitor activity along coastal sites of Katmai National Park has risen over the past two decades primarily due to increases in brown bear (*Ursus arctos*) viewing. A series of time-lapse photography studies have been implemented at coastal bear viewing sites to determine baseline bear activity patterns on coastal sedge meadows and how varying levels of visitor activity may affect bear activity and spatial distribution. We set up cameras at each site and photos were taken at set intervals for the duration of the bear-viewing season across multiple years. All bears and visitors present within the photos were digitized and relative positions were used to determine density patterns and relationships. We analyzed bear activity patterns in relationship to temporal variables and bear spatial distribution in the presence and absence of visitors. Bear activity varied between sites and with year, day of year, time, and tide. Bear activity on sedge meadows was highest in late June to mid-July. Daily use patterns showed a gradual increase in bear activity as the day progressed. Bear numbers were higher when visitors were present, suggesting that visitors target times when bears are present for viewing. Visitor presence alone did not seem to affect bear activity and spatial distribution. More study is needed to understand the visitation level at which bears are displaced and activity patterns are altered. Data collection is ongoing and has been expanded to include other coastal sedge meadow and salmon stream sites for future analyses and comparison. Results of this study will aid the park in the development of its wilderness backcountry management plan in an effort to balance visitor bear viewing opportunities while minimizing disturbances to bears and their habitats.

Microplastics in Tribal Subsistence Foods in Southeast Alaska

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Poster Presenter: Helen Dangel

The body of research about microplastics in the ocean and their effect on marine and terrestrial animals has increased substantially in the past ten years. This research has demonstrated that the amount of plastics and microplastics in our oceans is huge, and some of the microplastics may be absorbing additional toxins. The effects microplastics have on wildlife are varied, and the effect on humans that consume the wildlife is still unknown. Some research has suggested that the effects on people consuming animals that ingested microplastics and toxins will have devastating consequences over time. The Sitka Tribe of Alaska (STA) will collect subsistence food samples from one location within STA's traditional territory and test the samples for the presence of microplastics. A chemical digestion using potassium hydroxide is used to digest samples, then filter the samples, and examine them under a microscope for microplastic particles. STA is sharing results with Tribal citizens and the public, so people can make informed decisions about harvesting traditional foods, and bring public awareness to the presence of microplastics in our local environment.

Bridging Local Ecological Knowledge and Survey Data to Improve Assessment and Management of Rockfishes in Alaska

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Local ecological knowledge (LEK) of fishers is a valuable source of place-based information for data-poor regions and species. LEK has been used to document historical patterns in abundance, distribution, diversity, body size, and condition of marine animals. A growing body of research shows that LEK and scientific knowledge can be complementary, providing a more complete view of temporal and spatial patterns in the environment than either source alone. This study will document fishers' knowledge to help inform assessment and management of rockfishes in Alaska. Rockfishes (*Sebastes* spp.) are ecologically and culturally important to Alaska's coastal communities. Their episodic recruitment, late maturation, and small home ranges causes vulnerability to overfishing. Nearshore rockfishes tend to reside in rocky, high relief areas that are unsuitable for trawl surveys. Susceptibility to barotrauma means that tagging and other non-lethal monitoring efforts have limited success. These factors, along with the high cost of monitoring, have resulted in varied quality and availability of data for rockfish populations. While rockfish populations in Alaska are largely viewed as healthy, substantial increases in nearshore rockfish harvest in recent years, and a limited understanding of the population status has raised concerns regarding sustainable management. The objectives of this study are to 1) document long-term trends in size, relative abundance, and distribution of nearshore rockfishes using LEK; 2) evaluate how fishers' age and experience relates to observations of ecological change; and 3) combine LEK and scientific data to generate distribution maps and time series of relative abundance, which can be applied to management and assessment efforts. In 2018-2020, we will be conducting semi-structured interviews and participatory mapping with experienced commercial, recreational, and subsistence fishers (≥10 years experience) in Sitka and Kodiak. A chain referral approach, where interviewees refer additional respondents, will be used to interview 30-50 fishers in each community. Interviews will be designed to document long-term observations of rockfish populations, perceptions of management, and other questions that are of interest to fishing community members. We will seek community input at all stages of the research to ensure that the results are relevant to the participants and are shared widely.

NPRB 1801: Prevalence of Paralytic Shellfish Toxins in the Marine Food Webs of Prince William Sound and Kachemak Bay, Alaska

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Saxitoxins produced by the dinoflagellate *Alexandrium catenella* have long been a human health threat to coastal inhabitants along the Gulf of Alaska and the Aleutian Islands. These potent neurotoxic compounds readily accumulate in shellfish during *Alexandrium* blooms each summer, heightening the risk of paralytic shellfish poisoning (PSP) in consumers and non-commercial harvesters. Contemporary research has demonstrated saxitoxins not only occur in shellfish during blooms, but are also present in high level consumers (seabirds, marine mammals), indicating that these compounds are likely transferred through middle trophic level organisms such as zooplankton, forage fish and commercially important predatory fish species. The trophic transfer pathways for PSP toxins have not yet been elucidated in Alaskan systems. In order to help fill this critical information gap, this project investigates the transfer of paralytic shellfish toxins through the marine food web in Kachemak Bay, a system exhibiting periodic outbreaks of shellfish toxicity over the last two decades. Toxin transfer will also be examined in Prince William Sound, a system with little prior history of shellfish toxicity. The 2.5 year project began September 2018 and the objectives are to (1) characterize abundance and toxicity of *Alexandrium* cells within the phytoplankton community, (2) determine PSP toxin concentrations in bivalve shellfish, zooplankton, and forage fish species, and (3) quantify PSP toxin levels in organs and flesh of salmon and other commercially important predatory fish species before, during and after *Alexandrium* blooms. By leveraging resources from parallel projects, the study will also examine toxin levels in salmon and other predatory species from sites in the Kodiak and Aleutian Islands, albeit on a more limited scale. Examination of toxin levels in these species is critical to assess the risks to protected and endangered species, the Alaskan fishing industry and human health.

Community-Based Mitigation of Harmful Algal Blooms and Shellfish Poisonings in Southeast Alaska

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Paralytic Shellfish Toxins (PSTs) have been known in Alaskan shellfish for thousands of years and remain a present threat to all recreational and subsistence shellfish harvesters in the state. Limited State resources, dispersed and remote populations, and long coastlines have precluded the development of a statewide monitoring program or testing facilities for wild shellfish. As warming oceans have extended the harmful algal bloom (HAB) season in Alaska, traditional risk mitigation strategies, such as harvesting only during winter months, have become increasingly unreliable, causing many would-be harvesters to forgo shellfish entirely. To reduce the threats of paralytic shellfish poisoning and HABs in Southeast Alaska, the Sitka Tribe of Alaska (STA) has taken the lead in developing a community-based HAB sampling and toxin testing program. STA has brought together seventeen tribal governments to form the Southeast Alaska Tribal Ocean Research (SEATOR) network, monitor one or more local shellfish sites. Samplers collect and analyze weekly phytoplankton samples at each site and ship bi-weekly shellfish samples to STA's Environmental Research Lab for analysis. Results are available within 1-2 business days and are immediately communicated to each tribal government. The SEATOR partnership is building a regional database of shellfish toxins and phytoplankton abundances to make wild shellfish available as a safe, reliable food source. The SEATOR partnership's success has implications for all environmental public health programs, as well as programs that struggle to effectively serve remote sites.

Communicating Management Practice with Videogames

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Poster Presenter: Milo Adkison

The public's poor understanding of management strategies causes unnecessary anger and hinders their ability to offer suggestions for improvement in a way that's meaningful to managers. In salmon management, the concepts of maximum sustained yield and protection of substocks are readily understood, but the technical approach to translating these into escapement goals is very complex, and goals are routinely criticized. In-season openings and closing are probably even more criticized, as the public often fails to recognize the huge uncertainty about run size and run timing that the manager is confronting. I've developed realistic web-based video games with an intuitive graphic interface that lets lay people translate stock and recruitment data into escapement goals, or take in-season catch and escapement data and decide whether and for how long to open their simulated salmon fishery, and see the consequences of their decisions. These games illustrate the strategy managers are using, the type and quality of information they have available, and the difficulties they face. These games will be loaded on a computer for you to try - come show your skills!

Where Carnivores Clash: Evidence of Competition - Prey-Shifting by Brown Bears During a Period of Sea Otter Recovery

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Sea otters are an important component of the northeastern Pacific nearshore ecosystem because when present, they have dramatic effects on nearshore subtidal and intertidal community structure and dynamics. However, commercial exploitation in the 18th and 19th centuries eliminated sea otters from the vast majority of their range, allowing their invertebrate prey populations to proliferate. Prior to substantial recovery of the sea otter population along the coast of Katmai National Park and Preserve within southcentral Alaska, brown bears utilized the abundant intertidal clam resources available here. However, in recent decades, the Katmai sea otter population has increased by approximately seven fold. In the early 1990's, brown bears along the Katmai coast were commonly observed foraging on clams in the intertidal. At that time, the Katmai sea otter population was just beginning its recovery and was estimated to be less than 1000 animals. By 2006 the sea otter population had grown to approximately 7000 animals and appears to have peaked or stabilized, with clams being their primary prey. Since 2006, sea otter energy recovery rates have declined suggesting the otter population is approaching carrying capacity. In contrast, brown bears monitored from 2015-2017 showed almost no sign of utilizing intertidal clam resources. Our results suggest sea otters out-competed bears for intertidal resources by reducing clam abundance (and thus the calories bears could consume per unit time) to the point where most bears switched to other resources. With sea otters restored to the ecosystem, indirect effects on the nearshore community likely include increased canopy and understory kelps, which could enhance salmon smolt rearing habitat and positively influence availability of salmon, the single most important food resource of Katmai brown bears. This work adds to a growing body of evidence for the cascading ecosystem effects of top-level carnivores and highlights interactions between top-level marine and terrestrial predators that have not been documented elsewhere.

Patterns of *Ichthyophonus sp.* Infection in Age Zero Pacific Herring

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Poster Presenter: Catrin Wendt

Ichthyophonus hoferi is a protistan parasite that has been reported in more than 80 species of marine and freshwater fishes; it is one of the most economically and ecologically important pathogens of wild marine fishes. The monthly prevalence of Ichthyophonus infection was assessed in age 0 Pacific herring at index locations including Cordova Harbor, AK (2015) and three sites in the Salish Sea, WA (Port Angeles Harbor, Port Ludlow Harbor, and Admiralty Inlet) during 2018. A marked temporal increase in infection prevalence occurred in Cordova Harbor; however, analogous increases have not yet been detected from the other sampling locations. Possible causes for these differences in infection prevalence will be discussed in terms of hypotheses, and we outline a plan for testing these hypotheses in 2019.

Three Decades Later: Volunteers Continue to Photograph Inter-annual Variability of Rocky Shoreline Marine Life in Prince William Sound

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Poster Presenter: Alan Mearns

Every year, for the past 3 decades, volunteers and colleagues visited shoreline sites in western Prince William Sound to develop a visual history of change and variability in the abundance of life between the tides. During summer low tides photos were taken at fixed locations of easily-recognized or unique geological features such as isolated boulders and rocky outcrops. We used the photos to meet several objectives. First, we wanted to compile and display a portfolio of images for public display so that people (non-scientists) could get some idea of the extent to which marine life changes from year-to-year and over longer periods at specific sites. Second, we wanted to see the extent to which the photos could be used to estimate and graph year-to-year changes in the percent cover of rockweed, mussels and barnacles, using graphs to identify years of heavy, medium and light cover, and how frequently they occur.

This past summer (2018) four volunteers, while carrying out other monitoring and charter activities, visited and re-photographed seven sites, including several for which we have continuous annual photos for 29 years. The photos from one site (Mearns Rock in Snug Harbor, 1990 through 2018) are on continuous display at our NOAA website as well as on the entry hall wall of NOAA's Emergency Response Division in Seattle. Examination of the percent cover graphs for all sites indicates that rockweed has experience four or five randomly spaced episodes of heavy cover during the past 29 years while mussels reached peak abundances at intervals of 5 to 9 years. In 2018, the graphical data indicates that the cover of has declined after peaking at high cover several years ago, while mussels at two sites have begun an increase in cover. This project demonstrates that there is no particular year or percent cover condition that is "normal": rather it documents a "natural range" of variability that needs to be considered when evaluating recovery from disturbance, such as an oil spill, and underscores the great value of volunteers.

Using Circulation Mapping and Long-term Water Quality Data to Aid Community Monitoring Programs in Kachemak Bay, Alaska

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Poster Presenter: James Schloemer

Kachemak Bay is a biologically productive estuary connected to lower Cook Inlet and the Gulf of Alaska, which provides sportfish harvest opportunities and hosts aquaculture sites that rely on marine plankton for food. Ocean circulation patterns that provide nutrients, concentrate marine plankton, and distribute larvae are complex and important to the rich nearshore ecology and aquaculture activities in Kachemak Bay. By improving our understanding of seasonal oceanic conditions and updating circulation maps we enhance our ability to respond to harmful algal bloom (HAB) events and provide useful information to aquaculture activities. Using circulation maps created from satellite-tracked drifter buoys and data from Kachemak Bay National Estuarine Research Reserve (KBNERR) System-Wide Monitoring Program water quality stations we monitor the structure, timing, and movement of water in Kachemak Bay. Continuous monitoring of water quality provides insight on short-term variation and long-term trends in the marine environment. Analyzing these data along with spatial and temporal information on community structure of planktonic communities as observed through the KBNERR Harmful Species Monitoring Program provides resource managers and business operators a basis of understanding on which to make decisions. These data are used to mitigate and prevent impacts of invasive species and HABs on aquaculture practices, advance and support community-based monitoring programs, and develop models to illustrate links between environmental drivers and the observed ecosystem response.

Clam Predation Patterns as a Way of Understanding Sea Star Wasting Disease's Impacts in Kachemak Bay

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Poster Presenter: Tibor Dorsaz

Sea otters (*Enhydra lutris*) and sea stars are two major clam predators and often compete for this resource. In Kachemak Bay, Alaska, the sea otter population has been constant for the past several years, whereas sea stars have experienced a dramatic decline, most likely caused by sea star wasting disease. Here, we use a comparative study of sea star and sea otter predation on clams before and after the decline of sea stars, to obtain a better understanding of the predator interactions on the subtidal clam community. To do so, clam shells were collected pre- (2014) and post- (2018) sea star decline from 5 sites within Kachemak Bay, chosen because they sustain both otter and sea star communities: Port Graham, Kasitsna Bay, MacDonald Spit, Jakolof Bay, and Peterson Bay. At each site, divers collected recently predated clam shells and then determined cause of death (i.e., who preyed on it), and size being predated. Sea star surveys for abundance were also conducted at these sites showing compelling evidence of a decrease in sea star density pre- and post-sea star wasting disease. Data were compared between 2014 and 2018. Predation rates by each predator type (sea otters versus sea stars) on clams, and sea star abundances varied between time periods. The results of this study have led to a deeper understanding of how predation on clams have changed over the past four years, and also provided a more current idea of the status of sea star populations in Kachemak Bay.

Improving Communication of Coastal Flood Warnings to Western Alaska Communities

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Poster Presenter: Edward Plumb

Coastal flooding and erosion from strong storms pose an increasing threat to western Alaska communities. The delayed formation of sea ice in the fall and unusual periods of open water during mid-winter are making communities increasingly vulnerable to severe coastal storms. The National Weather Service (NWS) is collaborating with emergency managers from state, regional, local, and tribal organizations to improve impact-based decision support to communities before and during coastal storms. The NWS is also in the process of improving warning messages to rural Alaskans to effectively communicate threat level, convey risk from storm surge, forecaster confidence, and potential impacts of incoming storms.

The NWS is working to incorporate local terminology and place names, traditional knowledge of storm impacts, and storm observations into coastal flood warnings for communities. In order to accomplish these goals, the NWS is engaging in various rurally based workshops, meetings, and performing community visits to interact directly with residents and gain a better understanding of threats to their communities. This poster will highlight recent success the NWS has had in improving two-way communication and warnings to western Alaska communities during coastal flood events. Examples of additional decision support tools will presented as well. Gaps and potential improvements to NWS products and services will also be identified. The overall goal of the NWS is to build a Weather Ready Nation by helping to make western Alaska communities better prepared and more resilient to coastal storms.

Integration of Electronic Monitoring into Fisheries Stock Assessments

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Fisheries managers and scientists have traditionally relied on self-reported logbooks and independent human observations, among other data, to monitor and assess catch in commercial fisheries. Working with fishermen and other partners (e.g. fishery management councils, National Fish and Wildlife Federation), NOAA Fisheries has worked to improve the timeliness and accuracy of fishery-dependent data collection, while trying to reduce costs. To meet these objectives, electronic monitoring (EM), which includes the use of video cameras and sensors, is a tool being considered to collect much of the same information traditionally collected by other means. Commercial fisheries across the United States are increasingly using EM for catch accounting, compliance, and/or to audit self-reported data, including fisheries in the Northeast (Atlantic herring and mackerel, groundfish), West Coast (groundfish, Pacific whiting), Alaska (fixed gear groundfish, Pacific halibut), and Highly Migratory Species (Atlantic bluefin tuna). While many EM programs to date have used humans to review video, machine learning applications have the potential to further reduce data costs from EM systems. As more fisheries begin to incorporate EM, it is critical to carefully investigate how these new data streams can be integrated with traditional observer and other fishery-dependent data to support catch monitoring and fish stock assessments. We focus on synthesizing the current national picture of EM integration in stock assessments of the United States, such as the work being done in the groundfish fisheries of Alaska and the west coast region, identifying applicability to other EM programs, and discussing knowledge gaps and potential future steps.

Mercury Concentrations and Speciation in Seawater and Zooplankton of the Southeastern Bering Sea

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The southeastern Bering Sea (SEBS) is home to commercial, recreational and subsistence fisheries. While the nutritional value of fish is broadly acknowledged, the presence of the toxic form of mercury (Hg), methylmercury (MeHg), in marine organisms may pose public health risks, and deleterious consequences to marine top predatory fish, birds and mammals. MeHg can accumulate to these health-threatening levels despite extremely low concentrations in seawater (~6-8 orders of magnitude lower than in predatory fish). While there have been substantial efforts to curb Hg emissions in North America and various western European countries, the economic growth in Asia has resulted in a rise of atmospheric Hg emissions. Therefore, increasing levels of both inorganic Hg and MeHg have been projected for the North Pacific and SEBS via atmospheric deposition and advection by ocean currents. Yet, accumulation of Hg and MeHg in zooplankton, the main pelagic consumers linking primary producers to top predators in the food web remains poorly characterized. We will report the first measurements of Hg and MeHg in seawater and plankton from SEBS. We compare these values to data from Long Island Sound, a temperate sea on the North Atlantic coast, and data from the subpolar Hudson Bay. We hypothesize that %MeHg and MeHg concentrations will differ among the three ecosystems, largely due to differences in food webs structure, which will be inferred from $d^{13}C$ and $d^{15}N$ versus animal body sizes. Our results will inform future studies that will evaluate changes in Hg concentrations in seawater and biota over time and space and will help assess effectiveness of a global treaty i.e. the 2013 Minamata Convention on Mercury.

An Improved Target Strength Model for Bering Sea and Gulf of Alaska Krill Validated by Shipboard Backscatter and Material Property Measurements from Individual Animals

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Poster Presenter: Joseph Warren

Target Strength (TS, a measure of the sound energy scattered by a single target) values from theoretical models or empirical measurements are used to convert water column acoustic backscatter measurements to estimates of numerical density, biomass, or other biologically-meaningful parameters of marine organisms. Acoustic surveys are regularly conducted in the Bering Sea and Gulf of Alaska to quantify the abundance of pollock, but these data can also be used to estimate the abundance of krill found in these regions (i.e. E. pacifica, T. spinifera, T. inermis, T. raschii). Live krill were collected by Methot tows and their physical (animal length, three-dimensional body morphology) and material (animal density and soundspeed relative to seawater) properties were measured. A subset of these animals (74 from the Bering Sea, 107 from the Gulf of Alaska) were tethered in an experimental aquarium aboard the ship and their TS and orientation were measured at different frequencies ranging from 50 to 455 kHz. The measured TS values for individual krill were compared with theoretical TS models parameterized with data measured for the same animals, including complementary measures of lipid class composition and content. Differences in the empirical and theoretical TS values were used to refine the scattering model andinput parameters to produce an improved TS model for krill in these regions, as well as a sub-set of models to examine differences that may exist among the different krill species. We found that the best TS model slightly (~ 2-3 dB) under-predicts the measured TS of krill at 120 kHz, the frequency commonly used to estimate krill abundance. Correcting for this difference will reduce acoustic abundance estimates of krill by (roughly) 30 – 50%, bringing them closer to abundance estimates produced by net tows equipped with strobe lights.

Target Strength Calibration Through Parallel Measures of Intact Lipid Classes and Acoustic Profiles of Individual Euphausiids

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In the eastern Bering Sea and Gulf of Alaska, euphausiids (mainly *Thysanoessa rachii*, *T. inermis*, and *T. spinifera*) are a key lower trophic consumers that serve as an important link to upper levels including whales. At present krill population abundances based on net capture and acoustic-trawl estimates differ widely as the contribution of net avoidance and acoustic target strength (TS) are poorly constrained. In both regions, euphausiids experience large variation in food resources during annual ice advance and retreat, with intact phospholipids (IPL) as the major structural lipid and energy storage molecules. To refine krill TS measures and the impact of lipid content, we sampled krill with nets and acoustics during the summer 2016 and 2017 and evaluated TS together with intact lipid class composition via tandem mass spectrometry (LC-MS) of individual animals. Krill were collected by shallow (20 m depth) Methot tows and their physical (length, three-dimensional body morphology) and material (density and soundspeed relative to seawater) properties were measured. A subset of individual animals were subject to acoustic measures on shipboard followed by individual lipid class analysis to determine how lipid content and composition relate to acoustic properties. Lipid analysis showed that IPL's were the major lipid class in all three species with phosphatidylcholine seen as the primary structure accounting for up to 79% of total lipid content of individuals. Triglycerides were the second most abundant lipid class, especially in *T. raschii* and *T. inermis*, accounting for 5.7 to 47% of total lipids with variable amounts of other glycerides (i.e. diacyl-DG) present. *T. spinifera* showed lower contributions to total lipids from glycerides (TG and DG) among the three species based on wet weight. Results of detailed lipid content and density analysis of each species is being used to determine the impact of krill nutritional status on acoustic target strength metrics.

Coccolithophore Population Dynamics in the Eastern Bering Sea

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Poster Presenter: Tanika Ladd

Coccolithophore populations in the Eastern Bering Sea (EBS) remain understudied despite being an important component of a highly productive and culturally significant ecosystem. Since 1997, coccolithophore blooms mainly composed of the species *Emiliania huxleyi*, have become a prominent and ecologically important feature in the EBS where they have been associated with bird deaths, poor salmon runs, and altered distributions of other marine organisms. Although coccolithophore populations appear to respond to climate change in the Atlantic Ocean, Pacific populations are vastly understudied, and the reciprocal interactions between the environment and coccolithophore population dynamics are poorly understood. *Emiliania huxleyi*, the most cosmopolitan and the main bloom-forming coccolithophore species, is known for having huge intraspecific genetic, morphological, and biogeochemical heterogeneity such that extrapolating responses of individual strains to the field is a challenge. During this presentation, I will discuss data collected from two field campaigns in the EBS, during both bloom and non-bloom years. I will focus on populations of coccolithophores, particularly *E. huxleyi*, within the greater phytoplankton community while exploring relationships between coccolithophore populations and the environmental setting of the EBS.

Variation in the Subsurface Optical Environment of the Eastern Bering Sea: A Novel Approach to Estimating Apparent Optical Properties During Bottom-trawl Surveys

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Poster Presenter: Sean Rohan

Optical conditions in the marine environment (light and water clarity) influence the distribution, behavior, and sensory capabilities of marine fauna. However, investigation into how the optical environment affects the distribution and ecology of fauna in the eastern Bering Sea has been hindered by a paucity of scale-appropriate sampling of the optical environment conducted concurrently with biological sampling. To address this shortcoming, we developed a method to estimate apparent optical properties of the subsurface optical environment of the eastern Bering Sea, in three dimensions, using light measurements obtained from archival tags mounted to bottom-trawl gear during Alaska Fisheries Science Center stock assessment surveys. The apparent optical properties (optical depth and depth-specific attenuation coefficient) describe the vertical structure of the subsurface optical environment at 376 sampling stations, which were sampled annually during summer 2004-2018. Water column depth explained only 44% of variation in the near-bottom optical depth, and nearly 20% of stations had variation in optical depth corresponding with greater three order-of-magnitude variation in the near-bottom light levels. The remainder of the variation was likely caused by variation in bio-physical properties of the water column. We used vertical profiles of the depth-specific attenuation coefficient to identify the vertical structure of light clines in the water column. At individual stations, the shape of depth-specific attenuation coefficient profiles was largely similar between years, suggesting similar physical and biological processes were contributing to variation in the optical environment. Across much of the study region, there were substantial vertical differences in the depth-specific attenuation coefficient, indicating satellite-based remote sensing may not adequately measure the subsurface optical environment experienced by demersal fauna. The apparent optical properties we derived will provide a basis for investigating how variation in the optical environment influences the distribution and ecology of marine fauna in the eastern Bering Sea.

Reexamining an Assumption About Marine Mortality of Chinook Salmon

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It has become dogma that processes in the nearshore environment during the early marine phase of Pacific salmon life history largely govern adult population dynamics. As a corollary, it is widely assumed that the risk of mortality decreases dramatically after the first winter in the ocean, the marine environment is relatively safe thereafter, and that effects in this 'late' marine stage have minimal impacts on population characteristics, including dynamics and life history traits. However, recent evidence of concurrent declines in size-at-age and age-at-maturity, as well as lower-than-predicted returns of older adults suggest that late-stage, potentially selective, marine mortality may be more frequent than currently assumed. To examine this 'late-stage' selective mortality hypothesis, we examined diagnostic evidence of predation on large Chinook salmon in depth, temperature and light records collected during recent satellite tagging research. In total, 35 of 73 tagged Chinook salmon were killed, suggesting that predation on relatively large adult Chinook salmon by "warm-blooded" and "cold-blooded" predators may be relatively common. These results indicate the need to further investigate late-stage marine mortality of Chinook salmon and its possible effects on the population dynamics and life history characteristics of this species, and Pacific salmon more generally.

An Assessment of Biennial Spawning in *Chionoecetes opilio* in Relation to Temperatures in the Eastern Bering Sea

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The management of the eastern Bering Sea (EBS) snow crab *Chionoecetes opilio* stock assumes an annual reproductive cycle. However, crabs found in seawater temperatures below 1 °C have been found to extend the reproductive cycle to two years. With a maximum seven years of female functional maturity, a shift to primarily biennial reproductive cycles could result in females brooding only 2-3 clutches, compared to 5-7 clutches throughout their life span thus decreasing the total reproductive potential of the stock. The objective of this study was to assess what proportion of *C. opilio* in the EBS are on a biennial reproductive cycle relative to bottom temperatures. Mature female *C. opilio* were randomly collected as part of the summer annual National Marine Fisheries Service EBS bottom trawl survey from 2014-2018 at approximately 33% of all stations with ≥ 10 ovigerous *C. opilio*. Ten oocytes from the gonad of each crab were measured under a compound microscope using Image Pro-Plus 7.0. Separately, embryos were stained and fixed with Bouin's solution, and observed under a dissecting scope to determine developmental stage. More than 20,000 oocyte areas were measured from over 2,500 ovigerous snow crab during the study. Embryo stage was positively correlated with oocyte area across all years, however, was found not to be a good indicator of biennial spawning. Bimodality in oocyte area frequency distribution suggested the presence of biennial year 2 crab in all years, with colder near bottom temperature significantly correlated with larger oocyte area. Oocyte area was not correlated with crab age suggesting that environmental parameters may be more important than biological determinations of biennial spawning. Bottom temperatures in the EBS were coldest in 2012, warmed significantly through 2016, and remained high through 2018. As such, there was low incidence of biennial reproduction based on the methods used in this study. However, a shift back to colder temperatures could significantly increase the proportion of biennial crab and lead to a reduction in reproductive potential of one of the largest commercial fisheries in Alaska.

Catch Accounting and Vitality Metrics for Trawl-Bycaught Red King Crab in the Bering Sea

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Poster Presenter: Cory Lescher

United States fisheries policy requires managers to account for catch and discard mortality of fished species, including target catch, bycatch and prohibited species catch (PSC). Bycatch and PSC rates (e.g., PSC/ton of target species) for the North Pacific groundfish trawl fishery are estimated by extrapolating observer data on sub-sampled catch from the haul level. Understanding the degree to which current sub-sampling practices provide accurate data for accounting of actual quantities of incidentally-caught individuals in a fishing haul or trip is important for conservation and fishery management objectives overall as well as improvement of cooperative management. In this groundfish trawl fishery, reaching or exceeding PSC limits can result in closures to specific areas or an entire fishery sector. To better understand current PSC estimation methods and performance, we will examine sampling variance by conducting a census of trawl-caught red king crab PSC post observer sampling. Red king crab PSC catch rates (number of crab caught per metric ton of groundfish), and composition (sex, size, shell condition and vitality) will be assessed. In addition, the influences of bottom temperature, target species catch, tow duration, and haul speed on the relationship between red king crab subsample-based PSC estimates and actual red king crab catch will be explored with the goal of understanding the relationships between the spatial ecology of red king crab, extrapolation uncertainty, PSC estimates and fishing practices. This project also includes an at-sea crab vitality pilot study to determine what vitality assessment metrics can reliably be used to predict discard survival in red king crab and to better understand the variables that may influence delayed discard mortality. Ultimately, we expect that whole-haul accounting of red king crab will reveal important dynamics in the relationship between trawl-caught target and PSC species leading to more informed use of data generated via observer sampling along with potential improvements in PSC rate estimation for crab. We also expect that the vitality pilot study will enhance our understanding of the variables that influence discard mortality and determine metrics that can be used to quantify discard survival, leading to better field and laboratory studies in the future.

Preliminary Observations of Walleye Pollock Response to Survey Bottom Trawls

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Walleye pollock are a dominant component of the Bering Sea ecosystem. Due to their semipelagic distribution, separate bottom trawl (BT) surveys and acoustic trawl (AT) surveys are used to estimate their abundance and spatial distribution. Recently, methods have been proposed to combine BT and AT data to produce more accurate and precise combined estimates of abundance than what can be provided by either survey alone. These methods depend on the models of the pollock behavior in between the survey vessel and the survey trawl as they estimate parameters which can account for pollock diving behavior and for density-dependent efficiency of the bottom trawl. However, inferences from these models (e.g. that fish dive into the trawl from well above the headrope depth) have not been verified by observations and therefore uncertainty remains about pollock behavioral reactions to survey trawls. To validate the inferences of diving behavior drawn from the models currently used, it is necessary to perform direct observations of fish in front of the BT. Such observations would allow direct estimation of the effective fishing height of the BT and efficiency of the BT relative to the AT. Direct observations of semipelagic walleye pollock in front of the BT were conducted in the eastern Bering Sea in 2017 and 2018 using a remotely operated catamaran (ROC). The ROC is a new acoustic observation system, which can be towed behind a trawling vessel for up to 6 hours, and can be remotely steered to acoustically image locations between the vessel and the front of the trawl. The ROC combined with equivalent acoustic systems on the vessel will allow for comparison of fish vertical distribution and density under the survey vessel and in front of the BT. This poster will include preliminary data analysis from observations collected during the summer of 2018.

Distribution, Life History, and Reproductive Biology of Spawning Capelin *Mallotus villosus* in Norton Sound, Alaska

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Forage fishes are important for marine ecosystems and economies worldwide because they sustain marine predators, fisheries, and human cultures. One important Arctic pelagic forage fish is Capelin *Mallotus villosus*, which is considered a keystone and indicator species in the North Atlantic. Despite their importance, surprisingly little is known about Capelin in Alaskan waters. The objective of this project was to develop a better understanding of Capelin distribution, life history, and reproductive biology in Norton Sound, Alaska, relative to historical data for this species in this region. Aerial surveys were conducted from May through July 2018 to examine their spawning distribution, collect actively spawning fish, characterize physical spawning habitat, and compare fish size structure between sexes. Spawning Capelin were collected from five sites in Norton Sound between June 15 and 21. At these locations, water temperature was 9.0 ± 2.0°C, dissolved oxygen was 9.4 ± 1.0 mg/L, conductivity was 27.4 ± 4.0 µS/cm, and salinity was 24.3 ± 6.7 ppt. Sediment composition did not differ among spawning beaches; however, within the wash zone of a single beach there was more gravel in locations low on the beach and more fine sand high on the beach. All sediment samples contained eggs that ranged in development from unfertilized or newly fertilized to eyed; however, the fewest eggs were found in samples collected high on the beach. Males were larger than females in length (148.8 ± 6.7 mm versus 136.9 ± 8.3 mm, respectively) and weight (21.2 ± 2.9 mg versus 13.8 ± 3.0 mg respectively). Ongoing evaluations of collected samples will be used to estimate fecundity, age structure, and other life-history and reproductive biology attributes which will be compared to historical data to identify potential changes in spawning and/or fish condition. This study provides information that was previously unknown or dated for spawning Capelin in Norton Sound, which will improve our understanding of the contribution of this species to the marine food web.

MONDAY, JANUARY 28, 2019

WAVE 2
GULF OF ALASKA/BERING SEA

(7:30 PM TO 9:00 PM)

POSTER PRESENTATIONS: MONDAY, WAVE 2 7:30PM - 9:00PM
GULF OF ALASKA & BERING SEA/ALEUTIANS

TITLE	PRESENTER	SECTION	LOCATION (row & poster)
Nearshore high-frequency pH dynamics in Kachemak Bay, Alaska	Amanda Kelley, Cale Miller	Climate and Oceanography	R1 , P2
The Northern Gulf of Alaska LTER: results from the first year	Russell Hopcroft, Ana Aguilar-Islas, Seth Danielson, Jerome Fiechter, Andrew McDonnell, Suzanne Strom	Climate and Oceanography	R1 , P3
Spatial and Temporal Patterns in Nearshore Physical Oceanography in Tidewater Glacier Fjords	Deborah Kurtz, Dan Esler, Tahzay Jones, Benjamin Weitzman, Brian Robinson	Climate and Oceanography	
Nearshore benthic microscopic community assembly and succession over seasonal time scales	Alexandra Ravelo, Eric Collins	Lower Trophic Levels	R1 , P5
What's in a Pyrosome? Proximate and Stable Isotope Analysis of the Pelagic Tunicate, Pyrosoma atlanticum	Tayler Jarvis, Ron Heintz, Matthew Rogers	Lower Trophic Levels	R1 , P7
The effectiveness of zooplankton nets at sampling juvenile salmon prey in Southeast Alaska	Haila Schultz, Emily Fergusson	Lower Trophic Levels	
Summer doliolid blooms in the southeastern Gulf of Alaska shelf: potential importance for the offshore ecosystem	Alexei Pinchuk, Wesley Strasburger	Lower Trophic Levels	R1 , P8
Factors influencing recorded increases in pinto abalone (Haliotis kamtschatkana) recruitment in Sitka Sound, Alaska	Taylor White, Pete Raimondi	Lower Trophic Levels	R1 , P10
Evaluating iron as a tool to increase flexibility in kelp mariculture in Alaska	Margaret Sherman, Rachel Hennegan, Annie Raymond, Michael Stekoll	Lower Trophic Levels	R1 , P12
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Lithothamnion soriferum is the habitat-forming rhodolith of Kinzarof Lagoon, Alaska	Sandra Lindstrom, Jeffery Hughey, Paul Gabrielson, David Ward	Lower Trophic Levels	R1 , P16
Nurseries to Fisheries: Spatial-predictive Models to Characterize Habitat across the Life Histories of Fishery Resource Species	Jodi Pirtle, S. Kalei Shotwell, Chris Rooper	Fishes and Fish Habitats	
Factors affecting survival and life history strategies of Auke Creek coho salmon	David Tallmon, Scott Vulstek, Eric Buhle, Mark Scheuerell	Fishes and Fish Habitats	R1 , P18
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Consummate and consumed predators: evidence from telemetry and observations for offshore killer whale predation on Pacific sleeper sharks in an Alaskan glacial fjord.	Markus Horning, Daniel Olsen, Sharon Wildes, Christopher Lowe, Taylor Smith, Cindy Tribuzio, Amanda Bishop, Renae Sattler, Jared Guthridge, Richard Hocking	Fishes and Fish Habitats	R2 , P26
Sampling frame design for an untrawlable habitat survey in the Gulf of Alaska	David Bryan, Kresimir Williams, Chris Rooper	Fishes and Fish Habitats	
Determining Efficient Culturing and Spawning Techniques of Gulf of Alaska Scallops	Diana Perry, Kristin Cieciel	Fishes and Fish Habitats	
Below the surface - stereo image and video analysis of submerged benthic sandwaves and Pacific sand lance	Matthew Baker, H. Gary Greene, Kresimir Williams, Joseph Bizzarro	Fishes and Fish Habitats	R2 , P30

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Communicating the State of Alaska's Salmon and People: Sharing SASAP synthesis data with salmon decision-makers	Sarah Warnock, Jenny Seifert, Ian Dutton	Fishes and Fish Habitats	R2 , P31
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Regional differences in Walleye Pollock size, condition, and prey selectivity suggest density-dependent effects on the Western Gulf of Alaska 2013 year class	Jesse Lamb, David Kimmel	Fishes and Fish Habitats	
Passive Monitoring to Investigate Predation Pressure at Aleutian Tern Colonies in Coastal Alaska	Jill Tengeres, Donald Lyons, Robin Corcoran, Matthew McKown, Kelly Nesvacil	Seabirds	R2 , P34
Use of Thermal Imaging for the Study of Arctic and Subarctic Seabirds in the Gulf of Alaska: Implications for Management and Conservation	Emmylou Kidder, Chenoa Payne, Rick Sherwin	Seabirds	R2 , P35
Resolving the annual pelagic distribution of Tufted Puffins in the Gulf of Alaska: preliminary isotopic correlates of winter and summer marine habitat use	Kristen Gorman, Mary Anne Bishop, Anne Schaefer	Seabirds	R2 , P36
Are hatchery-feeding whales trendsetters or desperate scavengers?	Ellen Chenoweth, Kevin Boswell, Ari Friedlaender, Megan McPhee, Julia Burrows, Ron Heintz, Jan Straley	Mammals	R3 , P38
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Efforts to Examine and Mitigate the Potential Effects of Motorized Watercraft Use on Cook Inlet Beluga Whale (Delphinapterus leucas) Activity in Alaska's Twentymile River During Seasonal Fish Spawning Periods	Suzanne Steinert	Mammals	R3 , P40
Nanopore (MinION) sequencing to detect novel RNA virus genomes in Alaskan marine mammal species	Amy Klink, Xiao Bai, Amanda Bishop, Kathy Burek Huntington, Wendy Puryear, Jonathan Runstadler, Eric Bortz	Mammals	R3 , P41
Studying the potential for noise disturbance in Cook Inlet beluga foraging grounds	Manuel Castellote, Brian Taras, Justin Jenniges, Christopher Garner, Arial Brewer, Mandy Keogh	Mammals	R3 , P43
Seascapes of Fear: Characterizing the habitat associated with predation locations of juvenile Steller sea lions	Renae Sattler, Casey Brown, Amanda Bishop, Markus Horning	Mammals	R3 , P45
Use of Thermal Imaging for the Study of Harbor Seal (Phoca vitulina) Habitat Associations in Kenai Fjords National Park, AK: Implications for Management and Conservation	Chenoa Payne, Rick Sherwin, Michael Meyer, Emmylou Kidder	Mammals	R3 , P47
Marine Mammal Monitoring In The Gulf of Alaska Under U.S. Navy Funding 2017	Chip Johnson, Andrea Balla-Holden	Mammals	
Spatial and Temporal Variability in Humpback Whale Feeding Behavior in Glacier Bay National Park and Icy Strait, Southeast Alaska	Caitlin Marsteller, Mayumi Arimitsu, Christine Gabriele, John Piatt, Louise Taylor-Thomas	Mammals	
Fine-scale Trophic Ecology of Magister Armhook Squid (Berryteuthis magister) in the Eastern Gulf of Alaska	Janice Straley, Lauren Wild, Annie Masterman	Mammals	R3 , P51
Steller Sea Lion Rescue in Sitka: A team effort brings positive results	Katharine Savage, Kim Raum-suryan	Mammals	
Characterizing Juneau-Area Humpback Whales via Citizen Science Data	Brooke Davis, Aleria Jensen, Suzie Teerlink	Mammals	
Coastal Community Vulnerability Tool and Visualizations of Change in Cook Inlet, Alaska	Davin Holen	Humans	R3 , P53
Reducing the Risks of Biotoxins and Harmful Algal Blooms	Kari Lanphier, Esther Kennedy, Chris Whitehead	Humans	

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Leveraging Information Literacy Lessons in Science Communication: Modification of the ACRL Framework for Information Literacy for Science Outreach	Philina Richardson, Amanda Bishop, Markus Horning	Humans	R4 , P55
NPRB Project 1616: Implementation of Community Based PSP Testing for Subsistence and Recreational Shellfish Harvesting In Southwestern Alaska – Year 2 Update	Steve R. Kibler, Julie A. Matweyou, R. Wayne Litaker, Bruce A. Wright, D. Ransom Hardison, Patricia A. Tester	Humans	
The Alaska Harmful Algal Bloom Network – An Introduction	Kayla Schommer	Humans	R4 , P56
Alaska EPSCoR Coastal Margins Project: A new research capacity building program to investigate the effects of changing watersheds on coastal ecosystems along the Gulf of Alaska	Brenda Konar, Anne Beaudreau, Allison Bidlack, Lee Ann Munk, Matt Berman, Jason Fellman, Claudine Hauri, Eran Hood, Katrin Iken, Mark Johnson, Amanda Kelley, Eric Klein, Franz Mueter, Alexei Pinchuk, Jennifer Schmidt, Martin Stuefer, Trent Sutton, Anupma Prakash, Pips Veazey	Ecosystem Perspectives	R4 , P58
Scoping and disseminating important datasets for Alaska fisheries	Heath Kimball, Ben Williams, Sabrina Larsen, Stormy Haught, Stacy Vega, Ted Otis, Josh Mumm, Bob DeCino, Greg Buck, Katie Sechrist, Jack Erickson, Rich Brenner	Ecosystem Perspectives	R4 , P59
Still Awaiting Ecosystem Recovery Following the North Pacific Marine Heat Wave: Gulf Watch Alaska Pelagic Monitoring Update 2018	Mayumi Arimitsu, Mary Anne Bishop, Scott Hatch, Robert Kaler, Kathy Kuletz, Craig Matkin, John Moran, Dan Olsen, John Piatt, Anne Schaefer, Jan Straley	Ecosystem Perspectives	
Developing strontium isotope maps of Cook Inlet Basin to elucidate the foraging ecology and habitat use of species of commercial and conservation importance	Matthew Wooller, Mark Nelson, Brian Taras, Mandy Keogh	Ecosystem Perspectives	R4 , P61
Nutritional quality of Macrocystis pyrifera at the Northern End of its Range	Muriel Reid, Kate Nedens, Sonja Briles, Callie Simmons	Ecosystem Perspectives	R4 , P63
Ocean acidification does not affect embryo development, hatch success, or calcification in snow crab, Chionoecetes opilio	Robert Foy, W. Christopher Long, Katherine Swiney	Climate and Oceanography	
Extreme Physical Oceanographic Conditions in Alaskan Waters during Future Decades	Nicholas Bond, Wei Cheng	Climate and Oceanography	R4 , P65
Ocean Acidification Research: Using Observations and Models to Support Alaska's Blue Economy	Natalie Monacci, Jessica Cross, Sylvia Musielewicz, Wiley Evans, Darren Pilcher, Jeremy Mathis	Climate and Oceanography	R4 , P66
Time-series of direct net primary production and phytoplankton biomass observations in the Eastern Bering Sea: Responses to warm and cold year stanzas.	Michael Lomas, Lisa Eisner, Jeanette Gann, Steven Baer, Carol Ladd, Calvin Mordy, Phyllis Stabeno, Raymond Sambrotto	Lower Trophic Levels	R4 , P68
A skill assessment for the BESTNPZ Bering Sea biogechemical model	Kelly Kearney, Albert Hermann, Kerim Aydin	Lower Trophic Levels	R4 , P70
Why the shift? A temporal analysis of Nuculana spp. abundance and size class in the northern Bering Sea from 2001 – 2015	Lauren Swam, Christina Goethel, Jacqueline Grebmeier, Lee Cooper	Lower Trophic Levels	R4 , P72
Polychlorinated Biphenyl (Pcb) Contamination on Unalaska Island in the Aleutian Archipelago	Elise Adams, Frank von Hippel	Lower Trophic Levels	R5 , P74
Alaskan Bathymetry for Fisheries and Oceanography Research	Mark Zimmermann, Megan Prescott	Fishes and Fish Habitats	
Juvenile Chinook Salmon condition response to warm temperatures in the northern Bering Sea	Fletcher Sewall, Sabrina Garcia	Fishes and Fish Habitats	

TITLE	PRESENTER	SECTION	LOCATION (row & poster)
Examining the interaction of commercial fishing gears and structure-forming invertebrates in the Aleutian Islands	John Olson, Chris Rooper, Matthew Baker, Brad Harris	Fishes and Fish Habitats	R5 , P77
Migration of juvenile summer-run and fall-run chum salmon from the Yukon River mouth	Genevieve Johnson, Chris Kondzela, Jacqueline Whittle, Katharine Miller, Jeffrey Guyon	Fishes and Fish Habitats	
Integration of electronic monitoring into fisheries stock assessments	Lisa Peterson, Brett Alger, Patrick Lynch, Jane DiCosimo	Fishes and Fish Habitats	
Lipid storage and fatty acid profiles of juvenile yellowfin sole and northern rock sole from the eastern Bering Sea	Louise Copeman, Cynthia Yeung, Michelle Stowell, Carlissa Salant	Fishes and Fish Habitats	R5 , P80
Comparing a Numerical Integration Method for Constructing Size-Transition Matrix with Other Construction Methods	Lee Cronin-Fine, Andre Punt	Fishes and Fish Habitats	R5 , P81

Nearshore High-frequency pH Dynamics in Kachemak Bay, Alaska

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Poster Presenter: Amanda Kelley

Nearshore ecosystems help to protect the coastline and provide important habitat for marine animals. Despite Alaska's vast coastlines and vital fisheries, little is known about how ocean acidification (OA), a decline in ocean pH due to the absorption of anthropogenic carbon dioxide by the world's oceans, affects the nearshore environment. Because these ecosystems are highly dynamic and complex, it has been challenging to accurately monitor changes in ocean chemistry in coastal waters. Furthermore, with few baseline ocean pH records in place, it is difficult to determine the anthropogenic and natural influences on ocean pH variability. Current advances in pH sensor technology have led to OA monitoring networks along the west coast of the United States. One such network was established in Kachemak Bay, Alaska, in October 2017. pH, temperature, salinity and oxygen data were collected through August 2018, making this data-set one of the first records of nearshore, continuous, high-frequency pH measurements in coastal Alaska. These results demonstrate low wintertime pH_T variability followed by intense daily diel oscillations, with maximum summertime daily pH_T variability ranging between 0.1–0.3. Episodic reductions of pH_T ~ 0.3 within a 6-hour time period, correspond with freshwater intrusion events likely a result of intense rain and/or summertime glacial ablation. Over a ten-month deployment period, the total pH_T variability was ~0.5, making Kachemak Bay one of the most naturally dynamic marine environments, with respect to pH, on record. In addition to documenting baseline pH measurements for this region, these data provide critical information with which studies can be designed to test the sensitivity of marine species to ocean acidification.

The Northern Gulf of Alaska LTER: Results from the First Year

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Poster Presenter: Russell Hopcroft

The new NGA LTER completed 3 cruises during 2018 that help characterize the dynamics of the Gulf of Alaska Shelf. In particular, we encompassed features such as the Copper River, Middleton Island and Albatross Bank that lead to the enhanced regional productivity in the Gulf. Here we summarize observations on the physical, chemical, and biological conditions during these cruises, as well as initial progress on a new biophysical model for this ecosystem. New observations highlight the high heterogeneity of many parameters throughout the northern shelf. Also of note are the atypically warm waters that persisted during September 2018 throughout the Gulf, and how they will likely impact fall productivity.

Spatial and Temporal Patterns in Nearshore Physical Oceanography in Tidewater Glacier Fjords

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Physical properties of nearshore marine systems are notoriously complicated, as they are affected by terrestrial, oceanic, and atmospheric influences that are spatially and temporally variable at small scales. This is particularly true in glacierized fjord systems with inputs of sediment and freshwater. Documenting and understanding variation in physical features related to glacial meltwater is critical for understanding drivers of distribution and performance of nearshore marine biota along the glacier-to-marine gradient. We quantified water temperature, salinity, and turbidity in three tidewater glacier fjords in Kenai Fjords National Park (Aialik Bay, Northwestern Fiord, and McCarty Fiord) to determine the strength of the glacier-to-marine gradient in physical oceanography relative to smaller scale variation driven by local inputs. We conducted CTD profiles and secchi disk measurements at 20 nearshore stations and 15-17 mid-fjord stations within each fjord, spanning the glacier-to-marine continuum. We found that surface water conditions (within 10 m) were correlated with position along the glacier-to-marine gradient. However, we also found evidence that within-fjord circulation had an important influence, as did position above or below the main glacial sill. Local site effects were apparent and were likely related to both glacial and non-glacial freshwater inputs. Finally, we detected variation in these relationships through the summer, presumably as inputs transitioned from primarily precipitation to snow melt to glacial melt. Studies on inter-annual variation, year-round seasonal effects, and links to intertidal communities are our planned next steps.

Nearshore Benthic Microscopic Community Assembly and Succession Over Seasonal Time Scales

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Poster Presenter: Alexandra Ravelo

The nearshore communities of southeast Alaska are characterized by high benthic invertebrate and seaweed diversity. Within this region, Sitka Sound features extensive kelp beds, mostly dominated by *Macrocystis* sp., which enhances habitat complexity in nearshore areas by providing habitat and refuge to pelagic, epifaunal, and infaunal organisms and maintaining biodiverse communities. Previous research has established that microbial biofilms may play a role in the recruitment of sessile benthic organisms in other regions. To investigate such biotic conditions that may promote kelp recruitment in Alaskan nearshore benthic ecosystems, we established a seasonal sampling design over the course of five months (March to August) spanning the recruitment and growth season of nearshore benthic organisms. At two nearby sites, Battery Island and Kutkan Island, we deployed replicate plexiglass plates as artificial sites for benthic community recruitment. In one experiment, we replaced a set of new plates at each monthly sampling to observe changes in active settlement over the duration of the experiment. In a parallel experiment, we left another set of plates to accumulate growth for the duration of the experiment in order to observe biotic succession and the cumulative effects of settlement. Microscopic characterization of recovered plates revealed substantial differences in community assemblages at these two sites, which lie only 4 km from each other. Early recruits at both sites was dominated by coralline algae and Spirorbidae polychaetes. After five months, the recruited communities reflected the dominant communities at each site. The accumulative plates at Kutkan Island, a patchy sand-bedrock site, were quickly grown over with benthic algae, while at Battery Island, which features rocky substrate, plates remained relatively free of fleshy algal growth. Future work will use high-throughput DNA sequencing to investigate recruitment and succession of the microbial communities at millimeter-to-centimeter scales, and interactions between microscopic and macroscopic assemblages.

What's in a Pyrosome? Proximate and Stable Isotope Analysis of the Pelagic Tunicate, *Pyrosoma atlanticum*

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Pyrosoma atlanticum, a pelagic tunicate traditionally found in subtropical waters, is the most common, widespread species of pyrosomes. In 2017, *P. atlanticum* catches were observed in high abundance in surface trawls during the Alaska Fisheries Science Center's eastern Gulf of Alaska (GOA) Assessment Survey. Although unknown why this anomalous event occurred, it was associated with the 2014 marine heat wave. *P. atlanticum* have been observed as a frequent diet item in the stomachs of commercially important species such as adult sablefish, rockfishes, and Pacific halibut. Considering this, understanding the nutritional value and trophic behavior of *P. atlanticum* in better understanding trophic implications of their occurrence and high biomass within the GOA and other systems is of importance. Here we measured the percent moisture, lipid, and protein of *P. atlanticum* sampled in the eastern GOA during summer of 2017. Bomb calorimetry was used to determine energy density (ED). In addition, stable isotope ($\delta^{13}C$ and $\delta^{15}N$) analysis was performed to assess relative trophic position of *P. atlanticum* to other zooplankton from the GOA. Results showed *P. atlanticum* consisted mainly of water, with moisture levels averaging around 93%. Lipid levels were observed to be low, ranging from 0.03-0.43%. Percent protein varied widely between 23.3 and 6.8%. ED also varied greatly with a low of 1.93 kJ/g and a high of 13.37 kJ/g. Stable isotope analysis revealed average $\delta^{15}N$ and $\delta^{13}C$ values of 6.0 and -21.8‰, respectively, well within the reported range of isotope values observed for many zooplankton taxa (e.g. copepods and euphausiids). Thus, *P. atlanticum* may compete with a wide range of zooplankton, diverting energy away from juvenile stages of fish that prefer smaller crustacean prey. *P. atlanticum* may also be a higher quality prey item than originally thought, but not on a per unit mass basis, as shown from the analyses of ED and proximate composition. With continuing warming ocean conditions and the possibility of another *P. atlanticum* bloom, further study on the energetics and trophic relationships of *P. atlanticum* with other zooplankton and fish is warranted.

The Effectiveness of Zooplankton Nets at Sampling Juvenile Salmon Prey in Southeast Alaska

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Zooplankton are an important prey source for juvenile Pacific salmon during their early life in the marine environment. Measuring their availability is critical for understanding the foraging ecology of juvenile salmon. However it is not clear how best to characterize the abundance of salmon prey. Different plankton net mesh sizes have been shown to have disparate effects on abundance estimates of zooplankton taxa. Therefore, it is important to determine which mesh size best collects the dominant prey consumed by juvenile salmon in order to better understand prey availability and selection. We compared the zooplankton communities sampled with different gear from Icy Strait, Alaska on the Alaska Fisheries Science Center Southeast Coastal Monitoring Survey in 2017. Bongo nets equipped on one side with a 505-µm mesh net and on the other side with a 333-µm mesh net were towed obliquely through the water at four stations monthly from May through August. We used multivariate statistical methods to compare the plankton communities collected by both nets. In order to examine how these different collections might influence estimates of prey electivity, we calculated the Chesson's prey preference index for 11 prey taxa using salmon diets collected concurrently with the zooplankton samples in June and July. Environmental prey biomass was calculated for each mesh size and % volume in the diet was used as a proxy for biomass consumed. Overall, the zooplankton communities collected by the 333- and 505- µm mesh nets were significantly different along the first axis. The 333-µm mesh net captured more small copepods and hyperiids while the 505-µm mesh net captured more large copepods and decapod larvae. For chum, coho and sockeye salmon, prey electivity was estimated differently for key prey taxa like hyperiids, gastropods, fish, and larval decapods. While one mesh size indicated that a prey species was actively selected, the other mesh size indicated avoidance or neutral selection. These results suggest that different mesh sizes are likely to introduce significant bias when estimating prey electivity and availability.

Summer Doliolid Blooms in the Southeastern Gulf Of Alaska Shelf: Potential Importance for the Offshore Ecosystem

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Doliolids (planktonic tunicates) typically occur in the mixed layer where they occasionally form dense aggregations, which may contain several thousand animals per cubic meter. They are capable of ingesting a wide size range of food particles including microbs, packaging them into large faecal pellets and thus contributing to vertical carbon flux and a shunt of the microbial loop. They are also reported as a common food item for some commercially important fish. It is often assumed that patches of doliolids are ephemeral, occurring at unpredictable times and locations. Here, for the first time, we report consistent observations of doliolid (*Dolioletta tritonis*) swarms from the southeast Alaska obtained during NOAA Eastern Gulf of Alaska Ecosystem Assessment surveys in summer 2016 and 2017. Large densities (~800 individuals per cubic meter) were observed offshore (>3,000 m depth) during both years, with maximal density (up to 4,000 individuals per cubic meter) recorded in August 2016. Few doliolids were found on the shelf, apparently being advected from the offshore. Historical records reveal that during the warm El-Nino years of 1997-1998 the tunicates prevailed in the diets of juvenile sablefish collected along the eastern coast of Gulf of Alaska. Thus, we speculate that warming trends may increase the importance of doliolids in the Gulf of Alaska pelagic food web.

Factors Influencing Recorded Increases in Pinto Abalone (*Haliotis kamtschatkana*) Recruitment in Sitka Sound, Alaska

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Pinto abalone (*Haliotis kamtschatkana*) in Southeastern Alaska experienced continued population decline following peak years of the species' commercial harvest, 1978 – 1981. This pattern of decline is shared across the pinto abalone range, Salisbury Sound, Alaska to Point Conception, California, and has been attributed to predation, disease, loss of habitat, and overfishing. Surprisingly, recent surveys in British Columbia and Southeastern Alaska show that abalone have experienced increases in recruitment, as defined by an increase in emergent and measurable individuals greater than 2mm. These examples of recruitment are limited to sites of historically high abalone densities and preferred habitat. Such index sites offer "best case scenario" data to managers of populations, but these sites may not possess the characteristics of the entire population. To gain a more comprehensive understanding of population demography and factors that may influence abalone recruitment across aggregations, I surveyed abalone index sites and randomly selected sites within Sitka Sound in the summer of 2018. This poster focuses on abalone recruitment and how measured recruitment correlates with nearest neighbor distances, critical densities, habitat types, refuge seeking behaviors, depths, aggregation size structures, and sea star and urchin densities.

Evaluating Iron as a Tool to Increase Flexibility in Kelp Mariculture in Alaska

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Kelp aquaculture is a growing industry supported by a rise in consumer demand and by the possibility of ecosystem services associated with the industry. With the development of kelp farming, new ways to improve current practices are constantly being sought out. The ability to find and implement ways to control the life cycle of kelps would allow for more flexibility in a hatchery setting, benefiting hatchery operators and farmers. Our research focuses on the effects of chelated iron to control the microscopic gametophyte stages of the kelp species, *Saccharina latissima*. Previous studies have shown that environmental conditions can affect the gametophyte stages of kelp, in terms of both growth and progression through the life cycle. Specifically, past research shows that kelp species can be grown indefinitely in the gametophyte stage in media that lacks added iron. However, it has not been thoroughly studied how gametophytes held in an iron deficient environment function when iron is added after different iron deficient "hold times". To investigate this issue, gametophytes of *Saccharina latissima* were grown in treatments where iron was added to the nutrient media after three different "hold times". The ability of the gametophytes to progress through their life cycle (*i.e.* become fertile) after iron addition was measured by measuring ratios of female gametophytes, eggs and sporophytes. Additionally, data were collected on gametophyte lengths, sporophyte lengths and gametophyte cell widths. Our results confirm past studies with other kelp species and locations, suggesting that gametophytes of *Saccharina latissima* near Juneau, AK can be held indefinitely in iron deficient nutrient media without becoming fertile and progressing to the sporophyte stage. Data collection on the effect of iron deficient hold times on life cycle progression to female eggs and sporophytes are currently underway.

Can Seaweeds be Sustainably Harvested in Kachemak Bay?

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Seaweeds are a valuable resource and are harvested by people to use as food, nutritional supplements, and garden fertilizer. In Southcentral Alaska, harvesting seaweed for personal use is mostly prohibited, with many regions designated as non-subsistence areas that are closed to the taking of seaweeds that are alive and growing, whether they are attached, drifting, or even in the form of wrack. Interest in harvesting seaweeds for personal use is ongoing and the impact of this activity on wild populations in Alaska is poorly understood. As such, the Alaska Department of Fish and Game has put collection regulations into effect to ensure the sustainability of Alaska seaweed populations. This study aimed to determine reproductive timing, harvestable biomass, and rebound rates of wild populations of *Saccharina latissima* (sugar kelp), *Nereocystis luetkeana* (bull kelp), and *Fucus distichus* (rockweed). From March through October of 2018, we checked individual plants for reproductive viability and simulated harvesting activity in areas easily accessible to potential harvesters in Kachemak Bay, Alaska. We cleared blades of some *N. luetkeana* or the entire thallus above the holdfast of others to determine if rebound rates (i.e., regrowth following a harvest) varied between these two traditional harvesting styles. For *S. latissima,* only blades were harvested and for *F. distichus*, entire plants were harvested above the holdfast. Due to the presence of overwintering adults in spring, reproductive *N. luetkeana* were found during the entire study period. Reproductive *F. distichus* developed in May and *S. latissima* were not found to be reproductive in any of our collections. While harvestable biomass was spatially variable among sites, a general increase from early to late summer for all three species was apparent. Contrary to our expectation, rebound rates remained consistently low throughout the growing season, except for high regrowth from March to May for *F. distichus* and *S. latissima* and high blade regrowth for *N. luetkeana* at one of our sites. These data suggest that, ideally, regulations should mirror the temporal and spatial variability among sub-regions, as it appears that some areas during certain times of the year are less sensitive to harvesting activity.

Lithothamnion soriferum Is the Habitat-forming Rhodolith of Kinzarof Lagoon, Alaska

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Rhodoliths are unattached coralline algae that support a high diversity and abundance of marine organisms. They are widely distributed from tropical to polar regions but have relatively few records from high latitudes in the North Pacific. We discovered a small (20 ha) bed of rhodoliths in Kinzarof Lagoon, an embayment of Cold Bay, near the tip of the Alaska Peninsula. The rhodolith bed occurred in a shallow tidal channel at -1 to -2 m water depth (mean lower low water). The bed was located adjacent to an extensive eelgrass (Zostera marina) meadow and in some areas extended 1-3 m into the leading edge of the submerged eelgrass. Most (75%) of the rhodolith bed contained moderate to low (<50%) cover of live plants, but ca 5 ha contained high (>50% cover) densities with an average wet biomass of live rhodoliths of 1,864 (SD = 92.6, n = 5) g m-2. Bleached out and presumably dead or dying plants were common in much of the area. The identity of the rhodolith species was not immediately apparent despite obtaining DNA sequences (no match in GenBank). Subsequent sequencing of many North Atlantic specimens, including types, was necessary before we could put a name on the Kinzarof rhodoliths. Three sequences generated from specimens in the type collection of Lithothamnion soriferum were analyzed, and all were identical to the Kinzarof Lagoon specimens. Lithothamnion soriferum was originally described as endemic to the “Norwegian Polar Sea” and recorded from numerous sites in northernmost Norway (up to 71° N). In addition to the North Atlantic Arctic and Kinzarof Lagoon, Lithothamnion soriferum is also known from Adak Island and Prince William Sound, Alaska, where these rhodoliths occur in deeper water (~7 to 18 m).

Nurseries to Fisheries: Spatial-predictive Models to Characterize Habitat Across the Life Histories of Fishery Resource Species

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Poster Presenter: Jodi Pirtle

Habitat-based indicators 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 and fishery productivity. We applied spatial-predictive habitat modeling for a set of groundfish species with diverse life histories to produce habitat suitability metrics for these species and to compare habitat distribution and niche overlap among species and life stages across the GOA fishery management area. We developed presence-only habitat suitability models (HSM) and maps for up to three life stages for each species, including early post-settlement juveniles resident in nursery areas, older juveniles no longer nursery residents and considered fishery pre-recruits, and adults. We combined species observations from several fishery independent surveys and sampling programs with high-resolution regional habitat predictor variables to evaluate habitat suitability in the models and produced GOA-wide maps of the model results that describe suitable habitat availability and niche overlap. A pattern emerged for many species of reduced habitat specificity and increased depth distribution from the juvenile life stages to adults. For others, the early juvenile stages occupied similar depths and were associated with different habitat types, including Pacific cod with emergent seafloor terrain and high presence of rocky substrate and sablefish with the main channels of bays and low presence of rocky substrate. Our work supported the GOA Integrated Ecosystem Research Program Synthesis and the recent NOAA Fisheries Essential Fish Habitat update for the North Pacific. Information from these HSM can be incorporated into the new ecosystem-socioeconomic profiles as stock-level indicators within the stock assessment reports for these species. This information can also be used to project life stage-specific distribution shifts through time within a changing GOA marine ecosystem.

Factors Affecting Survival and Life History Strategies of Auke Creek Coho Salmon

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Poster Presenter: David Tallmon

A major unknown facing salmon fisheries biologists and managers is how climate change and other factors will affect productivity. We make use of >35 years of coho salmon (*Oncorhynchus kisutch)* census data collected at the Auke Creek weir to investigate factors that influence coho marine survival and life history strategies. In the last few years, we have recorded some of the earliest arriving and least abundant spawning runs of Auke Creek coho. Because Auke Creek smolt are coded wire-tagged and censused, our dataset provides an unequalled resource to investigate factors affecting salmon survival in an integrated population model. We quantify the effects of key environmental and biological covariates on coho marine survival and life history strategies using a Bayesian age-structured state-space model. Ultimately, understanding the impacts of environmental changes on salmon populations and accurately predicting response of these populations to these changes is necessary for successful management of these economically, culturally, and ecologically important fishes.

Environmental Factors that Influence Spatiotemporal Variations in Pacific Herring Spawning in the Gulf of Alaska

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Poster Presenter: David McGowan

Following the collapse of the Prince William Sound (PWS) Pacific herring (*Clupea pallasii*) population in 1993, there continues to be uncertainty as to which mechanisms are responsible for persistent weak recruitment and low population size. A high recruitment event has not occurred during the last three decades, creating uncertainty as to which environmental conditions will be favorable to the population's long-term recovery. Identifying environmental processes that influence recruitment variability is especially difficult when herring mortality is integrated over the three-year juvenile phase. To improve our understanding of linkages between physical and ecological processes to PWS herring recruitment, a multiyear study has been initiated by the Herring Research and Monitoring and Gulf Watch Alaska programs to examine relationships between environmental factors with herring spawning and stage-specific mortality prior to recruitment. This analysis will represent preliminary findings for the first part of this effort. Using aerial survey data collected between 1973 to 2017 by the Alaska Department of Fish and Game, interannual variations in distributions of mile days of milt will be quantified to characterize spatial and temporal shifts in spawning areas within PWS. To test the hypothesis that the timing of herring spawning is primarily driven by atmospheric and oceanographic processes that operate across the Gulf of Alaska (GOA), spawn data from multiple coastal herring populations will be examined using times series analyses to compare the influence of physical and biological factors on spawn timing for each population. The analysis includes data from the Sitka, Craig, and Revilla Channel in southeast Alaska, PWS in the northern GOA, and the Kamishak population in Cook Inlet.

Spatiotemporal Assessment of Pacific Halibut (*Hippoglossus stenolepis*) Size-At-Age in Southcentral Alaska

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Observed declines in average size-at-age of Pacific halibut in Southcentral Alaska have potentially serious implications to the total amounts of commercially exploitable biomass and female spawning biomass. While the mechanisms driving these declines are the subject of current research, efforts are hampered by our limited understanding of the spatiotemporal nature of the declines. This work seeks to explore spatial and temporal patterns in growth and size-at-age of Pacific halibut in the Gulf of Alaska by 1) describing the spatiotemporal distribution of halibut size-at-age, 2) determining the locations of persistent spatiotemporal anomalies in growth performance, and 3) exploring potential relationships between Pacific Halibut size-at-age and diet using $\delta^{13}C$ and $\delta^{15}N$ analysis of muscle samples collected in a spatially-explicit framework. Preliminary results indicate that decreases in size-at-age are not randomly distributed in space, with defined differences in size-at-age between the Eastern and Western Gulf of Alaska.

Using Cyst Mapping to Understand Patterns of Wintertime Paralytic Shellfish Toxicity in Geoduck Clams in Southeast Alaska

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Filter feeders, like geoduck clams (Panopea generosa), can acquire paralytic shellfish toxins (PST) by ingesting toxin-producing phytoplankton, Alexandrium sp. These toxins can cause substantial economic loss to the geoduck fishery through increased sampling costs and by delaying or closing harvest. In Southeast Alaska, the commercial geoduck fishery is lucrative, with annual ex-vessel value averaging $4.7 million (2010-2018). In recent years, this fishery has been hampered by PSTs as 76% of management areas failed weekly PST testing over four harvest seasons. Clam toxicity within a harvest area varied substantially from week-to-week, fluctuating well above (e.g., 900µg) and below (e.g., 40µg) the regulatory limit of 80µg saxitoxins/100g shellfish tissue. Such variation occurs throughout winter months, long after these phytoplankton are gone from the water column. To better understand patterns of variability in PSTs and geoduck toxicity in Southeast Alaska, we are mapping benthic Alexandrium cyst distributions and identifying locations of high cyst densities within clam harvest areas. We are also testing the hypothesis that ingestion of overwintering Alexandrium cysts is a mechanism for toxicity during winter months. By working with the dive industry and regulatory agencies to sample sediments in geoduck harvest areas we have already identified Alexandrium cysts in a majority of open fishing areas in the 2017/2018 season. The goal of this research is to better inform the fishery with respect to how geoduck clams may acquire PSTs and support a safer fishery.

Consummate and Consumed Predators: Evidence from Telemetry and Observations for Offshore Killer Whale Predation on Pacific Sleeper Sharks in an Alaskan Glacial Fjord

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We captured a 2.46m pre-caudal length (2.8m total length) immature female Pacific sleeper shark (*Somniosus pacificus*) in Resurrection Bay of the Gulf of Alaska region, using baited bottom hook and line setups. The animal was measured, sampled, tagged with a single Wildlife Computers mini-PAT satellite transmitter and released at the capture location. The mini-PAT was programmed to release and report after 180 days, or after exceeding a preset pressure threshold, or five days after detecting mortality of the host. The mini-PAT started reporting 15 days after release. Initial tag emergence location and subsequent movement were tracked via the Argos system, and the tag recovered after it washed ashore near the City of Seward, Alaska. Downloaded accelerometer data suggested a violent death 10 days after release, at a depth of 240m. At this same time and the subsequent emergence location, hunting behavior was observed for a group of 8 offshore ecotype killer whales. Long submergence indicating deep diving coincided with tissue appearing at the surface that was grossly visualized as a shark spleen. The tissue from the tagged shark matched the genotypes of the recovered tissue at 6 microsatellite markers. There is a 1 in 1000 chance that the recovered tissue is not the original tagged shark. The mini-PAT data in connection with direct visual observations and genetic tissue analysis provides strong added evidence of offshore ecotype killer whale predation on sleeper sharks in this region, and near the sea floor at depths in excess of 200m.

Sampling Frame Design for an Untrawlable Habitat Survey in the Gulf of Alaska

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Biomass and size composition estimates from the biennial AFSC Gulf of Alaska (GOA) bottom trawl survey are an integral component of stock assessments and fisheries management, yet approximately 18% of the GOA is comprised of rocky, high relief habitat that is not accessible to survey gear. These untrawlable areas include important habitat for many harvested fish species and may support local densities and age structures of fish that differ from trawlable grounds. Thus, the expansion of estimates from the trawl survey onto untrawlable areas may result in potential biases. In order to improve fishery independent survey estimates in the GOA, we propose a separate untrawlable habitat survey that takes advantage of technological advances in acoustics and underwater camera systems. One of the key components of this survey is the creation of an untrawlable habitat sampling framework that includes a range of physical and biological variables that divide the GOA into trawlable versus different untrawlable habitats. Significant effort has been made towards habitat mapping in the GOA and a range of data types that range from multi-frequency acoustics to predictive modeling are now available. Here we compare and compile these data sets to define the extent and composition of untrawlable habitat and use data from these maps and existing underwater camera studies to construct a fishery-independent survey framework. This framework will be used to create a robust survey design which is the first step necessary to implement a fishery-independent survey of GOA untrawlable habitat which will provide significant direct benefits to future stock assessments.

Determining Efficient Culturing and Spawning Techniques of Gulf of Alaska Scallops

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Poster Presenter: Diana Perry

Aquaculture is a developing industry on the United States' West coast. Although Alaska hosts a number of small hatcheries, the main focus is on oysters, clams, mussels, and, in recent years, kelp. With a push throughout the state of Alaska to increase aquaculture operations and productivity, we completed a novel project on Alaskan scallops to determine methods to improve spawning success and work toward determining the overall feasibility of an Alaskan scallop aquaculture operation. In our efforts to better understand culturing scallops, we adapted protocols from previous culturing techniques in British Columbia and adapted protocols from studies on the effect of sex steroids on gonad development and spawning in *Placopecten magellanicus*, the Atlantic deep-sea scallop. We injected the abductor muscle of various groups of scallops with **β**-estradiol and progesterone to determine whether these steroids increase gonad growth and lead to spawning. Ultimately, we will report on the most efficient methods for pre-spawn conditioning of the Pacific pink scallop, *Chlamys rubida,* and preliminary work with the weathervane scallop, *Patinopecten caurinus*.

Below the Surface - Stereo Image and Video Analysis of Submerged Benthic Sandwaves and Pacific Sand Lance

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Forage fishes, such as the Pacific Sand Lance (PSL, *Ammodytes personatus*), are important components of marine food webs, transferring energy from lower to upper trophic levels. As a result, the distribution and abundance patterns and biomass fluctuations of forage fishes have profound impacts on ecosystem processes, including the energetics and breeding success of a variety of fishes, seabirds, and marine mammals. Despite the importance of the PSL to the structure and functioning of North Pacific marine ecosystems, not much is known about the deep-water habitat of this species. Through support provided by OceanGate and collaboration with the University of Washington and NOAA Alaska Fisheries Science Center, we used a manned submersible to collect oceanographic, sonar, stereo camera, and video data on a submerged benthic sand wave field to observe and quantify fish abundance, distribution, movement, response to diel and tidal signals, and behavioral attributes, related to schooling, movement in and out of benthic substrates, and response to disturbance. These fish have an obligate association with sediment and use benthic substrates regularly for rest, to avoid predation, and for protection and energy conservation throughout an extended period of winter dormancy. We have identified and explored a set of benthic sand wave fields and have mapped these features, using multibeam acoustics. We have also surveyed these substrates regularly throughout the past 10 years, using surface-based sampling with Van Veen grabs. Demographic and life history attributes for fish in these sites has been well documented through these studies. The work presented here represents an alternate view on this system, using sonar, video, and stereo-image data processed through automated software to characterize the topography of this 2x1 km benthic feature, document sediment movement across tidal movements, and quantify fish abundance, distribution, movement, and behavior. Estimates of abundance suggest 20-100 million fish use this particular benthic habitat feature. Initial analyses suggest diel vertical movement out of sediments, related to foraging. Analyses also provide new insights on unique behavioral attributes associated with dissociated distribution for dispersal and burial in sediments and aggregating patterns, merging into dense schools for foraging and movement.

Communicating the State of Alaska's Salmon and People: Sharing SASAP Synthesis Data with Salmon Decision-makers

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Alaska's salmon management has a firm science foundation, but it can be difficult for stakeholders of Alaska's salmon systems to readily access and use up-to-date, accurate and integrated information. The State of Alaska's Salmon and People (SASAP) project is a collaboration of more than 100 academic, tribal, agency, industry and community leaders working to gather, synthesize and archive knowledge about Alaska salmon and the people who depend upon them. SASAP takes a multidisciplinary, cross-cultural and integrated approach to understanding salmon and people systems, and our goal is to share this knowledge with the full spectrum of salmon users, advocates, and decision-makers. SASAP's communication strategy was informed by a survey of salmon stakeholders and through discussions with key influencers. These efforts resulted in the development of a website targeted specifically for Alaska's salmon users:. Through stories, it empowers users with the available biological, cultural, economic and governance-related knowledge about each of Alaska's salmon regions. The website also links directly to a vast collection of datasets stored on the KNB Data Portal administered by the National Center for Ecological Analysis and Synthesis (NCEAS). This combination of stories and data reflects the project's integration of different ways of knowing, with the aim of providing inclusive information to support decision-making that can lead to a more equitable salmon system.

Do Smolt Data Improve Adult Sockeye Salmon Forecasting Models in the Chignik Management Area?

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Poster Presenter: Nyssa Baechler Russell

Preseason forecasts of adult returns for commercially-important Pacific salmon species provide initial guidance for fishery managers to meet escapement and harvest goals and serve to help the fishing industry plan appropriately for their fishing seasons. The goal of such forecasts is to reduce uncertainty in the management and harvesting processes, yet preseason forecasts often have limited predictive performance. This study compares predictive performance and forecast error of existing models – which use sibling relationships (returning adults of the same freshwater age and brood year) to forecast returns – to models with smolt and environmental predictor variables. I selected predictor variables related to the effects of smolt abundance, size, migration timing and water temperatures on subsequent adult returns and tested these in a nested set of model runs. In general, the simpler sibling models performed better in the most recent 5-year prediction periods than the more-complex smolt models. The two most common and consistent predictor variables across smolt models were the length of the smolt outmigration season (number of days between 5% and 95% total smolt run) and the temperature of the river at the date of 95% of the total smolt outmigration. This prompted me to create a class of hybrid sibling models using sibling predictor variables and the mid-June average river temperature. Results from all model classes suggest that the standard sibling forecast model remains the simplest and best predictive model to use in the Chignik Management Area. The relatively high performance of sibling-return models probably derives from the fact that the biological information captured implicitly in sibling relationships are redundant to the types of information smolt data reflect.

Regional Differences in Walleye Pollock Size, Condition, and Prey Selectivity Suggest Density-Dependent Effects on the Western Gulf of Alaska 2013 Year Class

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During the 2013 western Gulf of Alaska (WGOA) fall survey, age-0 walleye pollock (*Gadus chalcogrammus*) were found in higher abundance compared to other years: an average of 0.42 m^2, compared to 0.06 m^2 (2011) and 0.00087 m^2 (2015). To assess the potential for density-dependent resource competition due to these higher abundances, diet and condition of age-0 fish were examined from the 2013 year class. It was hypothesized that fish from different areas along the WGOA shelf would show differences in size, condition, and diet. An inverse relationship between fish abundance and condition was observed. High abundances of smaller, lower condition age-0 fish were found at stations southwest of the Shumagin Islands compared to low abundances of higher condition fish found near and around Kodiak Island. Fish in the Shumagin Islands region showed a higher intake of pteropods and larvaceans compared to fish from the Kodiak Island region that had consumed mostly large copepods and euphausiids. However, Prey-specific Index of Relative Importance analysis showed age-0 fish from the entire study area primarily preferred large copepods and euphausiids as prey. These results suggest that the lower condition fish found near the Shumagin Islands were the result of density-dependent food limitation as higher quality prey may be been depleted. In contrast, the higher condition fish found near Kodiak Island did not deplete the available prey at did not experience density-dependent food limitation. The results suggest that density-dependent mortality in the Shumagin Islands region contributed to the overall population dynamics of the 2013 year class of Walleye Pollock.

Passive Monitoring to Investigate Predation Pressure at Aleutian Tern Colonies in Coastal Alaska

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Trend analyses indicate that the Alaskan population of Aleutian terns (*Onychoprion aleuticus*) has declined by more than 80% at known colonies over the past three decades, and the causes for this decline remain unknown. Due to isolated nesting locations, multiple visits to colonies over the nesting season are often unfeasible. Because of this, standard methods used to monitor other species of nesting terns are not applicable. During the 2018 nesting season, we employed multiple passive monitoring technologies, including acoustic recording devices and game cameras, to remotely monitor Aleutian tern colonies across the Kodiak Archipelago. We deployed passive acoustic recording units at 11 colony sites, for a total of 657 recording days. The acoustic units were programed to record for one minute out of every 6 minutes for the duration of the deployment period. At seven of the 11 acoustically monitored colonies, we also placed game cameras at a total of 44 Aleutian tern nests. Three colonies with both acoustic units and nest cameras also had game cameras mounted above vegetation height for a colony-wide view. The hatching success of nests was extremely low, due largely to predation by red foxes (*Vulpes vulpes*), brown bears (*Ursus arctos middendorffi*), northwestern crows (*Corvus caurinus*), black-billed magpies (*Pica hudsonia*), and glaucous-winged gulls (*Larus glaucescens*). By pairing game cameras with acoustic recorders, we seek to develop acoustic markers of predator disturbance (e.g., prolonged and/or elevated alarm calling) that can be applied broadly at colonies monitored solely with acoustic devices.

Use of Thermal Imaging for the Study of Arctic and Subarctic Seabirds in the Gulf of Alaska: Implications for Management and Conservation

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The interaction between seabird species and their habitat has become increasingly important due to evidence of population declines associated with rising temperatures and habitat loss. Spending most of their lives on the open ocean, seabirds typically only utilize land during the critical time of the breeding season. Shifts in the spatial ecology of the pelagic and coastal habitats used during stages of seabird life cycles determines the timing of breeding and reproductive success of many seabird species. Fluctuating ocean temperatures, prey abundance, and habitat availability has led to multiple die-offs and nesting failures occurring along the Gulf of Alaska such as Black-legged Kittiwakes in 2017 and Common and Thick-billed Murres in 2018. This study focuses on utilizing infrared thermal technology to investigate the effect of habitat use and behavior on the thermoregulatory needs of seabirds in Kenai Fjords National Park. Boat-based surveys were conducted to collect images and video footage of seabirds in the Kenai Fjords National Park and the Chiswell islands of the Alaska Maritime National Wildlife Refuge using a thermal imaging camera (FLUKE Ti50) and a thermal imaging video camera (FLIR Rev 110 H-series). Thermal video footage was collected of seabirds engaged in various activities such as resting, swimming, flying, foraging, incubating and predator avoidance to study the energetic costs of these activities and how heat is stored and displaced in the body during these activities. In addition, thermal images were collected of birds utilizing diverse substrates such as ice, water, rock and plants in contrasting weather conditions. These data may elucidate how habitat and microclimate influence thermoregulation of seabirds. This study includes data collected from a wide variety of arctic and sub-arctic seabirds encompassing alcids, gulls, sea ducks, cormorants, and tube-nosed seabirds. The use of thermal imaging to collect data on these species could improve survey methods for population counts which can contribute to the management and conservation efforts of resident and migratory seabirds in the Gulf of Alaska.

Resolving the Annual Pelagic Distribution of Tufted Puffins in the Gulf of Alaska: Preliminary Isotopic Correlates of Winter and Summer Marine Habitat Use

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Poster Presenter: Kristen Gorman

We initiated a two-year, integrative field and laboratory study in 2018 that is examining the at-sea distribution of Tufted Puffins (*Fratercula cirrhata*) in the Gulf of Alaska (GOA) during the non-breeding season. Populations of Tufted Puffins throughout the GOA have historically been considered at least stable or increasing. However, new analysis suggests these populations are now declining and are predicted to do so in the future. While much is known about Tufted Puffin breeding ecology, the species' migratory routes and wintering areas are currently not specifically known, but have been noted as important to resolve for management purposes. The GOA has experienced rapid changes in recent years (since 2014) due to an anomalous marine heatwave, and resolving little known aspects of Tufted Puffin ecology is important for better understanding the species vulnerability to rapid changes in the marine environment. Here, we test the hypothesis that isotopic niche of male and female Tufted Puffins will be similar with adults shifting from a relatively variable, lower trophic level during winter to a more constant, higher trophic level during summer. We deployed 30 geolocator tags (Migrate Technology) on nesting adult Tufted Puffins at Middleton Island, Alaska during the mid-chick rearing period (late July 2018). Captured adults were measured and weighed, blood (red blood cell fraction) and feather (face patch) samples were collected for carbon ($^{13}C/^{12}C$, $d^{13}C$) and nitrogen ($^{15}N/^{14}N$, $d^{15}N$) stable isotope values, and blood smears were obtained for molecular sex determination. Our analyses explore sex- and tissue-specific differences in $d^{13}C$ and $d^{15}N$ values, and relationships with adult Tufted Puffin body size and condition. Once geolocator tags are retrieved in 2019, we will compare isotopic data between 2018 and 2019 at the individual level, and couple the 2019 isotopic data with specific information on at-sea movement patterns and oceanographic variables during the winter of 2018/19.

Are Hatchery-Feeding Whales Trendsetters or Desperate Scavengers?

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Humpback whales (*Megaptera novaeangliae*) feed on a wide range of prey types, but their modes of prey selection are poorly understood. Scientists lack an integrated framework for understanding how characteristics of these prey, such as patch density, depth, energy content and mobility interact to affect the energy humpback whales gain from feeding. Animal-borne tags were deployed to record humpback whale behaviour while feeding and measure *in situ* prey patch characteristics for four taxa in Southeast Alaska: krill, herring, and two novel prey: juvenile coho and chum salmon released from hatcheries. A process model was developed to determine the proportion of the prey energy density per volume in a prey patch the whale is likely to capture and the energetic costs based on the observed predator behaviour and constraints on prey escape. Among nine distinctive foraging targets considered, predicted net energy gain ranged from negative values to over 3,000 kJ per minute. No single species was universally energetically superior, with patch density playing the largest role in determining profitability. Notably, hatchery released juvenile coho salmon tended to be too diffusely distributed for humpback whales to profitably feed, underscoring the importance to whales of behaviours that aggregate prey, notably the production of bubble nets. Whales may forage on prey that only partially offset metabolic losses when energetically profitable prey are not available.

Between a Rock and a Hard Place: How Vessel Traffic and Declining Ice Cause Compounding Risks to Harbor Seals in a Glacial Fjord

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Cruise tourism has burgeoned in Alaska over the past half-century, with annual visitation recently topping 1 million, making it the largest tourist segment state-wide. The ice-filled waters of glacial fjords are featured on every cruise to Alaska, with Hubbard Glacier—the largest tidewater glacier in North America—projected to draw 214 cruise ships in 2019, up 40% in two decades. The seasonal peak in vessel traffic in adjoining Disenchantment Bay overlaps with harbor seal birthing and nursing, which occur on floating ice. In the early 2000s, concerns about impacts stimulated research on the mechanisms of disturbance and on whether ships represent a long-term threat to glacial-fjord seal populations, whose aggregations are some of the largest in the world. Studies since have described the distances at which seals react to ships and flush, the energetic costs of extra time submerged, the frequency of close approaches, and the likelihood of population-wide disturbance when ships transit haul-out areas. In 2015, these and other findings prompted NOAA to issue more formal, but still advisory, minimum approach distances and transit corridors to promote seal-ship separation. The aims of this study were to: 1) compare contemporary vessel behavior with earlier studies to assess changes and compliance with new approach guidelines, and 2) to examine disturbance effects on seal distribution using GPS-quality locations of ships and seals. Compared to 2002 (N = 27), we found that vessels during June 2017 (N = 39) increased the area used for transiting to/from the glacier by 65%, from 26.4 to 40.6 sq km, with most ships operating outside the recommended corridor. Ships in 2017 also penetrated deeper into the floating ice pack, approaching the glacier at an average 3.8 km (range 0.7-12.4) compared to 9.6 km (2.1-17.8 km) in 2002; half approached closer than the advised 1.5 mi limit. Patterns were similar in 2016. We believe declining ice cover to be a primary reason ships are operating over larger areas and closer to the glacier, and in turn closer to areas of concentrated seals. We assess possible effects of these shifts by comparing several metrics of seal distribution across days with varying ship traffic.

Efforts to Examine and Mitigate the Potential Effects of Motorized Watercraft Use on Cook Inlet Beluga Whale (*Delphinapterus leucas*) Activity in Alaska's Twentymile River During Seasonal Fish Spawning Periods

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Poster Presenter: Suzanne Steinert

Critically endangered Cook Inlet beluga whale (*Delphinapterus leucas*) (CIBW) activity in Alaska's Twentymile River has been confirmed by previous research and indicated via anecdotal observations. Heightened human activity on the river during seasonal fish spawning periods may coincide with increased CIBW use and need of access to the river and adjacent critical habitat during this time. Motorized watercraft use, the dominant use type in this location (primarily for the purpose of fishing), may adversely affect beluga whales as a source of noise and potential strikes. This pilot study initiated efforts to: 1) Document the extent of CIBW use of the Twentymile River; 2) Determine the potential effects motorized watercraft use may have on beluga activity and behavior in this location; and 3) Gauge boater knowledge of CIBW activity on the river. A final objective was engaging the boating community in a participatory manner to inform efforts to and mitigate impacts on belugas. Data was collected via: shore-based observation sessions (n=82) on 78 sampling days (May-October); recreational boater interviews (n = 49); and in collaboration with local commercial river guides (n=3). A total of 121 belugas were observed (including calves) and 160 boats (99% motorized). The highest levels of beluga and boating activity were observed during the salmon run period (August-October). Out of 15 total 'interactions' of belugas with watercraft observed or reported, 5 instances of belugas displaying acute behavioral shifts in apparent response to boats were documented. 41% (n=20) of boater interview groups displaying a lack of awareness regarding CIBW activity on Twentymile and the potential effects of motorized watercraft use on belugas, indicating a need for increased education to mitigate future impacts. To inform mitigation efforts, boaters were asked to reflect on the issue and provide useful suggestions to more effectively increase awareness and encourage 'beluga friendly' boating practices.

Nanopore (MinION) Sequencing to Detect Novel RNA Virus Genomes in Alaskan Marine Mammal Species

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Risk of RNA viral infection has become a growing concern among North Pacific marine species. Marine mammals with gregarious behaviors are of particular interest due to the feasibility of viral transmission between individuals and other wildlife species (e.g. avian). Morbillivirus (phocine and cetacean distemper viruses) and influenza A viruses are highly pathogenic, negative sense RNA viruses that cause respiratory infections. Both viruses have caused mass epidemics among marine mammal populations in the North Atlantic, North Sea, and Baltic Sea regions. Recently, in the summer of 2018, an unusual mortality event (UME) was declared for over 1000 stranded harbor seals (*Phoca vitulina*) and grey seals (*Halichoerus grypus*) throughout the North Atlantic region (UME 67). Moribund and dead animals showed symptoms of respiratory infections. Phocine distemper and influenza A have been detected in Alaskan pinnipeds; however, existing viral diagnostic methods are not optimized for understanding the pathogenicity or transmission properties among different wildlife interfaces. We propose to analyze full virus genomes using Oxford Nanopore Technologies (MinION) to map virus epidemiology among different geographical regions. Current viral diagnostic methods focus on amplifying short conserved regions of the viral genome through reverse transcription polymerase chain reaction (RT-PCR). We are utilizing a panel of primers through either a multi-segment (MS-RTPCR) or tiling RT-PCR approach to obtain full genome amplicons for input cDNA in the MinION library preparation. Using a $1D^2$ kit, sequencing of genomic cDNA in real-time for avian paramyxovirus 1 we were able to bioinformatically annotate a full virus genome (15 kb) using Geneious R11. Through this project we developed a workflow that will allow us to identify novel virus genomes from preserved primary samples. Viral genome sequencing is crucial for understanding virulence, transmission, and susceptibility of marine mammal species to RNA viruses among different environmental interfaces. This data can be integrated into the evaluation of how ecological and physiological factors impact the health of marine mammal populations throughout Alaska.

Studying the Potential for Noise Disturbance in Cook Inlet Beluga Foraging Grounds

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A major concern for the recovery of the endangered population of Cook Inlet belugas (CIB) is the potential for negative impacts by human-generated noise (e.g. vessels, pile driving, oil and gas activities, etc.). A well-described effect on odontocetes exposed to noise is avoidance behavior leading to temporary spatial displacement. If this displacement occurs in critical areas, such as foraging grounds, CIB may have reduced feeding opportunities, which may affect their survival and reproductive success. To address this concern, we initiated a multi-year cross-institutional research project funded by the NMFS Species Recovery Grants program in partnership with the Alaska Department of Fish and Game, the Joint Base Elmendorf Richardson, the University of Washington Joint Institute for the Study of the Atmosphere and Ocean, and the NMFS Alaska Fisheries Science Center Marine Mammal Laboratory. Up to 10 acoustic moorings and 4 intertidal “silo” packages were deployed year-round within the CIB critical habitat to monitor beluga foraging and human-generated noise occurrence. During the open-water season, moorings and silos were focused on the upper Inlet, especially in known feeding areas in the Susitna Delta region, Knik Arm, and Turnagain Arm. During the winter period, moorings and silos were more broadly dispersed, maintaining key upper Inlet areas while also exploring mid (Trading Bay, Kalgin Island) and lower Inlet (Chinitna Bay) areas where belugas and their prey are known to concentrate. Occupancy models will be used to explore the relationship between beluga presence and exposure to human-generated noise, and to investigate levels of displacement in these monitored foraging grounds. Data analysis is ongoing and this presentation will include preliminary results on beluga feeding and noise occurrence.

Seascapes of Fear: Characterizing the Habitat Associated with Predation Locations of Juvenile Steller Sea Lions

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The landscape of fear states that animals experience varying levels of predation risk associated with different habitat characteristics, and that this risk has indirect behavioral effects that influence movement and habitat use patterns. Characterizing the role predation plays in marine ecosystems is challenging due to the cryptic nature of pelagic marine predators and the difficulty of quantifying predation. Implantable Life History Transmitters (LHX tags) provide post-mortem data via Argos satellites that identifies predation events and their location in tagged individuals, without direct observations. LHX tag data revealed predation as the primary contemporary cause of juvenile Steller sea lions (SSL, *Eumetopias jubatus)* mortality in the Gulf of Alaska, and predation may be a driver in the lack of recovery of the endangered western stock of SSL. We analyzed if particular habitats are associated with a greater risk of predation for LHX tagged juvenile SSL in the Gulf of Alaska. As of 2018, 18 of 20 detected mortalities were classified as predation events. We used a time-reversed state-space model that incorporated an average daily drift rate to backtrack tag locations to estimate the location of tag emergence and generate an uncertainty buffer around the predation location, on 7 animals with time delay between death and first uplink <16 hrs. For 6 animals with >16hrs delay, we utilized average step length and distance to estimate the predation location with uncertainty. To account for the large variation in the size of mortality buffers across methods and individuals (0.27-9245.73 km^2) we generated 100 random points within each buffer to simulate and characterize potential locations of predation (n=1200). For each point we extracted the depth, slope, sea surface temperature and distance to nearest known haul-out or rookery and compared these to randomly generated locations within the total available habitat used (i.e. home range) by juvenile SSL (n=84) in order to assess habitat-risk patterns. Preliminary results showed the majority of simulated predation locations were outside of individual's home-ranges, and that there was variability in habitats associated with predation events. This information will lay the framework for developing predation risk models for this vulnerable age-class.

Use of Thermal Imaging for the Study of Harbor Seal (*Phoca vitulina*) Habitat Associations in Kenai Fjords National Park, AK: Implications for Management and Conservation

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The interaction between species and their habitat has become increasingly important with current rising temperatures and habitat loss. In Alaska, 10 - 15% of harbor seals (*Phoca vitulina)* utilize glacial ice as a seasonal haul-out during pupping and molting months (May-August). Understanding the complex nature of harbor seal haul-out selection has many implications for management and conservation as tidewater glaciers retreat, resulting in critical habitat loss for the species. The effects of thermal properties on habitat associations and behavior of many mammalian species have yet to be quantified; however, infrared thermal imaging allows for precise modeling of substrate temperatures and may provide insight into potential type, timing, and behavioral variability of habitat usage. This study seeks to quantify habitat association of glacial and terrestrial harbor seals in Kenai Fjords National Park by comparing the microclimate and influence of temperature on site usage and behavior using infrared thermal technology. Boat-based surveys in Kenai Fjords National Park were employed to collect images of terrestrial and glacial haul-out locations using a thermal imaging camera (FLUKE Ti50). The thermal qualities of the surrounding habitat, weather conditions, and behavior will be compared to observe variation between haul-out sites and potential basis for habitat association. Microclimatic analysis of the haul-out locations will illustrate variation in background temperature, substrate temperatures, wind speed, and maximum recorded temperature (indicative of harbor seal body temperature). The purpose of this study is to further elucidate patterns of physiological ecology in harbor seal haul-out usage by observing influence of thermal properties within selected habitat, thus, better informing conservation and management practices for this species in the Gulf of Alaska.

Marine Mammal Monitoring in the Gulf of Alaska Under U.S. Navy Funding 2017

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The U.S. Navy continues to periodically fund extensive marine mammal monitoring within the Gulf of Alaska. Previous efforts have included combined visual and passive acoustic line transect surveys (2009, 2013), deployment of up to five bottom-mounted passive acoustic recording devices (2011-2015), and deployment of an underwater glider with passive acoustic capability (2015). The long term passive acoustic deployments have provided valuable new scientific information on select marine mammal species occurrence and seasonality, as well as ambient sound conditions.

For this presentation, results will be presented from a late April through early September 2017 bottom-mounted passive acoustic deployment in the Gulf of Alaska. Two of three sites were in similar locations monitored during the 2011-2015 time frame for comparison purposes. This included one slope site and one sea mount site. A third device was placed at a new site in 2017. This location was in the central Gulf of Alaska abyssal plain in water depth of 4,200 meters (m) with hydrophone elements floating at 1,000 m. Observations on ambient soundscape, select marine detections, and anthropogenic sounds will be provided. The marine mammal analysis and reporting was focused only on a sub-set of marine mammal species present including: Northeast Pacific blue whale B calls, Central Pacific tonal blue whale calls, blue whale D calls, fin whale 20 Hz and 40 Hz calls, gray whale M3 calls, humpback whale calls, sperm whale echolocation clicks, Cuvier's beaked whale echolocation clicks, and Stejneger's beaked whale echolocation clicks. Reporting on additional species is contained in previous technical reports posted on the U.S. Navy public monitoring website: https://www.navymarinespeciesmonitoring.us/reporting/pacific/

Further background, additional results, and description of future efforts from 2019-2021 will be described.

Spatial and Temporal Variability in Humpback Whale Feeding Behavior in Glacier Bay National Park and Icy Strait, Southeast Alaska

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After more than 30 years of increasing abundance of humpback whales (*Megaptera novaeangliae*) in Glacier Bay National Park and adjacent waters, numbers declined by 47% between 2013 and 2017. This decline coincided with a sharp decrease in calf production, and apparent survival, in addition to an increase in observations of "skinny" whales (as evidenced by protruding scalpulae and/or postcranial depressions). We hypothesized that recent changes in prey characteristics, such as species composition, biomass, energy content, density, or depth distribution, may be limiting whale foraging success and thereby driving the downward whale trend in this region. To assess spatial and temporal variability in whale feeding behavior, we conducted humpback whale focal follows and measured whale density along transects in association with hydroacoustic-trawl prey surveys in Glacier Bay and Icy Strait, Alaska in the summers of 2001, 2002, and 2018. While the behavior and spatial distribution of whales in the region was similar among years, whale densities were lower and more variable in 2018 than in 2001-2002, particularly at Point Adolphus, a historically important foraging area. Whales in Icy Strait were tightly associated with Pacific herring (*Clupea pallasii*) aggregations, which fluctuated with tidal state, while those in Glacier Bay were associated with a greater diversity of prey, including Pacific sand lance (*Ammodytes personatus*), Pacific herring, and capelin (*Mallotus villosus*). This work compares contemporary and historical foraging habitat used by humpback whales, and the effects of tidal fluctuation on both predators and prey within these regions. The results of this continuing study will aid in understanding how prey characteristics influence the distribution, abundance and productivity of marine predators, thereby informing resource management decisions in Glacier Bay National Park.

Fine-scale Trophic Ecology of Magister Armhook Squid (*Berryteuthis magister*) in the Eastern Gulf of Alaska

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Magister armhook squid (*Berryteuthis magister*) diets vary from small zooplankton, copepods, to fish such as sand lance. The purpose of this project was to evaluate diet variability using stable carbon and nitrogen isotope ratios (δ13C and δ15N values) of magister squid in the eastern Gulf of Alaska ecosystem as a piece of a larger sperm whale diet study currently being conducted. Fifty-four magister squid were sampled from nine stations on the NOAA Gulf of Alaska Bottom Trawl survey offshore in the eastern Gulf of Alaska. We then compared their stable isotope ratios to the ecosystem baseline of copepods (*Neocalanus sp.*), and one of their known predators, sperm whales (*Physeter macrocephalus*). Sperm whales appear to be two trophic levels higher than squid and three higher than copepods. There is a correlation between δ13C and the region of the Gulf of Alaska in which the squid were caught, indicating that squid from different regions are feeding at different distances from the shore. Finally, a strong correlation between squid mantle length and δ15N values was observed and there was a significant difference between male and female squid δ15N values. These results indicate that as magister squid grow, they feed at a higher trophic level, and that in general, female magister squid have a higher and broader trophic range than male squid.

Steller Sea Lion Rescue in Sitka: A Team Effort Brings Positive Results

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On the morning of Friday, August 30, 2018 the NMFS Stranding Network in Juneau was notified of a large, male Steller sea lion observed on the grass of the SEARHC campus in Sitka.Through the remainder of the day and over the Labor Day weekend, attempts to get the animal back to the water evolved from simply allowing the animal time to relocate itself to hazing, and finally to sedation and transport through the use of heavy equipment.The event was a synergy of complications and challenges involving animal behavior, human behavior, and the physical environment, but a successful resolution was possible through tremendous collaboration and cooperation between a variety of groups and individuals. It is unclear what prompted the stranding. Disease or health issues were a consideration; however, no evidence of ill health was apparent throughout the time the sea lion was on land and it has subsequently been satellite tracked to haulouts on the outer coast with no indication of restranding. This event provided important lessons learned that could be applied to future stranding events of this nature.

Characterizing Juneau-Area Humpback Whales via Citizen Science Data

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In 2016, NOAA Fisheries reclassified humpback whales (*Megaptera novaeangliae*) under the Endangered Species Act (ESA), resulting in many recovered Distinct Population Segments (DPS). A basic understanding of the population parameters of recovered DPSs is vital to further monitor the population's recovery and is a requirement under the ESA, as detailed in NOAA Fisheries' Humpback Whale Monitoring Plan. In this study, citizen science photo-identification data collected from whale-watch vessels in Juneau, Alaska during the summer of 2017 were analyzed for the purpose of characterizing Juneau-area humpback whales. We estimated population parameters including number of unique individuals, site fidelity, transience, and residency rate. Where available, calf presence and body condition were documented to look for potential changes in population health. The results were compared to population metrics reported for previous baseline "'normal" summers in Juneau. The 2017 metrics were also compared with data from nearby Glacier Bay National Park and Preserve (GBNPP) to examine whale presence and shared anomalies. We reported 92 unique whale IDs for the 2017 summer season. Residency rate (39%), transience (40%), and site fidelity (adjusted, 60%) metrics were similar to those of summer 2013 and 2014. Although a decline in body condition was not detected, our findings raise concern regarding the low number of documented calves (2), similar to the findings of GBNPP. These data contribute to our understanding of Alaska humpback whale population health and provide monitoring metrics to inform NOAA Fisheries' management goals.

Coastal Community Vulnerability Tool and Visualizations of Change in Cook Inlet, Alaska

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Poster Presenter: Davin Holen

The Cook Inlet Response Tool, which provides for interactive layers of spatial data to be visualized, provides oil industry developers and responders to technological disasters a spatial platform for understanding marine and environmental conditions in Cook Inlet. Cook Inlet home to a majority of Alaska's population is an area with active fisheries and other resource harvesting activities. This project took recent GIS data from a harvest and use surveys in Cook Inlet geographically spanning from Tyonek in upper Cook Inlet to Nanwalek on the edge of the outer coast. This data is public at the community level and can be sorted by community, major resource category, access to the resource, and month of harvest. The goal is to provide developers and responders information on what activities are occurring in Cook Inlet during which months in which areas, and how residents are accessing those resources. This will hopefully help developers plan activities, so they do not interfere with harvesting activities, and will give responders an idea of potential impacts during a technological disaster if one should occur in Cook Inlet. To ground-truth the harvest and use data, as well as to get a better understanding of coastal change over time, the project was shared with tribal councils in three communities to get feedback on utility of the tool for planning. The goal is to provide a tool that could be used by coastal communities in Cook Inlet for their own planning efforts.

Reducing the Risks of Biotoxins and Harmful Algal Blooms

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The Southeast Alaska Tribal Ocean Research (SEATOR) partnership is a collaborative network of seventeen tribal governments that collect phytoplankton and shellfish biotoxin data at over thirty sites. All sites are strategically chosen from important subsistence shellfish harvest areas for partner communities. Sampling efforts are primarily focused on the phytoplankton genera Alexandrium spp., which produces a suite of toxins known as Paralytic Shellfish Toxins (PSTs), and Pseudo-nitzschia, which can produce the neurotoxin domoic acid, as well as commonly consumed wild shellfish species. PSTs and domoic acid readily accumulate in marine subsistence foods and present significant threats to human health and the marine ecosystem.

Since starting phytoplankton and biotoxin testing, SEATOR has been able to identify trends in HAB occurrences and shellfish toxicity that differ from the traditional ecological knowledge associated with subsistence shellfish harvesting. Nearly 20% of the shellfish tested within the SEATOR network for PSTs exceed the FDA regulatory of 80 µg of toxins per 100 g of tissue. Two PST events, one in Ketchikan in 2017 and one in Kake in 2018, have occurred in Southeast waters that exceeded the FDA regulatory limit by more than 1,400 µg. PST events have also been observed in locations and months typically considered to be lower risk. Domoic acid has not been a historic threat to subsistence harvesters, but it is now emerging in as a significant potential concern. A Pseudo-nitzschia spp. bloom in Sitka in July of 2018 produced low levels of domoic acid, which had not been previously reported from Southeast Alaskan waters. The geographic range Pseudo-nitzschia toxin production has not been fully assessed, illustrating the need for more routine monitoring. The SEATOR partnership's data collection has been crucial to documenting these harmful algal bloom and biotoxin events and to better understanding changing risks for subsistence harvesters.

Leveraging Information Literacy Lessons in Science Communication: Modification of the ACRL Framework for Information Literacy for Science Outreach

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Traditional methods of science outreach and communication rely on the deficit model, wherein educators and communicators assume knowledge deficiencies influence public perceptions of, and feelings toward, science. By addressing these knowledge deficits, communicators hope to improve public perceptions of scientific research. However, remedying these knowledge gaps may not improve public perceptions toward science, as these perceptions are more often influenced by pre-existing thoughts, opinions, and even social groups. Reducing knowledge deficits is not enough to shift public opinion; science communicators must engage in conversation with the public and stakeholder groups if outreach efforts are to be effective. As science literacy standards and practices are heavily entrenched in the deficit model, new practices should be sought.

The Association for College and Research Libraries (ACRL) Framework for Information Literacy in Higher Education is a set of threshold concepts used to guide information literacy instruction. While originally designed for use in college and university settings, the Framework is both flexible and adaptable, allowing for use outside of both libraries and higher education settings. To better suit the needs of science communicators and educators, the Framework was modified and combined with existing science literacy standards to guide creation of an outreach website for the Pacific Sleeper Shark Research Project. The modified Framework focuses on threshold concepts of authority and credibility, scholarly conversation, and the value of scientific research and information. The modified Framework may provide a useful set of guidelines for other science communicators wishing to move away from the deficit model in their outreach efforts.

NPRB Project 1616: Implementation of Community Based PSP Testing for Subsistence and Recreational Shellfish Harvesting in Southwestern Alaska – Year 2 Update

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Despite high risks of paralytic shellfish poisoning to subsistence harvesters in southwest Alaska, the State currently has no capacity for routine testing of non-commercially harvested shellfish. This project aims to provide tools to inform local shellfish harvesting decisions through community-based toxin monitoring and development of a new PSP testing method. The study leverages community networks from the 2012-2015 Alaska Department of Environmental Conservation (DEC) Recreational Shellfish Beach Monitoring Pilot program, the Aleutian Pribilof Islands Association, and NPRB-funded technologies (#118) to implement subsistence shellfish testing. Five communities including Old Harbor, Ouzinkie, Kodiak, Sand Point and King Cove participate with monthly collection of Butter Clam samples. Toxin testing is performed by high performance liquid chromatography and ELISA at the NOAA Beaufort Laboratory, with comparative samples being tested at DEC. Results through Year 2 of the study showed Butter Clam toxicity in Old Harbor reached high levels in the spring/summer that coincided with seasonal water temperatures, mirroring the regional pattern in the Aleutians. In contrast, northeastern Kodiak sites exhibited lower toxicities, a more irregular seasonal pattern, and more frequent toxicity during the winter months. Efforts to improve toxin extraction and detection methods yielded a new ELISA with a greater sensitivity toward neoSaxitoxin and gonyautoxins, congeners nearly undetectable with the commercially available field test kits currently used in some locations to inform harvest decisions. Data from Kodiak study sites showed gonyautoxin congeners sometimes accounted for 70-80% of the toxicity in clams harvested during spring *Alexandrium* blooms, but <5% at other times. To address community interest into the efficacy of cleaning and preparation methods in reducing PSP risk, this project also explores toxicity differences between tissues deemed edible and non-edible by Kodiak harvesters. Results from Butter Clams demonstrate that the highest toxicities were generally present in the siphons of the clams (as reported in other studies), but with indication that seasonality may be a factor in anatomical distribution. Taken together, the improved testing and cleaning methods represent a significant step forward in community-based analysis of shellfish, and further development may provide better data to inform clam harvesting and consumption decisions in remote areas of Alaska.

The Alaska Harmful Algal Bloom Network – An Introduction

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Poster Presenter: Kayla Schommer

Harmful algal blooms (HABs) are not new to Alaska and include both toxic and non-toxic phytoplankton. The most well-known and destructive HABs in Alaska include the toxic dinoflagellate *Alexandrium,* that produces paralytic shellfish toxins, and the toxic diatom *Pseudo-nitzschia,* that can produce amnesic shellfish toxins (or domoic acid) under certain environmental conditions. Non-toxic *Chaetoceros* has also been linked to fish kills and survival of hatchery reared salmon upon release to the marine environment. Paralytic shellfish toxins have killed or sickened people and marine wildlife in Alaska for decades. Domoic acid has been found in the tissue of marine mammals harvested statewide; however, there has never been a documented human case of amnesic shellfish poisoning. While the causes of these harmful algal blooms are not well understood, climate change is likely to increase the threat of HABs in Alaska, resulting in increases in HAB duration, intensity and regional expansion.

The Alaska Harmful Algal Bloom Network (AHAB) was formed in 2017 to provide a statewide approach to HAB awareness, research, monitoring and response in Alaska. AHAB coordinates a diverse group of coastal stakeholders to address human and wildlife health risks from toxic algal blooms. Objectives of the group include reducing health risks due to HABs and facilitating safe supply of seafood, improving effectiveness of HAB response and HAB education and outreach, expanding HAB monitoring and developing forecasting capabilities, and identifying needs and data gaps related to HABs. The network is a partnership of regional stakeholders dedicated to this mission. The group is co-sponsored by Alaska Sea Grant and the Alaska Ocean Observing System. The website http://www.aoos.org/alaska-hab-network was created to share information statewide, describe current monitoring and research, provide real time results and provide access to statewide experts and resources. This poster shares the objectives of the network and introduces the content of the AHAB website.

Alaska EPSCOR Coastal Margins Project: A New Research Capacity Building Program to Investigate the Effects of Changing Watersheds on Coastal Ecosystems Along the Gulf of Alaska

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Poster Presenter: Brenda Konar

Nearshore marine habitats along the Gulf of Alaska (GOA) play a vital role in the life stages of many commercially and culturally important marine species. These habitats are strongly influenced by adjacent watersheds that are currently undergoing rapid change. Warming temperatures are increasing glacier volume loss and precipitation is increasingly

falling as rain rather than snow, both of which affect the magnitude and seasonal timing of freshwater discharge. Alaska EPSCoR, funded by the National Science Foundation, has recently begun a new 5-year program to determine how climate change is altering freshwater and material flux in glacially-influenced coastal waters along the GOA. Research will take place in two regions, Kachemak Bay near Homer and Lynn Canal near Juneau. Researchers will use field and remote sensing data, field and lab experiments, modeling, and coastal resource user surveys to address three goals. First, we will characterize the hydrological and biogeochemical dynamics of rivers along glacial to non-glacial watershed gradients and their linkages to coastal oceanography. Second, we will quantify biological responses of nearshore marine organisms to varying physical and chemical conditions along the glacial to non-glacial gradients. Finally, we will increase understanding of how coastal resource users and managers may respond to anticipated future shifts in nearshore marine resources and explore strategies for building adaptive capacity. This presentation will highlight our research plan for 2019 and ways that researchers and community members can get involved in the work.

Scoping and Disseminating Important Datasets for Alaska Fisheries

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With funding and support from NPRB, the State of Alaska Salmon and People, and the Alaska Department of Fish and Game, we are working to scope and disseminate datasets that are likely to be important for fisheries management and for increasing our understanding of community and ecosystem dynamics in the North Pacific. These datasets span critical events linked to ecosystem changes in the Gulf of Alaska and Bering Sea ecosystems, including regime shifts, anthropogenic perturbations, and changes in regulations and associated management practices, including:aerial surveys of pink and chum salmon abundances in Prince William Sound (PWS) streams (1960–present); PWS salmon age, sex, and length (ASL, 1963–present); large-mesh bottom trawl surveys of PWS, the Gulf of Alaska, and Cook Inlet (1977–present); Lower Cook Inlet salmon ASL (1960–present); Lower Cook Inlet salmon escapements (1927–present); Upper Cook inlet salmon ASL (1967–present); and Bristol Bay salmon ASL (1957–present). We will discuss the types of data included in each dataset, challenges associated with compiling these data, the timeframe for when they will be available, the mode of dissemination, and what datasets we also hope to make available in the future. While draft versions of some of these data have been used for previous studies, our project will result in a single, reliable source that can be accessed by fisheries professionals, managers, and researchers.

Still Awaiting Ecosystem Recovery Following the North Pacific Marine Heat Wave: Gulf Watch Alaska Pelagic Monitoring Update 2018

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Poster Presenter: Mayumi Arimitsu

The Gulf Watch Alaska (GWA) long-term monitoring program supports several coordinated efforts to understand population status, trends and trophic interactions within the marine ecosystem. Building on long-term datasets, the GWA pelagic component includes five projects to detect changes in populations of marine birds, killer whales, humpback whales, and prey (forage fish and krill). GWA sampling extended through a persistent period of ocean warming in the Gulf of Alaska (GOA) in 2014–2016, and we have since detected changes in the abundance and distribution of pelagic predator and prey communities during and following this extreme perturbation to the marine ecosystem. During 2018 in offshore waters, high densities of birds occurred near Middleton Island, Cape Cleare, and the shelf-break. Pacific sand lance were important in seabird diets at Middleton Island, suggesting a return of some forage fish in diets as temperature conditions returned to normal along shelf waters in 2018. In coastal waters of Prince William Sound (PWS), however, summer densities of alcids and terns declined in 2018 while numbers of storm-petrels and jaegers increased. Additionally, late-winter (Feb-Mar) marine bird surveys and fall integrated predator-prey surveys indicated that marine bird densities for most species (except black-legged kittiwakes) were below normal. Since 2015 the fall aggregations of killer whales in Montague Strait have not occurred, and there is an indication of reduced calf recruitment in some pods. Humpback whale numbers and crude birth rates within PWS remain depressed relative to pre-heat wave years. In fall 2018 acoustic indices of fish and krill were low. Our results suggest that the pelagic ecosystem along the Northern GOA coast has not recovered from the marine heat wave in 2018. Continued monitoring of the pelagic ecosystem by the GWA program will provide data required to evaluate the response of key predators and their prey to changes in the marine environment.

Developing Strontium Isotope Maps of Cook Inlet Basin to Elucidate the Foraging Ecology and Habitat Use of Species of Commercial and Conservation Importance

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The Cook Inlet (CI) basin encompasses 101,000 km^2 of land with over 35 tributaries of varying sizes. CI supports recreational and subsistence fisheries with 5 species of Pacific salmon (*Oncorhynchus spp.*), razor clams (*Siliqua patula*), Pacific herring (*Clupea pallasii*), and eulachon (*Thaleichthys pacificus*) harvested commercially. CI also supports several species of conservation concern including the endangered CI beluga whale (*Delphinapterus leucas*) population and the invasive northern pike (*Esox lucius*), a predatory, freshwater fish that has spread within the CI basin lakes and tributaries. Understanding the foraging ecology, habitat use, or movement of species of commercial interest or conservation concern are important in recognizing how changes in prey availability or location may be influencing the broader food web within CI. Isotope ratios of elements, such as Strontium (Sr), have proven valuable in investigating the feeding ecology and migration of free ranging animals. Sr accumulates in mineralized tissues such as teeth and otoliths and has been used to investigate life history parameters such migration and movement of Pacific salmon. Although the Sr isotope ratios ($^{87}Sr/^{86}Sr$) of marine waters center around a global marine value (0.70918) there can be considerable variation across land and surface waters expressed as geographic gradients. During 2017 and 2018 we collected 45 water samples from within CI or its tributaries with the aim of establishing the range of isotope variability in the CI - an isoscape. Analysis is currently underway to determine the $^{87}Sr/^{86}Sr$ ratio in each water sample, which will supplement 15 samples previously analyzed. The combined results will be used to explore the spatial variability of $^{87}Sr/^{86}Sr$ across and within the CI and its tributaries.The goal of the project is to use the Sr isoscape of the CI basin to track the physical characteristics of run-off in an estuary environment as well as provide an isotopic tracer that can be used to understand habitat use of species of commercial and conservation including the endangered Cook Inlet beluga.

Nutritional Quality of *Macrocystis pyrifera* at the Northern End of its Range

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Poster Presenter: Callie Simmons

Macrocystis pyrifera (giant kelp), provides both habitat and food to a variety of marine invertebrates and fishes throughout its geographic range. The purpose of this study is to better understand the seasonal nutritional quality of *Macrocystis* in Sitka Sound, at the northern end of its range, and to test the hypothesis that the nutritional quality of *Macrocystis* in Southeast Alaska is significantly lower than at lower latitudes. We sampled 5 mature *Macrocystis* blades monthly from two sites within Sitka Sound. Samples were processed to determine total tissue carbon and nitrogen content and stable isotope ratios. By monitoring for carbon and nitrogen isotopic ratios we can better understand *Macrocystis* nutrition and track energy sources. Preliminary results from January – June indicate that the nutritional quality of *Macrocystis* is lower in Sitka Sound than in California and that the nutritional quality of kelp within Sitka Sound shows seasonal variation, decreasing throughout the first half of the year. Initial comparisons between California and Sitka Sound suggest similar seasonal shifts, but average monthly C:N mass ratios appear to be higher in Sitka Sound for this time period. C:N mass ratios were 13.3 in January, 21.6 in April and 67.5 in June. Seasonal shifts in C:N ratios, higher C:N ratios and reduced blade nitrogen content, suggest diminished nutritional quality of kelp in Sitka Sound compared to lower latitudes. Final results including July through December samples will be presented. The results of this research will be essential in understanding the annual nutritional value of this plant to grazers and human subsistence harvesters, as well as describing the seasonal energetics of nearshore food webs of this subarctic system.

Ocean Acidification Does Not Affect Embryo Development, Hatch Success, or Calcification in Snow Crab, *Chionoecetes opilio*

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Ocean acidification, a decrease in ocean pH due to absorption of anthropogenic CO_2, has variable effects on different species. To examine the effects of decreased pH on snow crab (*Chionoecetes opilio*), a commercial species in Alaska, we reared ovigerous females in one of three treatments: ambient pH (~8.1), pH 7.8, and pH 7.5, through 2 annual reproductive cycles. Morphometric changes during development and hatching success were measured for embryos both years and calcification was measured for the adult females at the end of the 2-year experiment. Embryos and larvae analyzed in year one were from oocytes developed, fertilized, and extruded *in situ*, whereas embryos and larvae in year two were from oocytes developed, fertilized, and extruded under acidified conditions in the laboratory. Embryo morphology during development was unaffected by pH during both years. The number of successfully hatched live larvae was unaffected by pH treatment in both years. Embryo mortality was very low and hatching success high and both did not differ with treatment in either year. Percent calcium in adult females' carapaces did not differ among treatments at the end of the experiment. The results from this two-year study suggest that snow crabs are well adapted to projected ocean pH levels within the next 2 centuries, although other life-history stages still need to be examined for sensitivity. These results contrast sharply with those of the southern Tanner crab, *Chionoecetes bairdi*, in which embryo development and hatching success were strongly reduced under acidified conditions in similar experiments. Future work will examine the physiological responses in both species to elucidate what mechanisms drive the differential outcomes in these two sympatric congeneric species.

Extreme Physical Oceanographic Conditions in Alaskan Waters during Future Decades

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Poster Presenter: Nicholas Bond

Extreme oceanographic conditions in Alaskan waters are projected for future decades in terms of probability distribution functions (pdfs) based on climate model simulations from the Coupled Model Intercomparison Project Phase 5 (CMIP5). Our analysis considers separately three different habitats: the southeast Bering Sea shelf, Gulf of Alaska (GoA), and Aleutian Islands. We focus on variables in the global model projections that are relevant to the marine ecosystem, including surface and sub-surface temperatures, mixed layer depth, and upper ocean stratification. The projected changes during the summer are considered separately from those during winter. A multi- model ensemble approach is used towards the development of robust estimates of pdfs for the regions of interest. This approach removes the "structural" uncertainties associated with differences in model formulations.

Ocean Acidification Research: Using Observations and Models to Support Alaska's Blue Economy

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High latitude regions are experiencing the rapid onset of ocean acidification (OA) driven by increasing atmospheric carbon dioxide (CO_2). Alaska is more vulnerable to the effects of OA than other regions due to naturally cold waters and local processes. Here we show OA data collected at four moorings (M2, Kodiak, GAKOA, and SEAK) and some projections of future OA based on these seasonal data. These data show the seasonal cycle of important OA variables and identify key modes of interannual variability at sites in the southern Bering Sea and the northern Gulf of Alaska. For example, warm years with low sea-ice coverage and cold years with high sea-ice coverage in the Bering Sea exhibit markedly different carbonate chemistry. Stronger surface production and more sub-surface vulnerability to OA was observed in cold years. 2018 was a particularly warm year in the Bering Sea, including record low sea-ice extent, a late spring bloom, and an overall weak drawdown of CO_2 in surface waters relative to the previous five years of data observed at M2. In the Gulf of Alaska, increasing temperatures and freshwater discharge can also affect carbonate chemistry from year to year. Despite these large interannual swings, these results suggest that the OA signal may be distinguishable from natural variability on decadal timescales. Accordingly, we project that southeast Alaska is likely to experience severely corrosive conditions by midcentury, the earliest onset of acute acidification of these four sites. This is critical information for resource managers and community leaders seeking to understand the risks posed by ocean acidification to local food and economic security. These projections can be applied to bio-economic models for the region as well as help develop strategies for resilience and adaptation in commercial, personal, and subsistence fisheries.

Time-Series of Direct Net Primary Production and Phytoplankton Biomass Observations in the Eastern Bering Sea: Responses to Warm and Cold Year Stanzas

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Poster Presenter: Michael Lomas

The eastern Bering Sea is sensitive to spatial and temporal changes in the seasonal ice cover that acts as a major organizing factor and driver of the ecosystem. During winter, atmospheric forcing, latitude, and ocean circulation combine to produce a massive expanse of seasonal ice, which in cold years can cover the eastern Bering Sea shelf from Bering Strait almost to the Alaska Peninsula. In spring, the retreating ice, increasing daylight hours, and nutrient-rich ocean waters result in intense marine productivity. This burst of spring production, together with more episodic summer and early fall production, provides the energy that ultimately sustains nearly half of the U.S. annual commercial fish landings as well as providing food and cultural value to thousands of Bering Sea coastal and island residents. Based upon satellite models, it has been hypothesized that with climate change, the reduced sea ice extant and warmer temperatures will lead to increased annual primary production values, with subsequent positive effects on higher trophic levels. Here we present direct primary production measurements, collected in spring and fall, from the recent cold (high ice) stanza (2007-2011) and warm (low ice) stanza (2014-2016) to evaluate this hypothesis. Over the duration of the time series, there was a significant ($P=0.02$) increase in integrated (0-50m) primary production, however, year explained only a small fraction of the variance (~4%). Contrary to the hypothesis, increased mean temperatures (0-50m) were not significantly related to rates of integrated primary production ($P=0.66$). Direct comparison of seasonal observations between cold and warm periods showed significantly ($P<0.05$) higher rates in spring and summer of warm years than in cold years, but no significant differences during fall. Other ecosystem variables, e.g. phytoplankton biomass (i.e., chlorophyll), nutrients, wind mixing and stratification will be evaluated to understand what is driving the increase in primary production. We conclude that temperature is not a primary driving factor of primary production in this system and thus temperature dependent primary production models, through temperature control on phytoplankton physiological rates, should be cautiously interpreted when predicting future rates of ecosystem productivity.

A Skill Assessment for the BESTNPZ Bering Sea Biogechemical Model

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The BESTNPZ biogeochemical model simulates the key processes and features of the Bering Sea lower trophic level ecosystem, including primary and secondary production in the pelagic environment as well as benthic-pelagic and ice-pelagic interactions. Over the past several years, it has quickly gained traction within the research community; coupled to a regional ocean model for the Bering Sea, it has been used to investigate a variety of topics related to biophysical variability. Following a recent overhaul of the underlying source code, which improved ice dynamics and revisited several biogeochemical process equations, we present a formal skill assessment of the model's ability to reproduce observed spatial and temporal patterns, with a focus on sea ice advance and retreat, cold pool formation, and primary production.

Why the Shift? A Temporal Analysis of *Nuculana Spp.* Abundance and Size Class in the Northern Bering Sea from 2001 – 2015

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Poster Presenter: Lauren Swam

Over the past decade the abundance of bivalves in the genus *Nuculana* has declined in the region just south of St. Lawrence Island in the northern Bering Sea. Collections were made of the two predominant *Nuculana* species, *N. radiata* and *N. pernula* prior to, and as part of, the current Distributed Biological Observatory (DBO) research program that began in 2010, with data available up until 2015. The study is focused on 5 time series sites within the DBO1 region that is influenced by the St. Lawrence Island Polynya (SLIP). Both species of *Nuculana* were dominant in abundance and biomass in the 1980's relative to other bivalves, specifically *Macoma sp.* and *Ennucula tenuis*, but both *N. radiata* and *N. pernula* have since declined in number.

These clam populations are significant prey for the winter foraging of the spectacled eider (*Somateria fischeri*), an important apex predator in the SLIP region in late winter. There is a preferred size class of *Nuculana* spp. that provides optimal caloric intake for spectacled eiders; therefore, the size classes that are present and available influence the prey base for the diving seaducks. In addition to the importance of nuculanid bivalves as a prey base, the relative abundance and dominance of the two *Nuculana* species as well as their size class ranges can provide insights about changes in their recruitment, growth and population dynamics. Ongoing environmental changes in the region such as reduced sea ice and warming seawater can also potentially influence faunal lifecycles. We use a suite of environmental conditions, including bottom water temperature and sediment characteristics, to evaluate key drivers influencing biological changes in these benthic communities over a fifteen-year period.

This analysis includes evaluation of the size classes and relative abundance of both *N. radiata* and *N. pernula* within the SLIP stations using GIS techniques, including geographically weighted regressions. Variations in bivalve size class abundance were also tracked to determine interspecific dominance and broader lifecycle trends over time.

Polychlorinated Biphenyl (Pcb) Contamination on Unalaska Island in the Aleutian Archipelago

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Poster Presenter: Elise Adams

Polychlorinated biphenyls (PCBs) are a group of man-made, hydrophobic organochlorines that persist at highly toxic levels in the environment and biomagnify within food webs. Although banned, their continued release from pre-banned products and persistence in the environment impact human and wildlife health. PCBs are transported to the Arctic via global distillation and biomagnify to high levels in the lipid-rich food web. Thus, the long-range transportation capacity of PCBs can affect food webs far from the area of release. In addition, the Arctic contains thousands of World War II and Cold War formerly used defense (FUD) sites, many of which are also a local source of PCB contamination. PCBs have the ability to modify or suppress thyroid, reproductive and immune function. Exposure can reduce cognitive function and greatly increase the risk of developing cancer, hypothyroidism and a host of other negative health effects. Human and animal exposure occurs via ingestion of contaminated food. PCB concentrations were analyzed in threespine stickleback (*Gasterosteus aculeatus*) and subsistence foods important to the Qawalangin Tribe of Unalaska (i.e., salmonid species and blue mussels (*Mytilus edulis*)). PCBs were extracted from samples using a modified QuEChERS method. Mean PCB concentrations were quantified in target species to assess potential risks associated with subsistence foods and to detect a difference between global and local sources of PCB contamination. Two FUD sites showed elevated levels of PCBs that exceed safe consumption guidelines. These results support the need to remediate the FUD sites of “Building 551/T Dock to Airport” and “Delta Western”. More generally, these results provide further evidence of the continued problem of PCB contamination at FUD sites in the Arctic.

Alaskan Bathymetry for Fisheries and Oceanography Research

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Poster Presenter: Mark Zimmermann

Detailed and accurate bathymetry provides the basis for describing fish habitats, understanding land and sea interfaces, and determining how biological and physical processes integrate over a range of geospatial scales. As funding and time permit, we have been publishing accurate bathymetry and sea floor features by combining data from hydrographic smooth sheets, multibeam bathymetry, and other data sources, but detailed bathymetry is still lacking for many areas of Alaska. Our previously published maps for the Aleutian Islands, Cook Inlet, Norton Sound and the central Gulf of Alaska have been used for a wide range of projects including coral and sponge distribution modeling, Essential Fish Habitat maps, and NPRB's Gulf of Alaska - Integrated Ecosystem Research Program. These bathymetries have resulted in numerous additional collaborations with tsunami, tide simulation and storm surge modelers, as well as geologists studying faults and uplift. In 2018 we published a new map of the eastern Bering Sea slope, showing the correct position of numerous canyons, providing updates/corrections for 45 seafloor feature names to national and international governing bodies, and disproving the existence of the Zhemchug Canyon pinnacles. A draft bathymetry compilation of the western Gulf of Alaska provides new details of the morphology of Shelikof Strait, an important habitat for several groundfish species, such as walleye pollock (*Gadus chalcogrammus*), which spawns in a small, deep area of the strait in the winter. We are currently revising our previously published (2013) bathymetry of the Aleutian Islands, focusing on the inshore area, using this complete shore-to-shore depth surface to provide the first update of Aleutian pass size in 50 years, and eventually, revising our NMFS bottom trawl survey stations, strata, and facilitating next-generation stock assessment modeling.

Juvenile Chinook Salmon Condition Response to Warm Temperatures in the Northern Bering Sea

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Poster Presenter: Fletcher Sewall

Adult Chinook Salmon (*Oncorhynchus tshawytscha*) returns to the Yukon River declined in the mid-2000s and have generally remained low despite increasing returns since 2014. The causes of such changes in abundance are unclear. Variation in adult returns is largely set by their abundance as juveniles in the northeastern Bering Sea (NBS) in autumn, indicating adult stock size is strongly influenced by earlier marine and freshwater survival. Survival of NBS juvenile Chinook may be promoted by attaining sufficient size to avoid predators and capture prey, and by storing sufficient fat to avoid winter starvation. In addition to size, autumn energy density (ED) can therefore be an important condition monitoring tool. Our objective was to describe trends in size and condition of NBS juvenile Chinook, and the potential influences of diet and temperature.

Juvenile Chinook Salmon were collected by surface trawls in autumn (late August – early October) in 2006 – 2017 from the NBS, and measured for size, diet composition, and energy density. Sea surface temperature (SST; < 10 m) was recorded by CTD casts concurrently with trawls. Juvenile Chinook ED increased with size, and size-adjusted ED differed among years. Differences in ED among years appeared to be due in part to annual differences in SST, with better condition in recent warmer years. In warm years (autumn SST ≥ ~9 °C), diets shifted away from predominantly capelin towards increasing proportions of Pacific Sand Lance and larval crabs, with less piscivory overall. However, despite lower piscivory in warmer years, the diets were adequate to support better energetic condition than in cooler years. Following the end of the cooler period from 2006 – 2012, juvenile abundances have generally increased, preceding the rebound in adult returns through 2017, suggesting warmer years favor juvenile survival through their first autumn at sea. These data indicate that changing ocean conditions cause changes in juvenile Chinook diets and energetics. Continued annual monitoring of juvenile Chinook size, condition, and diets will enable further investigation of the relationship between ocean conditions, fish condition, and survival.

Examining the Interaction of Commercial Fishing Gears and Structure-forming Invertebrates in the Aleutian Islands

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Understanding the effects of fishing on vulnerable habitat features is fundamental to long-term ecosystem monitoring and fisheries management. Currently-available data streams allow for quantitative assessment of the benthic impacts of commercial fishing at regional scales. However, information gaps on both the locations of vulnerable habitat features and the locations where fishing gear interacts with these features at sub-regional scales limit our ability to a) assess the localized impacts of commercial fishing on vulnerable benthic habitat features, and b) evaluate how larger-scale impacts are driven by targeted management policies. This project aims to investigate the interactions between commercial fishing gears (hook and line, non-pelagic trawl, pot) and long-lived structure-forming invertebrates (corals and sponges) at sub-regional scales and develop a risk assessment for the effects of fishing on structure forming invertebrates (SFI). First, vessel monitoring system (VMS) data gathered from (2003-2018) will be used to delineate the footprint of commercial fishing in the Aleutian Islands by gear type and target species. Next, regression analyses will be used to construct fishery distribution models which explore the degree to which environmental and terrain variables predict the probability of commercial fishing events by target and gear type across the entire Aleutian Islands. These predictions will include areas currently open to fishing and areas where fishing using is restricted. Finally, a risk assessment will be conducted using spatial overlap of predicted fishing (by gear type and target) and predicted occurrence of structure forming invertebrates. We anticipate these analyses will help span the gap between regional-scale assessments and localized gear-habitat interactions to provide a more complete picture of the dynamics at play in the management of habitat impacts.

Migration of Juvenile Summer-run and Fall-run Chum Salmon from the Yukon River Mouth

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To identify critical life history stages for salmon survival, it may be informative to compare adult returns with abundances at various life-history stages. Past genetic studies demonstrated that relative abundances of Yukon summer-run and fall-run juvenile chum salmon (*Oncorhynchus keta*) caught on the eastern Bering Sea shelf during late summer/early fall are correlated with adult returns for their respective year-classes. We are interested in testing whether earlier life history stages are also correlated with adult returns. Our project aims to estimate the relative proportions of summer-run and fall-run juvenile chum salmon as they out-migrate from the Yukon River. To estimate the seasonal run proportions, we genotyped 1,783 juvenile chum salmon collected in 2016 from 9 field sites on the Yukon River mouth. Genotypes at 13 microsatellite loci were compared with a chum salmon genetic baseline. About three-quarters of the juvenile chum salmon were from summer-run populations and one-quarter from fall-run populations. At finer spatial and temporal scales, differences were observed in the seasonal run proportions. Higher proportions of fall-run fish were present in the latter part of the outmigration and in the southern channel of the river mouth. Seasonal proportions also differed by fish length. Although the majority of small and large fish, separated by median size, were from the summer-run, the proportion of fall-run was nearly four times higher for large fish than small fish. Future analyses will compare the seasonal run proportions of out-migrating juveniles with those of juveniles collected on the eastern Bering Sea shelf during the 2016 summer/fall surveys, as well as the returning adults to the Yukon River.

Accounting for Shifting Distributions and Changing Productivity in the Development and Use of Scientific Advice for Fisheries Management: from Detection to Management Action

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There is growing evidence of climate-related effects on species distributions and productivity, and these effects are expected to increase with continued changes and increasing variability in climate and ocean systems. Shifting distributions and productivity can have significant impacts on management decisions and their outcomes, such as allocation, stock status determination, and catch limits. It is therefore important that managers take actions now to ensure they are better prepared to confront the current and future challenges posed by changing environmental conditions.The ability for managers to make informed decisions in the face of changing climate may require changes to how information is collected, analyzed, and delivered to managers. In 2017, the U.S. National Marine Fisheries Service (NOAA Fisheries) created a national working group comprised of scientists and other experts to identify specific issues, needs, and recommendations to advance the production, delivery, and use of climate and environmental information in the management of U.S. fisheries. The working group identified 6 main steps in the science-to-management process and developed recommendations on how to improve our NMFS ability to account for climate change at each step. Recommendations included: developing more flexible and adaptive monitoring programs for tracking species distributions; prioritizing mechanistic research; increasing the use of spatio-temporal and geostatistical modelling; strengthening the use of ecosystem indicators and assessments; standardizing the process by which results are communicated to managers; evaluating management strategies under projected future ocean scenarios; developing adaptive harvest control rules; and increasing cross-jurisdictional coordination. Successful implementation of these recommendations will better position NOAA Fisheries and its management partners to address the growing challenges of managing U.S. fisheries in a changing climate.

Lipid Storage and Fatty Acid Profiles of Juvenile Yellowfin Sole and Northern Rock Sole from the Eastern Bering Sea

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Poster Presenter: Carlissa Salant

Yellowfin sole (*Limanda aspera,* YFS) and northern rock sole (*Lepidopsetta polyxystra,* NRS) are commercially important flatfishes in the eastern Bering Sea (EBS). Studies of the relationships between these flatfishes and their habitats have been conducted in conjunction with the annual EBS bottom-trawl survey intermittently since 2009. In 2017, the survey was extended to the northern Bering Sea (NBS), providing an opportunity to assess the suitability of this area as juvenile flatfish habitat. We collected juvenile YFS and NRS from stations ranging from Bristol Bay to Norton Sound and compared the spatial variation in their body condition using multiple biochemical metrics. Total lipids and lipid classes were assessed to determine condition and fatty acid (FA) biomarkers were used to determine dietary links of age-0 and age-1+ YFS (n=91) and NRS (n=53). On average, total lipids per wet weight (WWT) was not significantly different between the two species at either age, but total lipid did significantly decrease with length for both species (YFS, $F=8.9$, $df=1$, $p=0.004$; NRSF=7.3, df=1, p=0.009). Age-0 NRS (SL<45 mm) contained 14.1 ± 1.7 mg/g total lipid/WWT, while age-0 YFS contained 12.6 ± mg/g. In contrast, age-1+ NRS (SL>45 mm) contained 8.9 ± 1.03 mg/g total lipid/WWT, while YFS contained 8.6 ± 0.7 mg/g. This suggests an important accumulation of lipids in both species during the first summer prior to overwintering, after which lipids stores are depleted with continued growth. A non-metric multidimensional (nMDS) plot of 11 FAs detected in both species and ages showed grouping by region (stress = 0.12, $p<0.05$) with Bristol Bay fish having higher lipid condition and increased diatom lipids storage markers. These preliminary lipids and FA data indicated: 1) there are similar ontogenetic trends in lipid storage for both YFS and NRS, and, 2) there is spatial variability in the diet of juvenile YFS and NRS within the EBS and NBS. The examination of the infaunal prey field, flatfish stomach contents, and otolith analysis in progress will help elucidate the mechanisms behind the spatial variability in juvenile flatfish condition and growth in nursery habitats across the Bering Sea.

Comparing a Numerical Integration Method for Constructing Size-Transition Matrix with Other Construction Methods

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Poster Presenter: Lee Cronin-Fine

Stock assessment methods for many invertebrate stocks, including crab stocks in the Bering Sea and Aleutian Islands region of Alaska rely on size-structured population dynamics models. A key component of these models is the size-transition matrix, which specifies the probability of growing from one size-class to another after a certain period of time. Size-transition matrices can be defined using three parameters, the growth rate (k), the asymptotic height ($L\infty$), and the variability in the size increment. Most assessments use mark-recapture data to estimate these parameters and assume that all individuals follow the same growth curve. Unfortunately, not accounting for individual variation in growth can result in biased estimates of growth parameters. It is also unrealistic to assume that every individual has the same k and $L\infty$. However, a method is now available that allows k and $L\infty$ to vary among individuals. This technique is compared to two other methods for creating size-transition matrices, each with different assumptions about individual variation in growth. The first assumes all individuals follow the same growth curve. The second assumes individuals follow one of three growth curves through the “platoon” method. This method divides the population into separate platoons, each with their own growth curve and size transition matrix. We conducted a simulation study comparing the performance of the three construction methods under a variety of scenarios such as whether individuals in the simulated growth population have their own growth parameters, and the number of mark-recapture data points to determine which performs best overall.

TUESDAY, JANUARY 29, 2019

WAVE 1
BERING SEA & ARCTIC

(6:00 PM TO 7:30 PM)

POSTER PRESENTATIONS: TUESDAY, WAVE 1 6:00PM - 7:30PM
BERING SEA/ALEUTIANS & ARCTIC

TITLE	PRESENTER	SECTION	LOCATION (row & poster)
Historically low extent of sea ice in the Bering Sea associated with low overwinter survival and breeding effort in the Black Guillemot, an ice-obligate seabird	George Divoky, David Douglas, Christophe Barbraud	Seabirds	R5 , P82
Assessing the Role of Harmful Algal Blooms as an Immunocompromising Factor in Susceptibility to Avian Influenza	Maile Branson, Eric Bortz, Douglas Causey	Seabirds	R5 , P83
Assessing the effects of saxitoxin ingestion in an avian model species.	Robert Dusek, Caroline Van Hemert, Robert Kaler, Kathy Kuletz, Barbara Bodenstein, Valerie Shearn-Bochsler, Matthew Smith, Jeffrey Hall	Seabirds	
Simulating the migration of northern fur seal pups through the Bering Sea and North Pacific Ocean	Noel Pelland, Jeremy Sterling, Devin Johnson, Mary-Anne Lea	Mammals	
Factors affecting energy expenditure in a declining fur seal population	Elizabeth McHuron, Jeremy Sterling, Daniel Costa, Michael Goebel	Mammals	R5 , P87
Effects of maternal care on Steller sea lion pup and juvenile survival	Alexey Altukhov, Russ Andrews, Tom Gelatt, Vladimir Burkanov	Mammals	R5 , P88
Cetacean distribution in the central Bering Sea basin: Results from the 2018 IWC-POWER cruise	Jessica Crance, Koji Matsuoka, Amy James	Mammals	
Using stable isotope analysis of vibrissae from northern fur seal pups and juveniles to establish individual foraging and migratory patterns	Tonya Zeppelin, Christina Kelleher, Brandon Güell , Rolf Ream, Carolyn Kurle	Mammals	
Alaskan Projects of the NIST Marine Environmental Specimen Bank & Their Tissue Access Policies	Amanda Moors, Debra Ellisor, Jennifer Ness, Jared Ragland, Jennifer Trevillian, Stacy Schuur, Teresa Rowles, David Roseneau, Rebecca Pugh	Mammals	
Sea otter mortality on Alaska Peninsula and Unalaska	Barbara Bodenstein, Michelle St. Martin	Mammals	
The Commander Islands Steller sea lion (Eumetopias jubatus) population:status update, 2018	Natalia Laskina, Denis Gaev, Vladimir Burkanov, Tom Gelatt	Mammals	R5 , P89
Abundance of the sea otter population on the Kuril Islands (Russia) and analysis of the environmental parameters that influence an uneven distribution of otters along the Kuril chain.	Ekaterina Ovsyanikova, Alexey Altukhov	Mammals	R6 , P91
Leptospirosis - A new normal for marine mammals in North Pacific?	Natalie Rouse, Kathy Woodie, Jane Belovarac, Caroline Goertz, Sarah McMillen, Pam Tuomi	Mammals	R6 , P93
First encounter of the North Pacific right whale (Eubalaena japonica) in the waters of Chukotka	Olga Filatova, Ivan Fedutin, Olga Titova	Mammals	R6 , P95
Assessing change and resiliency in marine resources and subsistence on St. Lawrence Island	Jenell Larsen, Sarah Wise, Shannon Atkinson DeMaster, Miriam Kulowiyi, Kayli Apatiki	Humans	R6 , P97
Conservation finance for fisheries	Suresh Sethi	Humans	R6 , P99
Introducing Trophic Indexes for Monitoring Ecosystem Status (TIMES): a new stable isotope-based framework for long-term monitoring of the Bering Sea ecosystem	Todd Miller, Matthew Rogers, Ron Heintz	Ecosystem Perspectives	
Environmental DNA (eDNA) uncovers the presence of eelgrass (Zostera marina) pathogens Halophytophthora sp. Zostera, Labyrinthula zosterae, and Phytophthora gemini in Alaska	Damian Menning, David Ward, Sandra Talbot, Sandy Wyllie-Echeverria	Ecosystem Perspectives	
Characterizing particle-associated and free-living microbes and their roles in the carbon cycle of the Bering and Chukchi seas	Rachel Lekanoff, Eric Collins, Andrew McDonnell	Climate and Oceanography	R6 , P101

TITLE	PRESENTER	SECTION	LOCATION (row & poster)
Primary production in the southern Chukchi Sea: June (ASGARD) and August/September (Arctic IES) 2017 survey results	Lisa Eisner, Michael Lomas, Dean Stockwell, Steven Baer	Lower Trophic Levels	
Distribution and diet of juvenile Pacific cod in the Chukchi Sea	Daniel Cooper, Kristin Cieciel, Elizabeth Logerwell, Nissa Ferm, Robert Levine, Robert Lauth, Lyle Britt, Lorenzo Ciannelli	Fishes and Fish Habitats	
Spatial and temporal variations of pHT on the central Alaskan Beaufort Sea coast	Arley Muth, Amanda Kelley, Kenneth Dunton	Climate and Oceanography	R6 , P105
Collaborative Development of Coastal Hazards Research Expertise for Arctic Alaska	Thomas Ravens, Tobias Schwoerer	Climate and Oceanography	R6 , P106
Waves, Ice, and Coastal Change in the Alaska Arctic	Jim Thomson, Nirnimesh Kumar, Erick Rogers	Climate and Oceanography	R6 , P108
Stratified Dynamics of the Arctic (SODA)	Harper Simmons, Luc Rainville, Jennifer Mackinnon, Craig Lee, Matthew Alford, Jim Thomson, Tom Peacock	Climate and Oceanography	R7 , P110
Arctic Alaska barrier islands: dynamic processes of change	Li Erikson, Ann Gibbs, Bruce Richmond, Jessica Lovering, Jeremy Kasper, Peter Bieniek	Climate and Oceanography	
Central Beaufort Sea Wave and Hydrodynamic Modeling Study	Jeremy Kasper, Li Erikson, Peter Bieniek, Rob Bochenek, Carol Janzen, Tom Ravens	Climate and Oceanography	R7 , P113
Continental Shelf Waves of the Arctic Ocean	Katherine Hedstrom, Seth Danielson	Climate and Oceanography	R7 , P115
Seasonality and forcing factors of the Alaskan Coastal Current in the Bering Strait from July 2011 to July 2012	Brett Morris, Rebecca Woodgate	Climate and Oceanography	R7 , P117
Evolution of water column hydrography and circulation in Stefansson Sound: The role of the spring freshet	Stephen Okkonen, Sam Laney	Climate and Oceanography	R7 , P119
The effects of seasonal abiotic regimes on benthic community structure in an Alaskan Arctic kelp bed	Christina Bonsell, Kenneth Dunton	Lower Trophic Levels	R7 , P120
Exploring Seafloor Communities of the Chukchi Borderlands	Sarah Hardy	Lower Trophic Levels	R7 , P122
Enhancing copepod species identification for metabarcoding analysis with a region-specific DNA sequence reference database	Jennifer Questel, Russell Hopcroft, Hayley DeHart, Ksenia Kosobokova, Caitlin Smoot, Ann Bucklin	Lower Trophic Levels	R7 , P124
Assessing shifts in the Chukchi Sea benthic food web over the past three decades	Nathan McTigue, Vanessa von Biela, Ken Dunton, David Douglas	Lower Trophic Levels	R7 , P126
The Search and Rescue of Legacy OCSEAP Beaufort Sea Data Files from NODC Archives	Susan Schonberg, Tim Whiteaker, Ken Dunton	Lower Trophic Levels	R8 , P128
Summer fat camp – How Arctic lagoons may promote growth and elevated body condition of coastal fishes	Kevin Boswell, Ron Heintz, Alexei Pinchuk, Brenda Norcross, Leandra Sousa, Chunyan Li, Seth Danielson, Mark Barton, J. Craig George, Elizabeth Dobbins, Caitlin Forster, Johanna Vollenweider	Fishes and Fish Habitats	
Evaluation of Juvenile Chinook Salmon (Oncorhynchus tshawytscha) Diets and Prey in the Lower Yukon River	Courtney Weiss, Rebecca Shaftel, Dan Bogan, Dustin Merrigan, Katharine Miller	Fishes and Fish Habitats	R8 , P131
A transcriptome resource for the Arctic Cod (Boreogadus saida)	Robert Wilson, Damian Menning, Kate Wedemeyer, Sandra Talbot	Fishes and Fish Habitats	
Carbon sources and trophic structure of fish communities in lagoons of Arctic Alaska	Matthew Rogers, Trevor Haynes, Johanna Vollenweider, Brian Perrault, Ron Heintz, Matthew Callahan, Alex Whiting, Tahzay Jones, Martin Robards	Fishes and Fish Habitats	

TITLE	PRESENTER	SECTION	LOCATION (row & poster)
Identifying Arctic Cod Hatch Dates and Location in the Alaskan Arctic Through Otolith Analysis	Zane Chapman, Franz Mueter	Fishes and Fish Habitats	R8 , P133
Temporal variability in densities and vertical distributions of pelagic fish and macrozooplankton on Hanna Shoal	Silvana Gonzalez, John K. Horne, Seth Danielson	Fishes and Fish Habitats	R8 , P134
No fluffy cakes: St. Lawrence Island seabirds respond to historic low winter sea ice.	Alexis Will, Jean-Baptiste Thiebot, Aqef Waghiyi, Michael Toolie, Punguk Shoogukwruk, Akinori Takahashi, Alexander Kitaysky	Seabirds	
Does Next Generation Sequencing hold the key to unravelling population structure among Arctic ringed seals?	Aimee Lang, Peter Boveng, Lori Quakenbush, Kelly Robertson, Morgane Lauf, Barbara Taylor	Mammals	R8 , P136
Reliable Areas of Uncertainty for Vocalizing Marine Mammals Using Novel Techniques	John Spiesberger, Catherine Berchok	Mammals	R8 , P138
The first instrument-based polar bear population estimate for the western Chukchi Sea.	Vladimir Chernook, Irina Trukhanova, Aleksandr Vasilev, Dennis Litovka, Dmitriy Glazov, Vladimir Burkanov, Mikhail Stishov	Mammals	R8 , P140
Gray Whale Calf Occurrence in the Eastern Chukchi Sea, 2009-2018	Amy Willoughby, Amelia Brower, Megan Ferguson, Janet Clarke	Mammals	
Seasonal movements and high-use areas of spotted seals (Phoca largha) in the Pacific Arctic	Justin Crawford, Lori Quakenbush, Anna Bryan, Mark Nelson, Andrew von Duyke	Mammals	R8 , P143
Bearded seal productivity in Alaska using harvest-based monitoring, 1975–2016	Ryan Adam, Anna Bryan, Lori Quakenbush, Justin Crawford, Louise Biderman	Mammals	R9 , P145
SNP genotyping as a new approach for genetic mark-recapture studies of polar bears, Ursus maritimus, in the Alaskan Arctic	Tatiana Ferrer, Andrew Von Duyke, Raphaela Stimmelmayr, Robert Suydam, Todd Sformo, Gregory O'Corry-Crowe	Mammals	R9 , P147
Movements and Habitat Use of Pacific Arctic Seals and Whales via Satellite Telemetry and Ocean Sensing	Lori Quakenbush, Stephen Okkonen, John Citta, Justin Crawford, Andrew Von Duyke, Craig George, Billy Adams, Ellen Lea, Mark Nelson, Anna Bryan	Mammals	R9 , P149
A cost effective method to determine Pacific walrus sex from skeletal remains	Nathan Taylor, Casey Clark, Nicole Misarti, Lara Horstmann	Mammals	R9 , P150
Molting Strategies and Seasonal Energetic Requirements of Spotted, Ringed, and Bearded Seals	Colleen Reichmuth, Nicole Thometz, Brandon Russell, Holly Hermann-Sorensen, David Rosen	Mammals	R9 , P152
Drone acquired orthorectified imagery with limited ground control: application to a large walrus haulout	Anthony Fischbach, Chadwick Jay, Josip Adams	Mammals	
Reference Intervals for Biochemical Analytes of Southern Beaufort Sea Polar Bears	Tricia Fry, Kristen Friedrichs, Todd Atwood, Colleen Duncan, Kristin Simac, Tony Goldberg	Mammals	R9 , P154
Persistent Mullerian Duct Syndrome- a rare form of male pseudohermaphrodism in a free-ranging beluga whale (Delphinapterus leucas) Utqiagvik, Alaska	Raphaela Stimmelmayr, David Rotstein, Tatiana Ferrer	Mammals	R9 , P156
Urine characteristics of ringed (Phoca hispida) and bearded seals (Erignathus barbatus), Utqiagvik, Alaska	Raphaela Stimmelmayr, Olive Kanayurak, Mike Pederson	Mammals	R9 , P158
Preliminary lessons learned from conducting Traditional Knowledge interviews to inform animal movement and habitat suitability models	Rowenna Gryba, Henry Huntington, Andrew Von Duyke, Qaiyaan Harcharek, Craig George, Francis Wiese, Phil Molloy, Marie Auger-Méthé	Humans	R9 , P160

TITLE	PRESENTER	SECTION	LOCATION (row & poster)
Repurposing real-time vessel tracking information into a valuable data asset for decision support	Carol Janzen, Molly McCammon, Rob Bochenek	Humans	R9 , P162
Marine ARctic Ecosystem Study (MARES): Mooring deployments on the Beaufort Sea shelf	Francis Wiese, Robert Pickart, Dave Fissel, Ed Ross, John Nelson, Carin Ashjian, Rowenna Gryba, Natalie Monacci, Jeremy Kasper, Kate Stafford	Ecosystem Perspectives	R10 , P164
Connecting the Dots of the Distributed Biological Observatory Through US Arctic Observing Network Benefit Mapping	Sandra Starkweather, Jacqueline Grebmeier, Emily Osborne	Ecosystem Perspectives	R10 , P166
Synthesis of Arctic Research (SOAR) – Physics to marine mammals in the Pacific Arctic, Phase II	Thomas Van Pelt, Sue Moore, Phyllis Stabeno	Ecosystem Perspectives	R10 , P168

Historically Low Extent of Sea Ice in the Bering Sea Associated with Low Overwinter Survival and Breeding Effort in the Black Guillemot, an Ice-Obligate Seabird

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Poster Presenter: George Divoky

In the winter of 2017-18 sea ice extent in the Bering Sea was the lowest on record, attaining less than half the long-term average. Mandt's Black Guillemot (*Cepphus grylle mandtii*), one of the few Arctic ice-obligate seabirds, occupies the Marginal Ice Zone in the nonbreeding season typically wintering over the Bering Sea shelf as far south as the shelf break. Adult survival and breeding biology of the species has been studied since 1975 at a breeding colony on Cooper Island in the western Beaufort Sea, with nonbreeding distribution and movements monitored since 2011 with light-sensitive geolocators. Late formation of sea ice in the Chukchi Sea in the fall of 2017 and a lack of ice in the traditional Bering Sea wintering areas in 2018 resulted in birds wintering further north than in any previous year with most remaining in the southern Chukchi Sea or just south of the Bering Strait.

Adult overwinter apparent mortality in 2017-18 was the highest on record with 32 percent of the birds breeding in 2017 failing to return to the colony, compared to 11 percent overwinter apparent mortality for the period 1976–2013. Of the 75 pairs occupying nest sites in 2018, only 50 pairs produced eggs and nearly one-half of those nests had no incubation. Nonbreeding by established breeders occupying nest sites and abandonment of nests immediately after egg laying were extremely rare in earlier years. The size of the breeding colony in 2018 was the lowest in four decades and punctuates a long-term decrease since 1989.

Analysis of geolocation and behavioral data from the 2017–18 nonbreeding period is being compared with earlier years to obtain insights into how the anomalous sea ice conditions in 2017–18 might have contributed to the observed high mortality and the apparent poor condition of surviving birds. Decreased prey availability in the Arctic Basin and Bering Strait regions, compared to the southern Bering Sea shelf, could be a factor, as could atypical oceanographic and sea ice conditions in the winter Marginal Ice Zone.

POSTER WITHDRAWN:
Bogoslof Island 2016-2017 Eruption Event: Impact on Breeding Seabirds

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Poster Presenter: Nora Rojek

Bogoslof Island, managed by the Alaska Maritime National Wildlife Refuge, is a major and important breeding site for seabirds and marine mammals in the southeastern Bering Sea, including one of the few breeding sites for red-legged kittiwakes (*Rissa brevirostris*). Periodic eruptions of the Bogoslof volcano results in a dynamic and continually changing landscape that irregularly alters the habitat available to seabirds. The most recent eruption event, between December 2016 and August 2017, consisted of at least 64 explosive eruptions. This resulted in continual changes to the size and shape of the island including a >300% increase in area to 1.3 km^2 and denuded or buried vegetation and soil. Due to continuous eruptive activity in summer 2017, seabirds were likely prevented from successfully breeding that season. In August 2018, a site visit revealed the presence of most seabird species known to breed on the island occupying similar, but altered areas, as in the past; however, there was little evidence of successful breeding. Cliff-nesting species that build nests, such as kittiwakes (*Rissa* spp.) and cormorants (*Phalacrocorax* spp.), lost access to nest materials. Small numbers had partial nest structures, but no chicks were observed, as would be expected at this date. The main breeding area for murres (*Uria* spp.) was altered and unoccupied and few appeared to be breeding. Burrow-nesting species, that rely on soil and vegetation, such as tufted puffins (*Fratercula cirrhata*), lost all nesting habitat. Tufted puffins were present in large numbers with evidence that they had attempted to dig new burrows but could not excavate far into the new hard surface layers. Glaucous-winged Gulls (*Larus glaucescens*) were the only species that appeared to successfully nest with many fledge-size chicks observed. No passerines or raptor species were observed. Most long-lived seabirds exhibit colony site fidelity; thus, birds were expected to return, and a few years of non-breeding will not strongly impact population numbers. However, given that no fine ash was deposited during the eruptions, soil development is expected to be prolonged and species relying on vegetation and soil, such as burrow-nesters, may be prevented from breeding for an extended period.

Assessing the Role of Harmful Algal Blooms as an Immunocompromising Factor in Susceptibility to Avian Influenza

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The marine environments of both the Arctic and Subarctic lie along the path of many migratory birds and can therefore serve as an ecological reservoir for avian viruses, particularly avian influenza (AIV). The introduction of novel strains that potentially originate from distant continents may pose a significant threat to the marine ecosystem stasis, particularly during periods of environmental change. Additionally, the virulence of AIV in some seabird species may be further influenced by concurrent exposure to the toxic products of phytoplankton blooms. These Harmful Algal Blooms (HABs) have increased in frequency with warming water temperatures in Alaska. Recent seabird mortality events have raised concern that the presence of the resulting phytotoxins in the marine environment may create an immunocompromised physiological state for resident seabirds, thus leaving them easily susceptible to bacterial or viral infection. This project will be framed as a classic case–control study examining the effects of HAB phytotoxins on susceptibility to AIV in seabirds of both the Arctic and Subarctic waters of Alaska. Samples obtained from breeding seabirds in Aleutians and northern Bering Sea islands, including puffins, murres, auklets, gulls, kittiwakes, and cormorant (n = 75) will be tested for the presence of AIV using PCR analysis. The resulting data will be compared against the incidence of HAB toxins in the same individuals. This analysis will be conducted for two of the most common algal toxins in Alaska, domoic acid (DA) and saxitoxin (STX). A closer examination of this hypothesized interaction between HABs and AIV will help to decipher key relationships between potential threats to marine populations in the waters surrounding Alaska. As AIV has high potential for both interspecific and zoonotic movement, an examination of its disease sequelae, ecological correlates, and prevalence among breeding Beringian seabirds may help to elucidate a clearer understanding of the disease ecology of this virus.

Assessing the Effects of Saxitoxin Ingestion in an Avian Model Species

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Poster Presenter: Robert Dusek

Since 2014 widespread, annual, mortality events involving multiple species of seabirds have been documented in the Gulf of Alaska, and Bering and Chukchi seas. In 2017, nearly 1600 birds were found dead, and emaciation was determined to be the cause of death among individuals submitted for necropsy. However, due to recent reports of harmful algal toxins detected in marine mammals in this region, a subset of these seabirds was also tested for the algal toxins saxitoxin (STX) and domoic acid (DA). No DA was detected but STX was detected in stomach contents, cloacal contents, or liver tissue in 35% (6/17) of individuals tested, indicating exposure of these seabirds to STX in the marine environment. Few data are available that describe the effects of STX in birds so the contribution of this STX exposure to this large-scale mortality event is not known. Saxitoxin is also toxic to humans and given that these same seabird species exposed to STX are also used as a food resource by Alaskan Native communities in this region there is concern about the potential for secondary poisoning via consumption of STX-contaminated tissues. To get a better understanding of the effect of STX in birds we used a gavage method to dose mallard ducks, as a model avian species, with STX to determine the dose at which 50% of birds will die (LD_{50}).We performed gross and histopathological examinations of inoculated birds to detect pathologic changes that could be attributed to STX intoxication and tested samples collected from each bird for STX. Using our methodology, we calculated the LD_{50} of STX in mallards at 167 ug/kg indicating they are more sensitive to STX than mice, a commonly used mammalian laboratory model for STX. We detected STX in fecal samples collected from inoculated birds for up to 48 hrs post inoculation (PI) but did not detect STX in any blood samples collected from either surviving birds or those that died acutely (<1 hr) following dosing. Analysis of samples is on-going and updates will be provided.

Simulating the Migration of Northern Fur Seal Pups Through the Bering Sea and North Pacific Ocean

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Poster Presenter: Noel Pelland

Newly-weaned northern fur seal pups born in the Bering Sea embark on long oceanic migrations that begin in late fall and may last up to 20 months as pups disperse widely throughout the subarctic North Pacific Ocean. This migration is a period of highly variable cohort survival for reasons that are only partially understood. Historical observations and satellite tracking studies indicate that surface winds predict pup migratory departure from land and movements at sea, suggesting wind-forced variability as a possible survival influence due to variable environmental and prey conditions across pup migratory range.The goal of this study is to construct simulations of northern fur seal pup migration whose output can be compared to historical and ongoing studies of pup survival, or used to forecast pup movements in future years. The simulations are constructed and validated using satellite telemetry observations of Bering Sea, AK northern fur seal pups in five separate years. Within the observations, interannual differences in the direction of pup dispersal are evident in the first few weeks of migration. Pups departing in two years with strong westerly winds (1997 and 2015) traveled farther to the east than the remaining years (1996, 2005, and 2006). These differences are apparent when controlling for pup sex, departure time, and island. Relative to the overall spread, interannual differences were greatest in the first 10-20 days at sea, a period potentially critical for pup survival. Individual-based simulations of pup movement were constructed including the effects of wind, surface currents, movement persistence, and background drift by sex. These simulations produce qualitatively realistic pup trajectories and, when initialized with the same distribution of departure times, islands, and sexes as the observations, have skill in reproducing the interannual variability in mean position with time. The simulations under-predicted the eastward displacement in 1997, and had an overall narrower east-west distribution than is observed. Our ongoing studies seek to refine the simulations to more fully replicate the observed statistical properties of pup dispersal, to construct a general model for departure as a function of environmental conditions, and to hindcast the migration in previous unobserved years.

Factors Affecting Energy Expenditure in a Declining Fur Seal Population

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Energetic measurements are a key input into bioenergetic models that are used to quantify prey requirements and provide insight into population dynamics. Northern fur seals have experienced an unexplained population decline since the 1990s, raising concern about overlap with the commercial pollock fishery and the role of prey availability during lactation in this decline. We concurrently measured at-sea field metabolic rates (FMR) and foraging behavior of lactating northern fur seals (n = 48) on the Pribilof Islands using biologging devices and fatty acid analysis to determine the influence of diving behavior, diet, season (summer vs. fall), and instrumentation on metabolic rates. At-sea FMR ranged from 5.19 – 9.68 W kg^{-1}, resulting in a mean daily energy expenditure of 23.3 MJ day^{-1}. On average, fur seals experienced a 7.2% increase in at-sea FMR from summer to fall, and a 1.9% decrease in at-sea FMR for each additional day spent at sea, with no effect of instrumentation or foraging behavior on energy expenditure. The seasonal increase in metabolic rates may be due to the onset of the annual pelage molt as has been observed in captive fur seals, but this did not affect the ability of females to gain mass on foraging trips. The lack of an instrumentation effect on at-sea FMR contrasts with results from a recent captive study, which may in part reflect the fact that our measurements integrate the combined influence of complex behaviors and physiological stressors experienced by free-ranging seals. Our results indicate that metabolic rates obtained from free-ranging seals are not artificially inflated due to instrumentation and are unlikely to vary among years due to behavioral changes associated with prey composition or oceanographic conditions. Seasonal changes in metabolic rates should be incorporated into bioenergetic models, particularly because they coincide with increased energy needs associated with lactation.

Effects of Maternal Care on Steller Sea Lion Pup and Juvenile Survival

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Steller sea lions (SSL) are a long-lived species that are expected to prioritize adult survival, but our previous results indicated a reasonable amount phenotypic plasticity. Therefore, we sought to determine the degree to which current reproduction is balanced with future survival. On Medny Island and Kozlov Cape, where SSL abundance has yet to recover after the recent range-wide decline, 1st-year survival was unexpectedly higher than in the Kuril Islands, where the population had been increasing through the 2000s. However, higher pup survival may have a cost, as females on Medny and Kozlov Cape reproduce less frequently than elsewhere. The benefit of less-frequent reproduction, however, may be increased adult condition, which might permit females to invest more in their pups during the first year. However, there were no differences in pup weights at 1 month old between observed rookeries (males 36.4±0.9 kg, females 30.9±0.8 kg). Thus, there is no evidence that females on Medny and Kozlov Cape invest more in pups during pregnancy or the first month of life. However, increased first-year survival on Medny Island could result from increased maternal investment through the rest of the first and possibly 2nd year. The proportion of 1 year-olds that were dependent upon their moms was higher on Medny and Kozlov Cape than in the Kuril Islands. Juveniles on Medny that continued to suckle for more than one year had higher survival than juveniles weaned before 12 months. Survival probability of dependent juveniles at age 1 was 0.84 (0.88 at age 2), while survival of independent juveniles was 0.53 and 0.69, respectively. Therefore, it does appear that maternal investment is higher on Medny Island. However, this may come at a cost to adult females, as next-year survival of females that gave birth and nursed their pups was lower than those who skipped a birth year on Medny Island and Kozlov Cape. The ultimate question is whether less-frequent reproduction and higher lactation investment, but lower post-reproductive survival is a positive trade-off, or whether Medny and Kozlov Cape SSL are not very prudent parents. Therefore, we are currently quantifying life-time reproductive success.

Cetacean Distribution in the Central Bering Sea Basin: Results from the 2018 IWC-POWER Cruise

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The IWC-POWER (Pacific Ocean Whale and Ecosystem Research) cruises in the North Pacific are a collaborative effort between the International Whaling Commission and the Government of Japan, with the main objective of obtaining information on abundance, distribution, and stock structure of large whales to inform conservation and management. Though primarily a visual line-transect survey, passive acoustics (via sonobuoys) was included to acoustically monitor for marine mammals, especially eastern North Pacific right whales (*Eubalaena japonica*, hereafter NPRW). The 2018 POWER cruise occurred between 16 July and 12 September in the central Bering Sea. The research area was divided into the northern stratum (shallow Bering shelf) and the southern stratum (deep basin). At the beginning and end of the survey, the vessel transited through the NPRW Critical Habitat. Results presented here focus on the passive acoustic component. A total of 253 sonobuoys were deployed, for a total of 700 monitoring hours. Species detected include fin whales, detected on 46.5% of sonobuoys, sperm whales (33.2%), killer whales (25.8%), right whales (12.4%), and humpback whales (11%). Other species detected include gray whales (4.6%), Baird's beaked whales (0.5%), probable fish grunts (3.2%), a double knock sound that we believe is attributed to fish (0.5%), and possible earthquakes (1%). NPRW gunshot calls were detected near St. Lawrence Island, two days before a confirmed NPRW sighting. NPRW upcalls were detected in the deep basin in approx. 3000 m water depth, but the calling animal was not visually sighted. The Baird's beaked whale acoustic encounter lasted over an hour, and consisted of buzzes, clicks, and whistles. Acoustic detections were in good agreement with visual sightings, with the exception of sperm whales and killer whales, which were detected acoustically more often than visually.

Using Stable Isotope Analysis of Vibrissae from Northern Fur Seal Pups and Juveniles to Establish Individual Foraging and Migratory Patterns

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The population of northern fur seals (NFS; *Callorhinus ursinus*) on the Pribilof Islands, Alaska, has declined by approximately 70% since the mid-1970s. Mortality rates of pups and juveniles can have a strong influence on NFS population stability. However, information on the foraging and migratory strategies that impact survival during this time is limited; pups depart on their first migration at ~4-5 months and typically do not return until 2 years of age. We used stable isotope analysis of NFS vibrissae, a tissue that grows continuously throughout their lifetime, to examine individual foraging and migratory patterns during this cryptic time. We serially sampled the longest vibrissae from 8 known age male juveniles (2-4 year-old) and 57 pups (~4-5 month-old) killed in subsistence harvests on the Pribilof Islands and measured stable carbon ($\delta^{13}C$) and nitrogen ($\delta^{15}N$) isotope values to provide a temporal record of their foraging ecology and habitat use. A clear isotopic shift in $\delta^{13}C$ and/or $\delta^{15}N$ signatures was evident at birth and weaning. The lack of fluctuation in $\delta^{15}N$ in pups prior to ~4-5 months of age and distinct drop thereafter suggests that NFS abruptly wean when they depart on their first migration. We found oscillations in $\delta^{15}N$ and $\delta^{13}C$ values associated with age reflecting annual migrations from the Bering Sea in winter and return in summer. Mean vibrissae growth rates were calculated based on annual migratory oscillations in $\delta^{13}C$ values. The average vibrissae growth rate for 0-1 year-olds (4.6 ± 1.1 mm/month) was faster than the growth rate found in 1-4 year-olds (3.0 ± 1.1 mm/month). Although there was a high level of variability in growth rate between individuals and sample size was small, our results were consistent with other pinnipeds. Differences in $\delta^{13}C$ patterns among 0-1 year-old juveniles and older juveniles suggests that they are utilizing different foraging habitats. Annual oscillations in $\delta^{15}N$ values were less distinct than $\delta^{13}C$ values suggesting trophic level of prey consumed was not as variable through time as changes in foraging habitat. Our results provide important insights into the ontogeny of foraging and migration for individual NFS during their critical juvenile years.

Alaskan Projects of the NIST Marine Environmental Specimen Bank & Their Tissue Access Policies

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The National Institute of Standards and Technology (NIST) has been involved in long-term environmental specimen banking since 1979 through environmental research and monitoring programs. Today, NIST maintains an archive of marine biological and environmental specimens collected throughout the coastal U.S., including Alaska and the Pacific Islands, in support of these projects. NIST standardized protocols for collection, processing, and banking were primarily developed for environmental contaminant analysis. In 1989, the National Marine Fisheries Service, Office of Protected Resources (NMFS/OPR), in collaboration with NIST began the National Marine Mammal Tissue Bank (NMMTB) for long-term cryogenic archival of marine mammal tissues. The NMMTB is part of NMFS's Marine Mammal Health and Stranding Response Program and is maintained by NIST as part of its Marine ESB projects. Marine mammal specimens from Alaska are provided to the NMMTB through the Alaska Marine Mammal Tissue Archival Project (AMMTAP), which was established in 1987. In addition to marine mammal tissues, NIST has collaborated with the U.S. Geological Survey Biological Resources Division (USGS-BRD), U.S. Fish and Wildlife Service (USFWS), and the Bureau of Indian Affairs (BIA), to collect and bank seabird egg contents for the Seabird Tissue Archival and Monitoring Project (STAMP) since 1999. STAMP was designed and implemented to serve as a systematic, long-term program to identify and track anthropogenic contaminants in Alaskan seabirds over multiple decades. Protocols for collecting and banking marine samples were designed to: (1) provide sufficient material for multiple analyses, (2) minimize the possibility of sample change and/or loss during storage, (3) ensure sample integrity by minimizing potential contamination during collecting and processing, (4) protect long-term sample stability by using cryogenic techniques, and (5) keep and maintain records of sample histories. The scientific community, contributors, and principal investigators can request tissues from the NMMTB and STAMP for scientific research through formal tissue access policies established by each project manager.

Sea Otter Mortality on Alaska Peninsula and Unalaska

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The U.S. Fish and Wildlife Service (USFWS) Region 7 Marine Mammals Management program (MMM) reported unusual morbidity and mortality in northern sea otters (*Enhydra lutris kenyoni*) near Port Moller-Nelson Lagoon on the southern Alaska Peninsula January through April 2018. A total of 195 dead otters were counted by local residents on a 35 mile stretch of southern Bering Sea on January 29th. Additional reports continued to come in including a few dead otters in Unalaska (starting in February) and observations of ~30-40 dead otters around Port Heiden (March-April). On 4 March 2018, USFWS Migratory Bird Management (MBM) flew a reconnaissance survey of the southern Alaska Peninsula shoreline, from Cold Bay to Pilot Point, Alaska searching for dead or dying sea otters and other marine mammals. Fifty-six dead sea otters were observed on the survey, the majority of which (91%) were in the Nelson Lagoon/ Port Moller area. Through the assistance of the local community members, three carcasses and selected tissue samples from five additional carcasses were expedited to the U.S. Geological Survey (USGS) National Wildlife Health Center, Madison, WI. *Streptococcus lutetiensis* (formerly known as *Streptococcus infantarius ssp. coli - a member of the S. bovis-equinus* complex) was confirmed as the cause of death in the carcasses submitted and suspected to have contributed to the cause of death of all animals examined. This mortality event involved more sea otters than previous events for the area and time frame and the effect to the listed Southwestern stock of sea otters is unknown at this time. In previous years, *Streptococcus spp*. related mortality has occurred across sea otter range in Alaska including Kachemak Bay, Kodiak Island, Unalaska, Prince William Sound, and Southeastern Alaska. This bacteria complex is a common cause of septicemia in Alaska's sea otter southcentral population. It has also been reported as a cause of endocarditis and septicemia in other mammalian species, including humans (Counihan et al, 2015). The source of the bacteria in the marine ecosystem is unknown.

The Commander Islands Steller Sea Lion (*Eumetopias jubatus*) Population: Status Update, 2018

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Yugo-Vostochny rookery is the major breeding site of the Steller sea lion (SSL) in the Commander Islands (CI), Russia, located on the southern tip of Medny Island, approximately 335 km west of Alaska's westernmost Aleutian Islands. Breeding season observations at the rookery have occurred annually since 1991. Surveys include visual counts of individuals by sex and age groupsand documentation of pup births and mortality events. Observations were conducted throughout the season without disturbing the rookery using binoculars and starting in 2017 the drone Phantom 4 quadcopter has been used to collect photographic images. In 2018 during the pupping and mating season a maximum 207 non-pup individuals were present on the rookery of which 142 were females; 54 were mature males, and 14 were juveniles. We counted 180 pups born at the rookery of which four died during the first month of life. Overall, the counts in 2018 indicated a decline in all non-pup age classes since 2017; the number of 1+ years old animals decreased by 34%; adult females decreased by 33%, mature males by 16%, and juveniles by 66%. These counts are similar to 2015 when abundance of all sex-age groups had declined, and pup production was the lowest recorded since 1999. The pup abundance in 2018 was similar to 2017, and 18% higher than 2015. The abundance of females on the rookery increased after the mating period to a level seen in 2017. The total number of SSL in the CI remains low compared to the previous decade. We did not observe a decline in pup number over the past three years, which is encouraging for the future improvement of this reproductive group. However, it is obvious that this population may not use all its reproductive potential, because many mature females were not observed until after the breeding period (July 10) and were not seen with dependent pups.

Abundance of the Sea Otter Population on the Kuril Islands (Russia) and Analysis of the Environmental Parameters that Influence an Uneven Distribution of Otters along the Kuril Chain

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Poster Presenter: Ekaterina Ovsyanikova

Population of sea otters (*Enhydra lutris*) in the Kuril Islands (Russia) was reported to undergo a decline in the recent years. No recent abundance estimate or habitat assessment has been done for this population. In this study we present results of our abundance estimate based on the data from survey conducted in 2012. To calculate abundance estimate we divided coastal waters (up to 50m isobath, optimal otter feeding habitat) of each island into sectors under 20km in length. For each of these sectors we assessed a range of environmental parameters. Chlorophyll-a concentration was used as a proxy for habitat productivity. Physical features of the coastline were incorporated into Fractal Dimentionality Index FDI = 2*log(P)/log(A), where P was the perimeter, and A – area. To quantify the extend of the shallow area, we calculated shortest distance from the shore to the 50m isobath contour. We also used the total area and the coordinates of the sector, as well as exposure to the Pacific Ocean or the Sea of Okhotsk side. We used generalized additive models with integrated smoothing functions to model sea otter abundance. We estimated sea otter number for four geographic regions within the Kuril Islands: Southern Kurils, Urup Island, Central Kurils, and Northern Kurils. The most abundant were the Northern Kurils with estimated number of sea otters of 4,003 (CI 95%: 2,354-7,697). In the Central Kurils the abundance was estimated as 753 (CI 95%: 334-2,797). Urup Island separately had around 795 sea otters (CI 95%: 322-2,070). In the Southern Kurils, including Lesser Kuril Islands estimated number was 451 (CI 95%: 65 – 1,843). Oveall abundance of the sea otters for the Kuril Islands (excluding Kamchatka peninsula) was estimated as 6,002 (4,490-11,051 CI 95%). Even accounting for uncertinaty and large confidence intervals our data shows significant decline compared to previously published assessment of 20,768 from the 2006. Our study provides updated abundance estimates for this scarcely studied population. We attempted to quantitatively evaluate environmental parameters responsible for the uneven distribution of the sea otters along the Kuril Islands, a factor that needs to be taken into consideration to ensure their recovery.

Leptospirosis - A New Normal for Marine Mammals in the North Pacific?

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Leptospira, a spirochete zoonotic pathogen, is known to cycle every 3-4 years along the Pacific Coast of California with seropositive rates from 38.2-100% during an outbreak. Formerly thought to be absent in the North Pacific, reports of positive marine mammal cases in Washington, British Columbia and Alaska have been increasing in recent years. Since 1998, we have routinely screened serum of animals admitted to Alaska SeaLife Center for antibody to six leptospira serovars (*Leptospira bratislava*, *L. canicola*, *L. grippotyphosa*, *L. hardjo*, *L. icterohemmorhagiae*, and *L. pomona*) using a microscopic agglutination microtiter procedure. Species screened include harbor seal, ring seal, spotted seal, Steller sea lion, northern fur seal, walrus, beluga whale and northern sea otter and animals were from locations throughout the waters off the state of Alaska. Although sample sizes do not allow for robust statistical analysis, clear peaks in seroprevalence were observed from the animals admitted to our center and despite the lack of symptomatic leptospirosis infection, 100% of animals screened in 2018 showed some level of titer. Positive antibody titers may develop for various reasons including acute disease, prior exposure, maternally derived antibodies, or cross reaction to antibodies to other disease. 3/8 animals screened in 2018 had titers suggestive of active infection (≥1600) however all three were asymptomatic, two tested negative for bacterial shedding by PCR, and none showed changes in clinical blood parameters that are typical for acute onset of leptospirosis-induced disease. These results suggest that marine mammals in the North Pacific may serve as maintenance hosts for leptospirosis and that leptospirosis bacteria presence in the waters of the North Pacific may be a new normal for this region.

First Encounter of the North Pacific Right Whale (*Eubalaena japonica*) in the Waters of Chukotka

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In recent years some subarctic and temperate species are seen more often in the Arctic waters due to the rapid increase in annual temperatures and ice cover loss. The North Pacific right whale is one of the most endangered whale species in the world. Both historically and in recent times the sightings of this species in the eastern North Pacific have been mostly concentrated between 40° to 60° of northern latitude.

In this note we report an encounter with a North Pacific right whale in the eastern Chukotka, far north from its typical range. The whale was observed during several days in August 2018 in Penkigney Bay on the eastern coast of the Chukotka Peninsula (64.848°N, 172.96°W). The whale was encountered from a small inflatable boat with outboard engine during a daily research trip dedicated to the study of a local humpback whale (*Megaptera novaeangliae*) feeding aggregation. When encountered, the whale was approached and photographs were taken of flukes and both sides of the animal's head for individual photo-identification. Callosity and scar patterns did not match any of the distinct individuals in the catalogues of right whales from the Russian waters and from the eastern North Pacific.

It is unknown whether the whale originated from the eastern or western population. Penkigney Bay is closer to the right whale critical habitat in the southeastern Bering Sea, than to the locations of contemporary encounters in the western North Pacific. However, the western population is larger, which contributes to the probability that the whale belongs the western North Pacific population.

Our sighting of the North Pacific right whale is the first confirmed record of the species in the waters of Chukotka Peninsula, and the northernmost sighting of the species recorded to date. Neither during the period of commercial whaling, nor in recent years were right whale sightings reported from the waters of Chukotka. This sighting can be related to the recent rapid increase in annual temperatures in the Arctic, which has been reported to drive northward range shifts in various subarctic and temperate marine species.

Assessing Change and Resiliency in Marine Resources and Subsistence on St. Lawrence Island

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The Bering Sea supports some of the world's largest commercial fisheries and provides habitat for approximately 30 marine mammal species. A growing body of peer-reviewed literature, as well as knowledge from local and traditional subsistence users, provides evidence that this region is undergoing rapid environmental change. Changes in the timing and abundance of subsistence hunts and harvests have been recorded, as well as shifting distributions of fish and marine mammal stocks. While these ecosystem changes are being documented, more research is needed on how communities are affected by these changes. This project addresses this issue by interviewing subsistence hunters and fishers in two remote communities on St. Lawrence Island: Gambell and Savoonga. The overarching goal of our research is to determine how climate change impacts the food security of St. Lawrence Island residents. This goal will be met by answering the following questions: 1) what subsistence foods do people use and depend on in these communities, 2) have these species changed in their abundance, movement or seasonal availability in recent years, and if so, why is that perceived to be, and 3) how are individuals and families responding to these changes? Working with local research assistants, semi-directive interviews were conducted with a randomized sample of community members as well as key expert informants. Interviewees were asked about changes in species abundance, movements, uses of subsistence harvested marine resources and time spent harvesting over three time frames: 10 years ago, 25 years ago and over the lifespan of elders. Results from this work will highlight community concerns regarding food security and document changes in marine resources as they relate to this unique location within the Bering Sea. This project provides novel insights into changes in this Bering Sea ecosystem that could not be observed via scientific surveys alone; rather, in working with local participants, we can view communities as long-term monitoring networks, critical to understanding ecosystem-wide changes on a decadal scale.

Conservation Finance for Fisheries

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Poster Presenter: Suresh Sethi

Wild capture fisheries produce 90 million metric tons of fish annually--approximately half of global seafood. When implemented, fisheries management has maintained long term sustainable fishery ecosystem services throughout the world. However, many fishery systems lack resources to enable management, leading to weak or nonexistent governance and thus persistence of classical overharvest and ecosystem degradation associated with open access common pool resources. Global estimates indicate a substantial amount of financial resources–on the order of $200 billion–are needed to reform unsustainable fisheries globally, yet increases in governmental or philanthropic funds to support this transition are not expected. Private return-seeking capital is now being looked to as the last frontier to address the 'fisheries reform finance gap'. The emerging field of Conservation Finance seeks to structure private capital investments deals which generate financial return for investors, but which have goals of improving the biological and social performance of natural resource systems. While other conservation finance sectors are quickly maturing, progress in fisheries remains slow. Here we introduce conservation finance for fisheries in order to raise awareness about this emerging field among the scientific, management, and fishing industry community. Presenting results from a combination of interviews with existing conservation finance practitioners and bioeconomic modeling, here we summarize key obstacles to advancing conservation finance for fisheries and identify potential solutions to catalyze activity in this sector.

Introducing Trophic Indexes for Monitoring Ecosystem Status (TIMES): A New Stable Isotope-based Framework for Long-term Monitoring of the Bering Sea Ecosystem

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Strong interannual variation in climate forcing and sea ice retreat within the eastern Bering Sea (EBS) has been shown to influence the timing and strength of spring blooms and zooplankton community structure, leading to variable energy pathways and bottom-up control of higher trophic levels. The understanding of major energetic pathways and their responses to biophysical processes across the Bering Sea are thus critical in projecting ecosystem-scale responses to climate change. Here we introduce Trophic Indexes for Monitoring Ecosystem Status (TIMES), a new framework for monitoring of the southeast Bering Sea (SEBS) trophic state using bulk and compound specific stable isotope analysis on key taxa of the ecosystem. As a preliminary test of TIMES, we performed a retrospective analysis of age-0 pollock from frozen and dry-stored tissues collected from the Bering Arctic Subarctic Integrated Surveys (BASIS) in 2012, 2014, 2016 and 2018, spanning warm/cool periods of the SEBS. Results showed a distinct increase in δ13C (~1.7‰) and δ15N (~1.0‰) in 2015 following the arrival of the warm blob in 2014, indicating a potential shift in trophic level and shift in source primary production to age-0 pollock. We also observed a consistent increase in δ15N with latitude across years, consistent with previous observations of higher δ15N in the northern SEBS associated with available nitrate. These initial results demonstrate the effectiveness of stable isotopes in capturing ecosystem trophic processes and their response to physical and biochemical shifts in ocean conditions. Next steps will involve inclusion of other species of fish, zooplankton, seabirds and marine mammals, incorporation of δ15N of amino acids to establish trophic level estimates and the development of trophic indices, and incorporation of results into ecosystem trophic models.

Environmental DNA (eDNA) Uncovers the Presence of Eelgrass (*Zostera marina*) Pathogens *Halophytophthora sp. Zostera*, *Labyrinthula zosterae*, and *Phytophthora gemini* in Alaska

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Eelgrass (*Zostera marina*) meadows provide important ecological services to the marine environment. They act as nurseries sheltering young animals, provide habitat for invertebrates, marine and anadromous fish, mammals, and birds, sequester carbon, and ameliorate terrestrial pollution on the marine environment. Major declines of eelgrass populations in North America have been attributed to a variety of both localized and general human-induced events, such as the release of oil, farming induced eutrophication, residential expansion, anoxia, and disease. For example, the pathogenic protist *Labyrinthula zosterae* is believed to be the causative agent of a wasting disease that caused the dieback of eelgrass along the Atlantic coasts of North America and Europe in the 1930s. Recently, disease lesions caused by *Labyrinthula* sp. have been found on eelgrass beds in the north Pacific. Additionally, two closely-related fungi-like oomycetes species, *Phytophthora gemini* and the newly described species, *Halophytophthora* sp. Zostera, both known to be potent pathogens on eelgrass, have been discovered in eelgrass beds in the North Atlantic. Although eelgrass meadows in Alaska are thought to be relatively healthy, some meadows are declining, and the presence of *L. zosterae* in Washington State prompted an investigation of disease pathogens in Alaskan eelgrass meadows. Our pilot research leveraging next generation sequencing of environmental DNA (eDNA) extracted from eelgrass samples collected from several locations in Alaska uncovered the presence of these two classes of pathogenic organisms - *L. zosterae* and the *Phytophthora*/*Halophytophthora* species complex - known to have caused decline in eelgrass elsewhere in the species' global distribution. We uncovered at least one eelgrass pathogen at every Alaskan locale sampled which may be concerning if impacts observed elsewhere to eelgrass from these pathogens have the same types of effects in Alaskan meadows. Our future research seeks to better understand the distribution and impact of these disease pathogens on eelgrass in Alaskan waters.

Characterizing Particle-Associated and Free-Living Microbes and Their Roles in the Carbon Cycle of the Bering and Chukchi Seas

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Particles play an essential role in the marine carbon cycle, especially in export and sequestration of carbon. Microbes (heterotrophic bacteria and archaea), both particle-associated and free-living, are instrumental to this cycling as they are responsible for solubilizing and metabolizing organic carbon into its inorganic forms. If not for microbes, this pool of carbon would remain untapped, unavailable for use to primary producers as building blocks for their own growth. Despite their importance, few studies have investigated microbes in Alaskan polar waters. My study provides a much needed overview on the diversity of particle-attached and free-living microbes in the Bering and Chukchi seas. In summer 2017, our lab sampled dozens of stations across the Bering and Chukchi, collecting microbial and particle samples. Particle-attached and free-living microbes can be distinguished from one another using in-line filtration (filter mesh sizes of 20 μm, 3 μm, and 0.2 μm) of seawater. Genetic sequences of the microbes were obtained using next generation sequencing techniques. Particle samples were used to obtain suspended particulate matter concentration and particulate organic carbon content. Taxonomic diversity and gene functional potential is constrained through the use of 16S rNA gene sequences and metagenome libraries. I expect particle-associated microbes will be the dominant microbe in areas of high particle concentration, particularly those particles with high POC content. I expect these microbes will have a wide array of carbon cycling genes they use to breakdown particles. My objective is to explore the partitioning of gene functions such as carbon fixation, and cellulose, lignin, and chitin degradation between the free-living and particle-associated microbial guilds. Another objective is to explore the relationship between spatial patterns of particle abundance and composition and trends in community structure of free-living and particle-associated microbes. These results will better define the microbial communities of Alaskan polar waters, and help understand the shifts these communities might undergo in the coming years due to climate change.

Primary Production in the Southern Chukchi Sea: June (ASGARD) and August/September (Arctic IES) 2017 Survey Results

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Understanding temporal and spatial patterns in primary production in the Arctic is important for both the global particulate carbon cycle and fisheries production. Currently, net primary production has a strong seasonal cycle driven by light and nutrient availability. With climate change and a reduction in seasonal sea ice, annual net primary production estimates may increase due to higher irradiance in the upper water column and longer periods of open water. However, because climate change may also increase stratification in the upper ocean, primary production in some regions may transition from light to nutrient limitation leading to enhanced formation of subsurface chlorophyll maxima as well as increased regeneration of nutrients fueling primary production. Thus in a future Arctic, while estimates of net primary production may increase, net community production - the production ultimately supported by external nutrient inputs (new production), and thus the carbon available to higher trophic levels, may stay the same or decrease. Understanding the balance of these two measures of production is essential to understanding patterns in higher trophic levels. For our study, rates of net (13C uptake), new (15NO3 uptake), and regenerated (15NH4 uptake) primary production, were quantified using stable isotope tracers with 6-h simulated in situ (deck-board) incubations of water samples collected in June (ASGARD) and in August/September (Arctic IES) 2017 in the southern Chukchi Sea, ~ 65-70ºN. We also estimated primary production for large (> 10 µm) and small (< 10µm) phytoplankton to determine which taxonomic groups (e.g., small flagellates vs. diatoms and dinoflagellates) contributed most to productivity. Estimates are compared across seasons and water masses. Satellite observations of sea ice, SST and ocean color data will be used to place observations into a broader spatial and temporal context and evaluate underlying factors influencing primary production.

Distribution and Diet of Juvenile Pacific Cod in the Chukchi Sea

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The goal of this study is to characterize juvenile Pacific cod habitat and diet in the Chukchi Sea, as part of a larger effort of the Arctic Ecosystem Integrated Survey (Arctic EIS/IES) program to document the state of the ecosystem. A small-mesh benthic trawl was used to collect demersal fishes and invertebrates in the Chukchi Sea in August and September 2012 and 2017. Pacific cod juveniles (59-83 mm TL) were present at 11 of 59 stations 2017 in the Chukchi Sea. The highest catch rates were at the most shallow (20-29 m bottom depth range) and southern stations. Diets were comprised primarily of demersal prey, and the most important prey groups were benthic copepods, polychaetes, and decapods. Pacific cod juveniles were absent in 2012 at all 40 stations in the Chukchi Sea, including 7 stations where Pacific cod were present in 2017. Although summer bottom temperatures in the Chukchi Sea were generally colder in 2012 than in 2017, the southern and shallow sites with Pacific cod presence in 2017 were not uniformly warmer in 2017, and in fact some were warmer in 2012. If temperature played a role in Pacific cod presence in 2017 and absence in 2012, then the temperature effect was at an earlier life history stage than the observed benthic juveniles. Pacific cod juveniles (40-101 mm TL) were also present in 2017 in pelagic trawls over deeper water (40-60 m depth), which may indicate that juvenile Pacific cod in the Chukchi Sea can either occupy demersal habitat in shallow areas or pelagic habitat in deeper areas as nursery areas, similar to reports for the species from the eastern Bering Sea. The size range of juveniles caught suggests that the fish are young-of-the-year based on size-at-age data from the eastern Bering Sea. This work indicates that Pacific cod are able to survive, feed, and grow in the Southern Chukchi Sea at least up to the young-of-the-year stage, in some years.

Spatial and Temporal Variations of pHT on the Central Alaskan Beaufort Sea Coast

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Poster Presenter: Arley Muth

Arctic seawater is acidifying at an accelerated rate and in some areas has crossed biological thresholds. Benthic assemblage variations in the central Alaska Beaufort Sea lead to questions of small-scale spatial differences of seawater chemistry, specifically carbonate chemistry. Seafet pH sensors, in conjunction with Seabird CTDs (salinity and temperature) were deployed July 2016-July 2018 inshore and offshore sites within Stefansson Sound. Contrary to our expectations, we found pH values were consistently lower at the offshore, higher salinity site than the inshore, lower salinity site.Discrete water samples corroborated sensor results; lower salinity waters had higher pH values (R^2=0.78; salinity range 0-32; pH range 7.4-8.4).Counter to many observations globally, pH was higher (most values > 8.0) at salinities < 5, but total alkalinity (TA) was much lower (r^2=0.61, salinity range 0-32, TA range 1800-2700 μEq L^{-1}), and calculated calcium carbonate saturation levels were also low. We hypothesize that these unique water chemistry parameters in Stefansson Sound are driven by run-off from the Sagavanirktok (Sag) River that drains limestone deposits and results in alkaline river water. The Sag River is the second largest river on the North Slope of the Arctic, draining snowfields and glaciers from the Brooks Range, classifying it as a mountain stream that results in a higher run-off pH when compared to tundra streams (such as the Kuparuk River).Annual fluctuations of pH were up to one pH unit at both sites during both years, documenting one of the largest ΔpH_T recorded.These results highlight the importance of seasonal water chemistry and source water monitoring and represent the first annual, high-frequency, continuous pH data from the Arctic Ocean.

Collaborative Development of Coastal Hazards Research Expertise for Arctic Alaska

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Poster Presenter: Thomas Ravens

The University of Alaska Anchorage (UAA) and its partners are developing an NSF Research Coordination Network (RCN) in the area of Arctic Coastal Hazards, considering both physical science / engineering issues as well as social / economic science issues. The RCN is known by the acronym ANCHOR, standing for Arctic Network for Coastal community Hazards. ANCHOR emphasizes community engagement, collaboration, and openness as we rise to the challenge posed by coastal hazards. As a backdrop for the RCN, the ANCHOR research team is engaging with communities in the Yukon-Kuskokwim Delta, Norton Sound, and on North Slope coast to develop community-based coastal monitoring programs. For example, programs are being developed to monitor beach profiles, storm surge height, and wave run-up. Data from the monitoring effort is used to calibrate and validate coastal hazards models including models of coastal erosion and coastal flooding, and models quantifying coastal infrastructure vulnerability. Once the models are validated, they will be used to develop coastal hazards scenarios and risk maps for the next 50 years, including scenarios of coastal erosion and flooding. These scenarios will be discussed with coastal communities who will be use them to plan their futures. Throughout this process, we will be reflecting on how best to quantify community risks such as risks associated with permafrost thaw, coastal erosion, and coastal flooding – as well as quantify coastal infrastructure vulnerability. Can we develop improved rubrics that allows us to better quantify community vulnerability and resilience? What knowledge gaps need to be filled to better respond to the Coastal Hazards challenge? The presentation/poster will present the coastal monitoring data and coastal hazards models, and communicate the ANCHOR Coastal Hazards Network vision.

Waves, Ice, and Coastal Change in the Alaska Arctic

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Poster Presenter: Jim Thomson

Ocean surface wave activity is increasing in the Beaufort and Chukchi seas, which is directly related to increases in the open water fetch available for wave generation in ice-free regions. A new project will examine how longer seasons of stronger wave conditions affect the coasts, including changes in circulation patterns, shoreline erosion, and storm surges. A key aspect is the interaction of waves and shore fast ice, which may attenuate waves and protect the coast. A 30-year wave climatology from a model is being used to design field experiments and year-long monitoring at three sites along the north slope. Results will be integrated as wave-ice interactions in the 'SWAN' wave model, with coupling to the 'ROMS' circulation model and the Sea Ice or CICE models. The models will then be used to assemble a climatology and understand the role of increasing waves in driving coastal change along the Alaskan Arctic coast.

Stratified Dynamics of the Arctic (SODA)

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The overall goal of the Stratified Dynamics of the Arctic (SODA) project is to understand the processes setting the stratification of the Beaufort Sea, and in particular how heat, buoyancy and momentum are redistributed and mixed laterally and vertically given typical patterns of forcing.

In September and October 2018 we conducted oceanographic measurements from the R/V Sikuliaq and the USCGC Healy using a novel suite of instrumentation. Atmospheric and ocean boundary layer and interior measurements of fine- and microstructure heat fluxes, and temperature, salinity, velocity directly quantify or constrain estimates of the rate of turbulent kinetic energy dissipation and horizontal and vertical heat fluxes in sections 1) along and across the shelf break and slope of the Chukchi Sea, 2) North and East of Barrow Canyon, and 3) further offshore where conditions are more representative of the mid basin. In all locations we sampled anomalously warm subsurface waters consistent with recently reported increasing rates of heat input from the Pacific into the Beaufort Sea. In some locations we observed vertical turbulent heat fluxes (from sub-surface pockets of heat upwards towards the ice) one-two orders of magnitude larger than classic mean basin values.

Although many of the processes have been observed previously, the unusually high resolution of the fastCTD system plus large numbers of submesoscale resolving measurements of turbulence and vertical heat flux provide an unprecedented level of detail and allow us to document details of the heat budget of the waters of Pacific Origin: the Bering Sea and Alaska Coastal Waters. Ongoing analysis goals are to 1) quantify the local upper ocean heat budgets in these southern Beaufort locations, and 2) understand the processes controlling the rates of warm salty water subduction, particularly at fronts, dispersal under the ice in sub-surface filaments and eddies, 3) calculate the associated turbulent heat fluxes both in the surface ocean and below. Preliminary results of that analysis will be presented here.

Arctic Alaska Barrier Islands: Dynamic Processes of Change

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Barrier islands comprise approximately 50% of the open-ocean exposed Alaskan Arctic coast and provide shelter to shorebirds (including threatened species), denning habitat for polar bears, haul-out areas for walruses, protect energy and defense-related infrastructure situated on the mainland coast, and underlie many “at risk” native villages that struggle with the potential need to relocate as the land they reside on erodes.

While decade-long changes in barrier island position, erosion, deposition, and migration rates have been documented, studies indicate that migration rates are changing. The underlying processes driving the variations are not fully understood but are likely a combination of changes in sediment supply, loss of barrier sediment through entrainment in sea- and landfast-ice, sea-level rise, and changes in storm-generated water levels and wave energy that mobilizes and erodes or builds barriers. Testing these theories has been limited or impossible due to a lack of historical data on sea ice prevalence and break-up, wave conditions (storm and non-storm related), and water level variations. Ongoing and recently completed studies now make it possible to test these hypotheses. Understanding the dominant processes that have caused observed decades-long changing footprint patterns across Alaska’s North Slope is critical for projecting the future fate of these islands.

Here, we evaluate morphological differences of Arctic Alaska Barriers, document temporal changes, and investigate controlling processes. We also present preliminary work on the effects of eroding barriers on planned oil exploration construction. The focus site is located along the Beaufort Sea coast in Foggy Island Bay, ~30 km east of Prudhoe Bay, Alaska and is part of a study initiated and supported by the Bureau of Ocean Energy Management (see abstract by Kasper et al.). An artificial island approximately 5 km offshore in 6 m water depth is to be constructed. In its current state, the region is protected from the direct onslaught of waves by a system of barrier islands. In this work, we investigate the potential of these barriers to diminish and the changes in wave energy that could affect planned construction, facilities, and a nearby submerged boulder patch, a somewhat unique Alaskan Arctic habitat.

Central Beaufort Sea Wave and Hydrodynamic Modeling Study

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The decreased extent of sea ice has led to an increase in wave height and longer period waves in the Arctic. In order to understand how this might affect development in the Outer Continental Shelf and adjacent waters, the Bureau of Ocean Energy Management (BOEM) initiated the Central Beaufort Sea Wave and Hydrodynamic Modeling Study. This study is focused in Foggy Island Bay (FIB) east of Prudhoe Bay on the northslope where Hilcorp, Alaska has proposed developing the Liberty Prospect from an artificial drilling and production island in the center of the bay. As part of this effort, oceanographic moorings were deployed in summer 2018 to make year-round measurements of wave spectra, currents, hydrography and sediment transport within FIB. New hydrographic measurements (salinity, temperature, pressure, multibeam bathymetric sonar and velocity) were gathered this past summer (2018) and historical physical oceanographic observations from the area were acquired and evaluated for baseline analysis and use for model inputs and validation. The ultimate goal of the project is to provide a successful and validated model outcome that will be used to produce both hindcasts and projections of waves, water level, currents and coastal erosion from 1979 through 2049, including the 15 to 20 year projected lifetime of the Liberty project. Information from the study will be useful for predicting the potential for impacts on important and sensitive habitats such as the nearby Boulder Patch. This effort is highly leveraged and builds upon other recent observational (e.g. the newly initiated Beaufort Lagoons Long Term Ecological Research), and modeling efforts in the region (e.g. the USGS' ongoing work near Kaktovik and the University of Alaska Anchorage's U.S. Airforce funded erosion model studies).

Continental Shelf Waves of the Arctic Ocean

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Poster Presenter: Katherine Hedstrom

Storms that drive high-amplitude coastal convergences or divergences can trigger the generation of energetic continental shelf waves (CSW). We show that CSW can traverse thousands of kilometers around the rim of the Arctic shelf seas. Results from a coupled ocean and ice circulation model along with sea level and ocean velocity measurements from coastal tide gauges and moored subsurface pressure sensors help us describe the character of the Arctic Ocean's CSW field. Time series analysis of surface wind stress and oceanic potential energy and kinetic energy fluxes reveal common sites of shelf wave generation and dissipation. The Pan-Arctic model was run both with and without tides to tease out tidal effects. Results from this study have implications for episodic mixing, advection, coastal erosion, ice runup, and landfast ice breakout events at locations far downstream of the wave generation site.

Seasonality and Forcing Factors of the Alaskan Coastal Current in the Bering Strait from July 2011 to July 2012

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Poster Presenter: Brett Morris

A relatively narrow (~85km) and shallow (~50m) Bering Strait is the only connection between the Pacific and Arctic oceans. Flow through this strait dominates water properties of the Chukchi Sea, impacts Arctic sea ice and stratification, and may influence global climate through freshwater input to the global thermohaline circulation.

A buoyant coastal current, the Alaskan Coastal Current (ACC), typically present in the eastern strait from approximately late April to late December, contributes significantly to heat and freshwater fluxes (approximately 10^{20}J/yr of heat (T_{ref}=-1.9ºC) and 600km^3/yr of freshwater (S_{ref}=34.8psu)), and drives much of the spatial variability in water properties in the eastern Chukchi Sea. However, the seasonal variability of this current has not yet been quantified in any detail. We use temperature, salinity, and velocity data from a 6-mooring array deployed across the eastern channel of the Bering Strait from July 2011 to July 2012 to study the seasonality and driving mechanisms of the ACC.

We find the ACC is present (and flowing strongly) in July 2011, but disappears from the strait in November 2011. The ACC starts to reappear in June 2012, and is well established by July 2012. The greatest monthly mean ACC flow is northward at approximately 70cm/s during July 2011, equivalent to a monthly average transport of ~ 0.2Sv, assuming a current width of 10km and average depth of 40m. This is approximately 1/3rd of the total flow through the Bering Strait at this time. At the ACC's peak in July 2011, mooring data suggests its monthly mean salinity was at least 1.4psu fresher and 4.4ºC warmer than the main Bering Strait throughflow, although summer hydrographic sections suggest this is an underestimate.

Building on the known high correlation between flow and local wind (r~0.7), we examine a single value decomposition of the velocity flow structure in the strait and investigate its relationship to the local wind, considering especially wind-driven flow reversals. Related hydrographic data from July 2018 show that, under strong southward winds, the ACC can completely separate from the Alaskan coast, reverting back to the coast within 3 days of the wind relaxing.

Evolution of Water Column Hydrography and Circulation in Stefansson Sound: The Role of the Spring Freshet

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Poster Presenter: Stephen Okkonen

Rivers supply freshwater and heat to the coastal ocean and, in doing so, influence nearshore hydrography and circulation. In the arctic, these effects are generally greatest during and following the spring freshet. In particular, the heat carried by the freshet melts overlying sea ice and the resulting meltwater augments the riverine contribution to buoyancy in the nearshore region. These processes were monitored during spring-summer 2018 by an array of moored and through-ice sensors deployed within Stefansson Sound. Prior to the freshet, the water column is largely well-mixed. We use acoustic Doppler current profiler (ADCP)-measured acoustic backscatter and currents in conjunction with measurements of temperature and salinity to show that, with the onset of the freshet and associated induced melting of overlying sea ice, the water column transitions to a two-layer system with interface depth increasing monotonically until the overlying ice cover breaks up. Open water allows winds to mix the water column and weaken stratification.

The Effects of Seasonal Abiotic Regimes on Benthic Community Structure in an Alaskan Arctic Kelp Bed

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Poster Presenter: Christina Bonsell

In the Arctic, kelp beds occur along retreating coastal shorelines that are characterized by high sediment loads from shoreline erosion and freshwater inputs. Despite the importance of these habitats to promoting regional diversity and production, connections between physical drivers and ecosystem characteristics are not well established. In the Stefansson Sound Boulder Patch kelp bed, long-term studies include observations of spatial variation in a benthic community dominated by macroalgae and invertebrates. Differences in the composition of the benthic biota suggest that seasonal freshwater inputs from the adjacent Sagavanirktok (Sag) River and changes in bathymetry could drive the observed patterns in community structure. To assess the effect of the abiotic environment on the biological community, we coupled seven-years (2011-2017) of *in situ* physiochemical monitoring with benthic surveys and recruitment studies. Multivariate and univariate analyses that incorporated temperature, salinity, currents, and underwater irradiance with information on community structure revealed strong spatial distinctions between sites, particularly due to the complete absence of crustose coralline algae near river inputs and higher abundances of attached invertebrates in areas near deep, inter-island channels. While sites were generally similar in temperature (~-1.9 °C) and salinity (~33-35) during ice-covered winter months, stark abiotic spatial differences manifested throughout the rest of the year. In late spring through fall, temperature and salinity showed strong cross-inner shelf gradients: summer temperatures at offshore sites remained around 2 °C with salinities of 28 while onshore site temperatures were >6 °C and experienced salinities <10 near the Sag river delta. In all seasons, currents were higher and more variable near-channel sites where invertebrates were more dominant. Recruitment studies revealed the additional importance of successional processes in guiding community structure, with foliose red algae as a key early successional group. Succession also occurred extremely slowly, suggesting limited ecosystem recovery after catastrophic disturbances. Notably, no kelp recruits were observed in any recruitment plates, even after three years *in situ*. Overall, our work indicates that fluvial inputs and hydrodynamic forces affect algal dominance in Arctic kelp bed communities, with distinct effects on regional ecosystem function and community structure.

Exploring Seafloor Communities of the Chukchi Borderlands

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Poster Presenter: Sarah Hardy

In the Chukchi Borderlands, water masses from the Arctic, Pacific and Atlantic oceans meet and interact over tremendously complex bottom topography, creating intricate currents and sea ice drifts. This region also experienced the most dramatic summer sea ice meltdown in the last few decades. We explored sediment communities across the complex Chukchi Borderlands region, including environmental correlates of community structure and biogeographic affinities to adjacent slope areas in the Beaufort Sea. We also investigated a field of pockmarks in the study region for unique associations of benthic organisms. This project is part of a larger, multi-disciplinary group effort toexplore marine communities from microbes to mammals and from sea ice to seafloor in this poorly known, bathymetrically and hydrographically complex Arctic region. We sampled sediments using a 0.25 m^2 box core at depths ranging from ~500 – 2500 m, and examined sediment parameters and infaunal communities. Video surveys of the seafloor were also conducted using and ROV. Organic matter content of sediments was extremely low at all locations sampled, and macrofaunal communities were correspondingly low in abundance and biomass, with average densities on the order of 100 – 400 individuals m^{-2}.One exception was the most southerly station on the Chukchi slope, where macrofaunal densities were an order of magnitude higher (1264 ± 152 individuals m^{-2}).This higher abundance corresponds to higher sediment chlorophyll-a concentration at the same location, although community composition was not significantly different than other stations with lower chlorophyll-a concentrations at similar depths.Most of the variation in community structure appeared to be related to depth. Macrofaunal communities within pockmarks did not appear to differ from those in other locations.

Enhancing Copepod Species Identification for Metabarcoding Analysis with a Region-Specific DNA Sequence Reference Database

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DNA-based analyses are powerful tools for characterizing biodiversity of complex marine ecosystems. Metabarcoding analysis (i.e., large-scale taxonomic identification of complex samples via high-throughput sequencing of a DNA barcode region) frequently uses hypervariable regions of the eukaryotic 18S rRNA gene. However, species-level taxonomic identification is hampered by the conservative nature of the 18S gene. Additionally, metabarcoding analyses rely on DNA reference databases for Operational Taxonomic Unit (OTU) identification; databases that are not yet comprehensive nor complete. Our efforts have focused on creating a region-specific 18S sequence database for the subclass Copepoda, the most diverse zooplankton group in the Arctic Ocean, to improve the taxonomic resolution of OTU identification. Sequences were determined from live copepods identified by morphological taxonomic experts during the Chukchi Borderland and R/V Polarstern Arctic cruises. Additional sequences were obtained from public repositories. Of the two hypervariable regions (V4 and V9) used for metabarcoding, V4 yielded deeper taxonomic resolution of copepod diversity than V9. V9 reliably categorized 7 copepod families, compared to 18 families for V4. Within the 18 families categorized by V4, 32 species were identified, with the most abundant sequences and OTUs belonging to *Calanus glacialis, Neocalanus cristatus* and *Metridia longa*. Our results demonstrate the usefulness of region-specific DNA sequence databases for enhancing the taxonomic resolution of OTUs, allowing species-level identification in some cases, and thus yielding more accurate and detailed assessments of pelagic biodiversity.

Assessing Shifts in the Chukchi Sea Benthic Food Web Over the Past Three Decades

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In Arctic seas, emphasis has been placed on the continued reduction in sea ice extent and earlier break-up. The timing and rapidity of spring sea ice retreat modulates sea ice algae and the ice-edge phytoplankton bloom. Anticipating how changes in the sea ice regime will impact primary production and, thus, the entire Arctic shelf food web is critical to assess the vulnerability of the ecosystem. To address this, we utilized the Pacific Marine Arctic Regional Synthesis (PacMARS) database to examine a compilation of 3,924 stable carbon and nitrogen isotope values of organisms from the Chukchi Sea that span the past three decades (1986-2016). Although 346 species were represented, we focused on the most common organisms, particularly bivalves. Overall, stable carbon and nitrogen isotope values of bivalves exhibited pronounced inter-annual variation with clear differences in minimum and maximum values. For example, some bivalves collected in the years 2002 and 2009 were over 2‰ more ^{13}C-depleted than the most ^{13}C-depleted individuals collected in 2004, 2010, and 2016, an indication that different food sources were assimilated during those years. Bivalves from 2010-2016 were ~2‰ more enriched in ^{15}N compared to previous years, which may indicate a shift in trophic level or trophic baseline. A generalized additive model (GAM) was applied to simultaneously examine the many facets that can drive differences in stable isotope values, such as sampling location, date, and year, along with other environmental drivers. This allowed us to analyze how sea ice extent along with other ecological drivers might shape benthic food web function.

The Search and Rescue of Legacy OCSEAP Beaufort Sea Data Files from NODC Archives

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The goal of this data rescue project is to design and implement a program that facilitates access to Arctic data files that were deposited at the National Oceanographic Data Center (NODC) in the 1970's and 1980's.These legacy data were collected by numerous scientists in the first large field effort to describe the oceanography, chemistry and biology of the American Arctic under the Outer Continental Shelf Environmental Assessment Program (OCSEAP). The files were stored in a hierarchical database format which required extensive programming to create useful data records.Without strong support for the necessary programming, the majority of the data submitted by participants in the OCSEAP program disappeared into the NODC database and effectively became inaccessible.

This project developed a protocol and supporting Python scripts to turn the NODC files into usable records that can be opened in Excel for general access by interested scientists working in the Arctic. The code converts the archive file to a set of CSV files. The parsed NODC files enable the post-processing steps required to create useful data for an end user. This project uses OCSEAP infaunal invertebrate data collected on the Beaufort Sea shelf as a test case for developing the protocol and procedures for file manipulation. A supplementary file was created from the parsed NODC files that joins data fields of interest from multiple CVS files. Our immediate use of the retrieved infauna data is focused on a comparison of data collected in recent Beaufort Sea projects with historical OCSEAP data.We examined the abundance and biomass distributions of dominant species and groups, diversity, and physical parameters (near bottom temperature, salinity, and sediment grain size).PRIMER was used for statistical analyses and maps of results were created in the ESRI ArcMap application. At the end of the project period, the data will be submitted to the NCEI archives for global accessibility and long-term availability, with links to the archive from the UT hosted Western Arctic Environmental Studies website (www.arcticstudies.org).

Summer Fat Camp – How Arctic Lagoons May Promote Growth and Elevated Body Condition of Coastal Fishes

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Lagoons are prominent features along much of the U.S. Arctic coastline, however their ecological importance and connectivity to Arctic marine productivity is poorly understood. To that end, we conducted a multidisciplinary ecosystem study in three nearshore habitats in the oceanographically-dynamic area near Point Barrow, where the Chukchi and Beaufort Seas intersect with the extensive Elson Lagoon. Over the course of 3 6-week ice-free summer seasons (2013-2015), we measured 1) physical habitat characteristics including water temperature and currents using oceanographic moorings and conductivity-temperature-depth instruments, 2) fish and zooplankton community assemblages using beach seines, midwater and bottom trawls and hydroacoustics, 3) diet, trophic level and body condition of fishes from laboratory analyses, and 4) prey quality of zooplankton species via chemical analysis. We found a large diversity of fish comprising 37 species from 14 families, many of which were juveniles. Fish communities were distinct between marine and lagoon habitats. Prevailing wind patterns with strong east and northeast components drove surface ocean flow in an eastward direction along the Beaufort Shelf, with a significant diversion through Elson Lagoon. A constricted waterway on the west side of Elson Lagoon, along with occasional wind reversals acted to retain water in the lagoon for several weeks. Juvenile fish with limited swimming ability were transported from the Beaufort Shelf into the lagoon, where warm temperatures and concentrations of high quality brackish water zooplankton may have contributed to enhanced growth and body condition relative to marine habitats. Results indicate lagoons have potential to bolster fish condition during productive summer periods prior to winter, with possible benefits for survival.

Evaluation of Juvenile Chinook Salmon (*Oncorhynchus tshawytscha*) Diets and Prey in the Lower Yukon River

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The lower Yukon River is an important habitat for out-migrating juvenile Chinook salmon (*Oncorhynchus tshawytscha*) and previous work has shown that prey availability and quality can influence the energy content of the smolting fish. Thus, prey availability and quality may be important determinants of marine survival and recruitment. We hypothesized that Chinook primarily consume the most abundant prey source in favor of the highest quality prey. To evaluate our hypothesis, we examined diets of out-migrating Chinook salmon and the quantity and quality of their prey. Nine permanent stations on the three main lower Yukon distributaries were sampled from ice out until late July in 2016. Invertebrate drift samples and potential prey fish were quantified by station to determine prey density. An electivity index was developed based on fractional composition of prey in drift samples and stomach contents. A subsample of invertebrates were analyzed for lipid content and prey fish were analyzed for energy density to determine the quality of prey consumed. Preliminary analyses indicated that Chinook salmon stomach fullness and energy density were low in 2016 compared to the two prior sampling years. The two invertebrates most often selected for consumption also had the highest lipid content. Beetles were the most abundant prey item and among the top five preferentially selected prey, but they had approximately 80% less lipid than the most preferred invertebrate, caddisflies. The invertebrate biomass varied greatly by species and abundance over the season. Of the prey fish, small cisco and whitefish had the highest energy densities, but were only available late in the season. Generally, fish are small enough to be prey for Chinook only a few weeks during the summer, before growing too large for consumption. Preliminary results suggest that lipid resources are available to Chinook salmon during peak outmigration periods, however, temporal variation in invertebrate abundance in this system is unknown, as is the biomass of prey needed to sustain the population for out-migration. Diet analyses can only evaluate the most recent meal and additional research is needed to investigate Chinook prey consumption and prey availability over the entire out-migration period.

A Transcriptome Resource for the Arctic Cod (*Boreogadus saida*)

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Arctic cod (*Boreogadus saida*) serve as an important link in Arctic food webs and are thus considered an important species for environmental monitoring. Arctic cod are stenothermal and have demonstrated a response in growth rates when confronted with changing water temperatures. A species' rapid or short-term response to changing environmental conditions will likely be displayed in differences in gene expression profiles rather than mutations in DNA sequences. Thus, to understand how Arctic cod may respond to new environmental challenges in the near future, we assembled a partial transcriptome from wild-collected individuals using an RNA-SEQ protocol. Using samples from various age classes and different tissue types, we recovered 44,002 proteins/genes based on the Atlantic cod (*Gadus morhua*) transcriptome as a reference. Of those, 74% of the predicted Arctic cod transcripts were nearly identical to the Atlantic cod, but a large number of genes showed substantial differences including genes that regulate muscle development (e.g., MEF2C), circadian rhythm (e.g., CLOCK), and environmental and nutritional stress (e.g., AMP-activated protein kinase). Overall, we identified well-known genes that are associated with environmental variables (temperature, salinity, and oxygen availability) and immune response, in particular genes known to be up-regulated to pollutant exposure. This RNA-SEQ effort provides the first insight into the *Arctic cod* transcriptome, which can be a starting point for investigations identifying genes associated with local adaptation and genomic responses to future environmental change in the Arctic.

Carbon Sources and Trophic Structure of Fish Communities in Lagoons of Arctic Alaska

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Coastal lagoons make up about a third of the Arctic coastline and provide critical subsistence resources for Alaska Native villages. Lagoon habitat has a unique vulnerability to climate change because of its connection to both the marine and freshwater ecosystems. Increased storm action, permafrost degradation, timing of ice formation and break-up, and increases in anthropogenic activities in the Arctic (vessel traffic, oil and gas development) may impact lagoon habitats. The cumulative toll of these effects will potentially have a large impact on lagoon fish communities, making understanding of their basic ecology vital. Despite these threats, little is known about lagoon processes in Northwestern Arctic. We characterized the stable isotope composition and energy density of ten fish species collected from four different lagoons along the Bering Sea coast just north of Kotzebue Sound. The lagoons were characterized by size and the degree of connectivity to saltwater. Stable isotope analysis of fish collected in 2016 and 2017 revealed the effect of fresh water input on the importance of terrestrially derived carbon on fish diets. We observed a dependence between isotopic niche breadth and connectivity with the Bering Sea, and trophic web structure varied among the locations. In addition, energy densities for most species increased between 2016 and 2017. Lagoons are important to fish production in the eastern Chukchi Sea, and data presented here demonstrate that many of these systems function in different ways. In order to better understand climate related risk in this region we require a more detailed understanding of lagoon processes.

Identifying Arctic Cod Hatch Dates and Location in the Alaskan Arctic Through Otolith Analysis

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Poster Presenter: Zane Chapman

Arctic Cod (*Boreogadus saida)* are an important pathway for energy transfer from primary producers to upper trophic level species inhabiting the Chukchi and Beaufort Seas. In a rapidly changing climate, understanding when and where Arctic Cod spawn is becoming more important in order to inform the management of Arctic marine ecosystems and their natural resources. As the Arctic seas warm and sea ice continues to decline, these waters are becoming more navigable to humans, allowing for an increase in exploration for potential resources. Arctic Cod are very sensitive to temperature increases, as well as anthropogenic disturbances, making a better understanding of their life history key for conserving this vital resource. Here we outline a study to understand when and where hatching occurs and provide preliminary results from examining otoliths of young-of-the-year (age 0) Artic Cod. Hatch dates were estimated by counting daily growth increments and back-calculating the time of hatching from the sampling date. Otoliths from Arctic Cod have previously been used and validated for measuring daily growth in juvenile and larval cod. Otoliths were extracted from age-0 cod, mounted on slides, and polished. Daily growth rings were then counted and measured under a microscope and hatch dates were back calculated from the sampling date using the estimated age. In addition, we outline a pilot study to infer potential spawning locations and environmental histories by estimating the ratio of trace elements to calcium along a cross section of the otolith through laser ablation. The findings from this study will provide a better understanding of the early life history of Arctic Cod and help inform a biophysical transport model for larval cod that is being developed concurrently.

Temporal Variability in Densities and Vertical Distributions of Pelagic Fish and Macrozooplankton on Hanna Shoal

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Quantifying temporal patterns and understanding underlying processes in abundances and behaviors of pelagic animals are required to detect or predict biological responses to environmental change in Arctic seas. Arctic pelagic ecosystems are variable across a wide range of temporal scales due to numerous physical and biological processes acting and/or interacting across an equally-wide temporal scale range. As a result, a comprehensive understanding of temporal patterns in pelagic communities requires the collection of high-scope (i.e. long term and high resolution) biological data—a challenging task in high latitude environments. One efficient approach uses stationary active acoustics (i.e. moored echosounders) to characterize and monitor biological variability in seasonally ice-covered waters of Arctic marine ecosystems. In this study, we characterize temporal variability in densities and vertical distributions of fish and zooplankton at the Chukchi Ecosystem Observatory. Active acoustic data from an ASL Acoustic Zooplankton Fish Profiler operating at four frequencies (38, 125, 200 and 455 kHz) were processed and analyzed at high temporal (every 15 seconds, 0.067 Hz) and spatial (ca. 4 cm) resolutions. Four metrics, derived from acoustic backscattered energy, were used to characterize temporal variability of fish and zooplankton densities distributions: mean volume backscattering strength (i.e. acoustic density), center of mass, inertia, and an aggregation index. Wavelets were used to describe the temporal scales of variability for each metric. We observed seasonal changes in vertical migration timing and variations in backscattering strength that are attributed to variable day length and sea ice formation and melt cycles. Understanding temporal density patterns increases our ability to detect biological responses to environmental change in Arctic ecosystems.

No Fluffy Cakes: St. Lawrence Island Seabirds Respond to Historic Low Winter Sea Ice

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By April 29th, 2018 sea ice was completely absent from the Bering Strait, marking an unusually early start to spring marine primary production in the region. Such a sudden transition from a system with ice in the spring to one without any ice provides an opportunity to examine the responses of Arctic species to severe environmental perturbations and to understand how those changes may affect culturally significant food resources of Arctic communities. We studied the reproductive success, diet, and physiological state of five migratory seabird species that breed on St. Lawrence Island in 2016-2018, and in 2018 surveyed egg harvesters to measure the impact ocean conditions had on murre egg collection. The responses of these species to ocean conditions in 2018 encompassed a spectrum from a mass mortality event (thick-billed murres, *Uria lomvia*), to wide-spread reproductive failure (least and crested auklets, *Aethia pusilla* and *A. cristatella*), to less affected (black-legged kittiwakes, *Rissa tridactyla*). Murre eggs are of particular importance to the community of Savoonga, Alaska. Reports from this past summer suggest that murre egg harvests were 1/10th or lower than what is normally collected. Here we discuss the insights these seabird species provide on what ecosystem changes may have occurred in the wake of a winter with historically low concentrations of sea ice, and highlight how sudden changes in seabird reproduction can immediately affect local communities.

Does Next Generation Sequencing Hold the Key to Unravelling Population Structure Among Arctic Ringed Seals?

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Although Arctic ringed seals (*Phoca hispida hispida*) are currently abundant and broadly distributed, their dependence on sea ice and snow cover for survival and reproduction puts them at risk of substantial declines in the future due to continued climate warming. Understanding population structure within this subspecies is an important component of predicting its response to climate warming. this has proven challenging due to the large effective size of the subspecies and the limited number of genetic markers previously available. Here we take advantage of recent advances in next generation sequencing to discover and genotype ~5700 SNPs in ringed seals inhabiting the Pacific Arctic (n=79). Small but significant genetic differences were identified between seals sampled in the eastern Bering (EBS) and the Alaskan Beaufort (BFS) Seas, as well as between the combined eastern and northern Bering Sea (E&NBS) and southeastern Chukchi Sea and BFS (CS&BFS) strata (EBS v. BFS: F_{ST}=0.001, p=0.005; E&NBS v. CS&BFS: F_{ST}=0.001, p=0.007). Genetic assignment tests assigned individuals to the region where they were sampled with relatively high success (mean=80%) in the two most well-sampled strata (EBS and BFS). The low magnitude of differences identified between regions suggests a lack of reproductive isolation between areas, such that the current levels of connectivity are likely sufficient to maintain the evolutionary potential of the subspecies. However, the small but significant genetic differences identified between some strata provide tentative evidence that some degree of demographic independence could be present at a regional scale. Our results suggest that a comprehensive analysis of samples collected throughout the range of the Arctic subspecies, in combination with the large-scale genotyping approach used here, is needed to more fully assess connectivity among regions and thereby better understand the impacts of future environmental changes on ringed seals.

Reliable Areas of Uncertainty for Vocalizing Marine Mammals Using Novel Techniques

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Poster Presenter: John Spiesberger

We are demonstrating an acoustic method yielding extremely reliable Areas of Uncertainty for calling marine mammals using Time Differences of Arrival (TDOA) computed between fifteen widely-separated fixed recorders in the Chukchi Sea in 2010-2012 (CHAOZ experiment). The goal is to measure their distribution in space and time and produce a very reliable lower bound for the number of calling mammals, sorted by species. AOUs are the 100% confidence intervals derived with Sequential Bound Estimation (SBE): a technique independently and successfully evaluated by the U.S. Navy. SBE is a nonlinear non-Bayesian technique capable of explicitly accounting for all errors affecting uncertainty. One factor is sound speed where isodiachrons are used for location instead of hyperbolas. To date, its AOUs always contain the true location of the source, both in simulation and real data. Since the recorders are not time-synchronized, clock offsets are estimated with TDOAs. Work supported by the North Pacific Research Board.

The First Instrument-Based Polar Bear Population Estimate for the Western Chukchi Sea

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In the Chukchi and East Siberian Survey (ChESS) project a Russian team completed an instrumental multispectral aerial survey of polar bears in the western Chukchi Sea between April 18 and May 18 2016. To collect comparable data and combine survey results, the survey was conducted using procedures that were coordinated with the U.S. team, who conducted a similar survey simultaneously in the eastern Chukchi Sea. 12,180 km of transects were flown “on-effort” in the Russian waters, with approximately 6000 sq km of coverage by the survey instruments, or about 1.2% of the total survey area. The processing of images collected with the survey equipment is completed and shows over 70 bear detections, 2000+ detections of polar bear tracks as well as several hundred of ringed and bearded seals detected on ice. Data analysis and extrapolation of survey results over the unsurveyed area allowed to obtain a first reliable population estimate for polar bears in the Russian waters of the Chukchi Sea. It was found that instrument based polar bear density estimate was three times higher than the one estimated based on visual observations. At the next stage of the project the polar bear distribution model derived from the Russian data will be applied to the American side using the same environmental covariates (such as ice conditions and seal densities) and the distribution of bear tracks to get a joint estimate.

Gray Whale Calf Occurrence in the Eastern Chukchi Sea, 2009-2018

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Thirty gray whale (*Eschrichtius robustus*) calves were observed during systematic line-transect aerial surveys conducted from July to September 2018 in the eastern Chukchi Sea (67°-72°N, 156°-169°W). These surveys, part of the Aerial Surveys of Arctic Marine Mammals (ASAMM) project, funded by BOEM and co-managed by BOEM and NOAA, have been consistently conducted from July to October since 2009 to document the relative abundance and distribution of marine mammals. The Chukchi Sea is the northernmost extent of the gray whale's range, serving as important foraging and weaning grounds during summer and fall. Calf distribution in 2018 was similar to previous years, with the greatest number of sightings occurring along and offshore of the Alaskan coast from Icy Cape to Point Franklin. The annual number of gray whale calves was greater from 2012 to 2018 (22-55 calves per year) than from 2009 to 2011 (0-10 calves per year). Calf sighting rates (# calves per km flown) were also higher from 2012 to 2018 than from 2009 to 2011. When calf ratios (# gray whale calves/total # gray whales) were compared for the area flown consistently from 2009 to 2018 (68°-72°N, 156°W-169°), the calf ratios for 2009-2011 were lower than 2012-2018; however, the calf ratio for 2018 (0.12; 28 calves/235 gray whales) was the lowest since 2012 (0.17; 39 calves/232 gray whales). The seven consecutive years (2012-2018) of moderately high to high (0.12 to 0.21) gray whale calf ratios suggest that the calf ratios in 2009-2011 (0.00 to 0.07) were uncharacteristically low. The 2018 calf ratio may indicate a difference in the age structure of the gray whales using the ASAMM study area since 2012, with calves making up a smaller proportion of the total number of gray whales, or may reflect reproductive cycles during which calf ratios tend to fluctuate from low to high over three-year periods. Continued monitoring would be required to test these hypotheses.

Seasonal Movements and High-Use Areas of Spotted Seals (*Phoca largha*) in the Pacific Arctic

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Spotted seals (*Phoca largha*) are pelagic foragers that use Bering Sea pack ice for pupping, nursing, and resting when ice is present (December–June) and nearshore habitats for resting during the open-water season (July–November). Warming of Pacific Arctic waters associated with climate change may affect fish and invertebrate prey of spotted seals, and therefore affect their foraging behavior. Decreases in the extent of sea ice and lengthening of the open-water season have eased access to the Arctic for development and shipping, prioritizing the need to identify areas important to seals. Our understanding of movements and foraging habitats of spotted seals, however, is limited. We worked with Alaska Native hunter-taggers along the Beaufort and Bering sea coasts to deploy satellite-linked tags on 24 spotted seals from July through September 2016–2018 to study movements and habitat use. Individual seals were tracked 137–443 days. During the open-water season, the movements and behavior of seals tagged in the Beaufort (Dease Inlet and Colville River) and Bering (Scammon Bay) seas differed.Seals tagged in the Beaufort Sea made frequent east-west movements between foraging areas in the Chukchi Sea and the Alaskan coast, including their tagging locations, often resting on islands near Icy Cape, Peard Bay, and Dease Inlet. The primary foraging area was between Herald Shoal and nearshore waters of the northeast Chukchi Sea (<50 m deep). Seals tagged in the Bering Sea also made frequent east-west movements, here between foraging areas in the central Bering Sea and the Alaskan coast, often resting on islands near Scammon Bay. The primary foraging area was between St. Lawrence Island and St. Matthew Island (<60 m deep). In December, seals tagged in the Beaufort Sea moved south, ahead of the advancing pack ice. By mid-January, all seals regardless of tagging location occupied pack ice and foraged in the central Bering Sea. These results show the importance of regionally spaced tagging locations to understanding movements and habitat use throughout the Pacific Arctic. Continued studies of seal movements will be necessary to monitor for changes in behavior with continued changes in climate and development activities.

Bearded Seal Productivity in Alaska Using Harvest-based Monitoring, 1975–2016

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Declines in arctic sea ice extent, thickness, and duration are projected to negatively impact bearded seals (*Erignathus barbatus*) by reducing their time to rest, pup, nurse, and molt on sea ice. Existing population estimates for bearded seals in Alaska cannot be used to detect trends; however, the Alaska Department of Fish and Game works with Alaska Native hunters to collect data from the subsistence harvest that are used to determine several population health indices, such as: pregnancy rate, age of maturity, and the proportion of pups in the sampled harvest. These indices were previously used to determine if declines in sea ice have affected bearded seals between 1975–1984 and 2003–2014. During these time periods pregnancy rates varied minimally (92–99%); however, the average age of maturity decreased from 4.2 years in 1975–1984 to 2.9 years in 2003–2014. Additionally, pups were harvested in lower proportions during 1975–1984 than during 2003–2014 (26% and 48%, respectively), indicating that pups are still being produced, weaned, and are surviving to be harvested. Through 2014, we have not detected the decreases in population indices that have been predicted to occur with climate change. However, due to continued declines in sea ice, further monitoring is important; therefore, here we update our 1975–2014 results to include samples from 2015 and 2016.

SNP Genotyping as a New Approach for Genetic Mark-Recapture Studies of Polar Bears, *Ursus Maritimus*, in the Alaskan Arctic

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Poster Presenter: Tatiana Ferrer

Effective polar bear management across the changing Arctic, including the Chukchi and Beaufort Seas, relies on cooperative and collaborative research that can detect responses of these apex predators to changes in their physical and biological environment in real or near real-time. To this end, there is a growing need for detailed baseline information on polar bear movements, residency times and habitat use, on bear breeding behavior and population structure, and on bear population dynamics including abundance, trends and vital rates. Cooperative research and management efforts at local, state, federal and international levels have all recognized the utility and power of genetic mark-recapture approaches in co-management studies of polar bears. Coordinated sampling and rapid genetic analysis of individual bears can reveal unique insights into the seasonal movements and local abundances of polar bears onshore, as well as population-wide information on sex ratios, breeding behavior, dispersal patterns, population size, kinship and survival. Genetic profiling can also provide a more in depth understanding of polar bear viability including determinants of individual fitness and the incidence and long-term effects of hybridization with brown bears, *Ursus arctos*. Until now, microsatellite genotyping has been the standard method of genetically profiling polar bears. Though potentially very powerful, these markers have several well documented limitations.

We, therefore, decided to investigate the utility of the next generation of DNA markers known as single nucleotide polymorphisms (SNPs). Here we present our findings on: (1) the establishment of a SNP array for genotyping individual bears, and (2) a cost-benefit comparison of established microsatellite panel (n=17 loci) with a SNP panel (n=96 loci). We also present preliminary findings on: (3) the utility of hair samples versus tissue samples in both genotyping methods. We demonstrate that SNPs are a very powerful and efficient alternative in bear genotyping studies eliminating many of the obstacles associated with microsatellites while offering huge potential for tackling emerging scientific and management questions.

Movements and Habitat Use of Pacific Arctic Seals and Whales via Satellite Telemetry and Ocean Sensing

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Poster Presenter: Lori Quakenbush

Oceanographic features such as fronts and stratified layers are known to enhance feeding opportunities for marine mammals.Such oceanographic features aggregate zooplankton, which then attract forage fish.Hence, marine mammals that feed on zooplankton (e.g., filter feeding whales) or fish (e.g., ice seals) may also be attracted to fronts and stratified layers.Oceanographic data (e.g., temperature and salinity) used to identify water masses and the boundaries between them are difficult to collect in remote areas that are often ice-covered.Ship-based oceanographic surveys are often limited to ice-free months and fixed moorings sample a limited number of locations.The use of animal-borne Conductivity-Temperature-Depth (CTD) satellite-linked tags can alleviate many of these problems by having the tagged animal collect oceanographic profiles, paired observations of temperature and salinity with depth, as it travels.Profiles are transmitted to Argos satellites.During 2016–2018, CTD tags made by the Sea Mammal Research Unit of St. Andrews, Scotland, were deployed on three ringed (*Pusa hispida*), eight bearded (*Erignathus barbatus*), and 20 spotted seals (*Phoca largha*) at seven locations in Alaska.Eight bowhead whales (*Balaena mysticetus*) were also tagged; two near Tuktoyaktuk, Canada, and six near Utqiaġvik, Alaska.Animals were tagged with and by local hunters.As of 1 October 2018, we have collected 13,194 CTD profiles; 5,707 in the Bering Sea, 5,978 in the Chukchi Sea, and 1,509 in the Beaufort Sea. In addition, 5,491 profiles were collected in winter months when ship-based oceanographic surveys are rare due to ice cover.We will compare oceanographic conditions where animals travel versus where they linger and look for selected use of specific water masses.For example, preliminary dive and CTD data show that both ringed seals and bowhead whales will sometimes target the halocline between Pacific and Atlantic water in the Arctic Basin.This boundary layer is known to aggregate zooplankton that attract fish and is also targeted by beluga whales.In addition to identifying oceanographic characteristics important to marine mammals, the CTD data are also useful for understanding the physical oceanography of the Pacific Arctic and will be useful for improving and testing oceanographic models.

A Cost Effective Method to Determine Pacific Walrus Sex from Skeletal Remains

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Pacific walruses *(Odobenus rosmarus divergens)* are vital to the Alaskan Native way of life and are an integral part of Arctic marine ecosystems. Therefore, the past, present, and future of walruses is of interest to Alaskan communities and researchers. There are numerous Pacific walrus specimens in museums and in archeological collections that have proven useful in many different studies, but often the sex of these specimens is unknown. A method for determining sex of adult Atlantic walruses *(Odobenus rosmarus rosmarus)* based on mandible measurements has been previously developed. We used a similar approach for Pacific walruses and measured mandibles from the extensive collection at the University of Alaska Museum. The goals of this research were to use known-sex walrus specimens to determine if previously developed methods could predict the sex of Pacific walruses and compare average mandible measurements of Pacific and Atlantic walruses. Four measurements, mandible length, height, least mandible depth and thickness, were taken on 55 known-sex walrus mandibles using high precision digital calipers (+/-0.01mm). We found significant differences between male and female walruses with fully fused mandibles ($p<0.001$). We then used discriminant function analysis to determine which measurements best distinguished males and females in Pacific walruses. The measurement that had the most predictive power was least mandible thickness, while mandible depth, height, and length had less predictive power. Posterior probabilities indicate that the discriminant function analysis classified the known-sex walruses with ≥96% confidence and assigned sex to nine unknown-sex specimens with 100% accuracy. The mean depth and thickness of Pacific and Atlantic walrus mandibles differed the most, while length and height were similar for both subspecies. Therefore, the method developed for Atlantic walruses is transferrable to Pacific walruses and will allow for sexing walrus specimens from museum collections and archeological sites. This technique is more cost effective than genetic sex determination, and will be particularly useful when DNA is too degraded for replication. This approach will be beneficial in establishing the historic range and hunter preferences of sexes in Pacific walruses.

Molting Strategies and Seasonal Energetic Requirements of Spotted, Ringed, and Bearded Seals

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Poster Presenter: Colleen Reichmuth

Spotted (*Phoca largha*), ringed (*Pusa hispida*), and bearded (*Erignathus barbatus*) seals use sea ice as a substrate for various critical functions, including rest, giving birth, nursing, and predator avoidance. They also rely on sea ice during the annual molt, when they shed several layers of epidermis and fur and regenerate a new coat. To facilitate this process, seals haul out for extended periods, increase blood flow to the skin, and maintain elevated skin temperatures. Molting is assumed to have a significant metabolic cost, which would increase if appropriate haul-out substrate were unavailable; however, the energetic consequences of molt have only been quantified for a few species. Working with trained spotted (n=4), ringed (n=4), and bearded (n=2) seals, we tracked changes in coat condition and seasonal energetic demands to identify key periods when the loss of sea ice may have the greatest impact. We documented the timing, progression, and duration of the visible molt for all seals. In addition, we used open-flow respirometry to track fine-scale changes in the resting metabolic rate (RMR) of six seals for a minimum of one year. We observed clear patterns in seasonal costs that related to the distinct molting strategies of each species. For species that molted over a relatively short interval (spotted: 36±4.6 days, ringed: 29±2.5 days), individual RMR increased on average 26-47% during the molting period. In contrast, molting over a longer interval (bearded: 107±14.8 days) appeared to limit the metabolic cost of molting as indicated by a stable annual RMR. These findings reveal the relationship between molting strategy and seasonal energetic requirements and provide quantitative data that can be used to assess species-specific vulnerabilities to changing environmental conditions.

Drone Acquired Orthorectified Imagery with Limited Ground Control: Application to a Large Walrus Haulout

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Poster Presenter: Anthony Fischbach

Structure from Motion (SfM) is a method for deriving digital surface models (DSM) and orthorectified imagery (orthoimages) from sequences of 2-D images. To make real-world measurements, the DSM and orthoimages must be transformed into an absolute coordinate system using camera locations (from the drone's GPS) or ground control points (GCPs). GCPs are manually placed targets or natural markers on earth's surface, with measured real-world coordinates, used to scale the DSM for precision mapping. Because manually placing GCPs throughout a wildlife study area can be problematic, we investigated the accuracy of SfM orthoimages processed with various types of GCPs, in context to repeated unmanned aircraft surveys of a large walrus haulout (> 2km long by > 100m wide). Specifically, we compared georeferencing errors of SfM orthoimages derived using 1) camera locations only with no GCPs, 2) natural markers visible in satellite imagery with 0.43 m resolution and 2.7 m horizontal accuracy, 3) GCPs with locations measured with hand-held GPS, and 4) GCPs measured with survey-grade GPS. We place these spatial errors into the context of the need to enumerate walruses based on walrus herd density and area measurements, and the desire to collect body measurements from imaged animals.

Reference Intervals for Biochemical Analytes of Southern Beaufort Sea Polar Bears

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Poster Presenter: Tricia Fry

The effects of chronic environmental stress on the metabolic processes of polar bears (*Ursus maritimus*) are unknown due to a lack of baseline data. A panel of appropriate biochemical analytes can be used to monitor physiological processes like organ system function, electrolyte balance, and protein catabolism for signs indicative of metabolic impairment. Establishing reference intervals, i.e. baseline values for commonly measured analytes, is essential for using biochemical panels as monitoring tools. Using data from the southern Beaufort Sea subpopulation of polar bears, we defined reference intervals for 13 biochemical analytes. Our reference population includes 659 polar bears from which serum samples were collected between 1983 and 2018. We established specific criteria for defining a healthy reference population and relevant subgroups, and followed rigorous guidelines for calculating reference intervals. To account for differences in seasonal life history characteristics of polar bears, we determined separate reference intervals for spring and fall. We present reference intervals for five subgroups in spring based on sex, age-class and female breeding status and three subgroups in fall based on sex and age-class for females only. Alkaline phosphatase did not differ between seasons; however, activity of this enzyme was twice as high in subadults as in adult polar bears ($p<.001$, both males and females). Denning females had significantly higher glucose concentrations than non-denning female, possibly reflecting energy expenditure during lactation Seasonal differences in reference intervals were relatively small with the exception of sodium concentration in females and total protein concentrations in both sexes. For each of these analytes, fall concentrations were significantly higher than spring concentrations ($p<0.05$). Increases in sodium concentrations may be a result of seasonal dehydration, while increases in total protein concentration maybe based on diet or increased immune function. These reference intervals provide a foundation for making temporal and spatial comparisons both within and among polar bear subpopulations and may provide insight into physiological responses to their changing habitat.

Persistent Mullerian Duct Syndrome- A Rare Form of Male Pseudohermaphrodism in a Free-ranging Beluga Whale (*Delphinapterus leucas*) Utqiagvik, Alaska

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Poster Presenter: Raphaela Stimmelmayr

Beluga whales (Delphinapterus leucas) are an important marine mammal subsistence resource on the North Slope, AK. Opportunistic hunting of migrating whales occurs primarily during summer to early fall at Utqiagvik, Alaska. We report on a case of intersex in a subsistence harvested beluga whale from Utqiagvik, Alaska. Life history samples were collected at the butchering site (beach) from a ~ 3.96 m (13') subsistence harvested beluga whale (color white) with an external appearance of being male. Based on standard length, the animal was estimated to be between 10 - 25 years old. Muktuk (epidermis plus blubber), the head, the fluke, and both flippers had already been removed by the hunter prior to tissue sampling. Sex identification was determined by palpation of the genital slit for the presence or absence of the penis. The penis was located within the genital slit with the majority of it being coiled within the abdomen. Upon examination of internal organs a female tract like structure was observed as well. Gonads reminiscent of testis and epididymis were embedded in the broad ligament of the uterus. Microanatomical findings confirmed bilateral presence of male gonadal tissue and cytogenetic analysis identified the animal as a male. This is the first report of a persistent muellerian duct syndrome in a cetacean. Disorders of sex development is a rare condition in cetaceans with only 12 reported cases (including this case). Intersex cases have been most frequently observed in beluga whales from the St. Lawrence estuary (~6). Other species include dolphin (n=2), bowhead whale (2), and fin whale (1).

Urine Characteristics of Ringed (*Phoca hispida*) and Bearded Seals (*Erignathus barbatus*), Utqiagvik, Alaska

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Urine as an excretory product and its analysis is a valuable diagnostic tool for post mortem examination of found dead pinnipeds and clinical examination of ice seals undergoing rehabilitation. There is limited published clinical information available for pinnipeds in general and in particular for ice-associated ringed (Phoca hispida) and bearded (Erignathus barbatus) seals. The objective of this study was to establish baseline reference values for normal biochemical variables in urine from healthy subsistence harvested ice seals. During 2007-2016 fifty-eight urine samples were collected from subsistence harvested subadult and adult female and male bearded (n=44) and ringed seals (n=14) from Barrow (71.2906° N, 156.7886° W), Alaska. Urine sampling by cystocentesis was performed during routine post mortem examination. Samples were stored frozen in cryovials at minus 20 0C until analyzed by urinary dipstick analysis (CLARITY ®urine analysis reagent strips 10SG). Urine color was categorized as colorless (0), light yellow (1), yellow (2), dark yellow (3) and orange/reddish (4). Transparency was (0), cloudy (1). Results [range (mode)] are reported in conventional units [leucocytes 15- 500 Leu/µL), Nitrite (neg-pos), Urobilinogen (0.2-8 mg/DL), Protein (neg-300 mg/dL), pH (5-9), blood (neg-200 Ery/ µL), Ketone (neg-80 mg/dL), Bilirubin (neg-4 mg/dL), Glucose (neg-1000mg/dL). Both species have a distinct urine odor with bearded seal urine being more pungent than ringed seal. Ringed seal (n=14; 2010-2016): Urine color ranged between colorless to orange reddish (dark yellow); transparency (clear (13/14), pH 5-6.5 (6), ketones:0-15 (5),bilirubin 0-2 (1), urobilinogen 0.2, protein 0-300 (15), blood 0-200 (200), glucose non detect (14/14), nitrite non detect (14/14), and leucocytes 0-70 (15). Bearded seal (n=44;2009-2014): Urine color ranged between white to orange reddish (light yellow); transparency (clear (38/44), pH 5-9(6), ketones: 0-15 (5),bilirubin 0-1 (0.2), urobilinogen 0.2, protein 15-300 (30), blood 0-200 (200), glucose non detect (44/44), nitrite non detect (44/44), and leucocytes 0-70 (15). Observed urine characteristics are discussed in relation to known life history and health status of ice seals included in the study and the influence of sample collection and storage time.

Preliminary Lessons Learned from Conducting Traditional Knowledge Interviews to Inform Animal Movement and Habitat Suitability Models

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Poster Presenter: Rowenna Gryba

Quantitatively combining traditional knowledge (TK) with western science has proven challenging due to differences in the type and structure of the information and the difficulties associated with developing a quantitative framework that can integrates both types of knowledge. TK is a vast source of information and, while often well documented, is typically included in scientific studies as supplementary or corroborative information. Although the depth of knowledge inherent in TK is acknowledged, this approach treats these types of knowledge in parallel frameworks. Quantitative methods to combine TK and western science into one framework are emerging but examples are still few. We are seeking to develop an analytical approach that allows for the formal quantitative integration of TK and western science into animal movement and habitat suitability models for ringed, bearded, and spotted seals. To do this, we are initially focusing on methods to interpret and quantify TK and represent it spatially in a way that can be included in further analysis. Our first step was to determine the parameters that would be used in the models to define behavior and habitat use, and the relevant, complementary threads of TK that would be included in the analysis. Initial interviews were conducted in Utqiagvik, Alaska. The interviews focused on topics related to ringed, bearded, and spotted seal movement, activity and behaviors associated with specific locations or times of year. Preliminary lessons learned about the types of questions asked during TK interviews, and how the TK can be quantified, provided insights into furthering our approach and efforts to develop models that equally consider and integrate two valuable sources of information into one analytical framework.

Repurposing Real-Time Vessel Tracking Information into a Valuable Data Asset for Decision Support

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Poster Presenter: Carol Janzen

The Automatic Identification System (AIS) is a real-time network of shipboard transmitters and land- and satellite-based receivers that allow vessel movements to be broadcast from ship to shore or ship to satellite, tracked and recorded. The original purpose of the AIS was collision avoidance, but many other real-time information applications have since developed including maritime security and monitoring, search and rescue, oil spill response, and using historical information for incident investigations. Recent interest in using historical AIS data records for other applications in the Arctic has led to projects focused on resource management and oil spill response planning and identifying changing patterns in vessel traffic in an emerging ice-free Arctic. Historical AIS records, though archived, have not been readily accessible or easy to use for other applications, and AIS datasets are also immense, making traditional data storage and processing techniques insufficient to deal with the data, even on a local scale. To make these data more tractable, recent implementation of a proven methodology for handling the “big data” issue has allowed successful repurposing of historical Arctic AIS data records. One project with the Arctic Domain Awareness Center synthesized a 5-year record of AIS vessel tracking data collected by the Marine Exchange of Alaska throughout the U.S. Arctic region. The primary goal was to format data into usable inputs for the NOAA model used to prioritize charting efforts. Stakeholder inputs on this project also guided the development of a specialized data portal hosting over 30 data layers for comparison and analysis against this 5-year AIS data record. Another project supported by the National Academy of Sciences synthesized vessel traffic patterns and identified vessel traffic hotspots, and aggregated subsistence use mapping and harvest surveys along the Beaufort Sea coast. Using ocean circulation and atmospheric wind models to power oil spill trajectory scenarios, vessel traffic areas with the highest potential impacts to subsistence use can now be identified in advance. Both projects integrate data into an interactive mapping tool hosted by the AOOS data system to increase public knowledge and inform government agency and community decision-making.

Marine ARctic Ecosystem Study (MARES): Mooring Deployments on the Beaufort Sea Shelf

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Poster Presenter: Francis Wiese

The overarching scientific goal of MARES is to increase our understanding of the impact of physical drivers (ocean and ice) on the trophic structure and function of the marine ecosystem on the Beaufort shelf. To support this goal, we deployed five moorings across the Canadian Beaufort Sea shelf west of Herschel Island, between 10 and 440m depth. This part of the project, funded by BOEM under the auspices of the National Ocean Partnership Program (NOPP), has been a collaboration between Stantec, ASL, the Woods Hole Oceanographic Institution, the University of Alaska Fairbanks, SeaStar Biotech, and the University of Washington. Consultations with the local Canadian Hunters and Trappers Committees provided needed and valued input for the approval and licensing of this project. Moorings during the first year (Oct 2016-2017) were equipped with sensors to measure fluorescence, conductivity, temperature, depth, current velocities, ice thickness, ice velocities, nutrients, pCO_2, abundance of zooplankton and fish, and passive acoustics. During this presentation we will illustrate some of the biophysical and chemical characteristics gained from this unique year-long multidisciplinary data set. Particularly, we focus on under-ice dynamics, cross shelf processes, the influence of the Mackenzie River plume in the eastern Beaufort Sea, the distribution patterns of zooplankton and fish, and the presence of marine mammals.

Connecting the Dots of the Distributed Biological Observatory Through U.S. Arctic Observing Network Benefit Mapping

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The Arctic is experiencing significant system-wide environmental change, in particular across its cornerstone cryospheric features, with cascading impacts on ecosystems and food webs. Timely, reliable, and coherent information on changes, which impact U.S. citizens from Alaska to the mid-Atlantic, are urgently needed by decision makers at all levels. At present, U.S. and international observational assets – critical to tracking these changes - are woefully sparse, lack elements of coordination and integration, need a shared vision about key observing targets, and need to evolve beyond ad hoc support. In response to these challenges, National Oceanic and Atmospheric Administration (NOAA) leadership initiated U.S. AON to work within NOAA, across agencies and with our international partners to advance structured approaches for coordination.

The "Distributed Biological Observatory (DBO)", a key asset in the U.S. Arctic observing system, is a *change detection array* distributed along a latitudinal gradient extending from the northern Bering Sea to the Barrow Arc already contributing critical insights to ecosystem change. DBO sampling is focused on transects centered on locations of high productivity, biodiversity and rates of biological change. Because of the unique, open sampling strategy employed by DBO, data resources and their availability vary from year to year, opening the need for value-added facilitation to support integrating and applying their results. One critical target for such integration and application is the development of a biologically-relevant, Arctic ecosystem-level forecast model.

In response to intrinsic integration and application challenges, U.S. AON has developed a relational mapping methodology to elucidate dependencies between specific observations and the applications they are poised to support. The objectives of such an approach include: 1) clarifying the user base for the observing system and their product/service/information needs; 2) identifying barriers to efficient exploitation of current observing system to meet those needs; and 3) improving readiness for the future observing system (i.e. identifying gaps and needed technological advancements). This presentation will convey some of the lessons learned in the developing evolution of a biologically-relevant, Arctic ecosystem-level forecast model.

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

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Poster Presenter: Thomas Van Pelt

The Synthesis of Arctic Research (SOAR) brought together a multidisciplinary group of Arctic scientists and Alaskan coastal community representatives to explore and integrate information from completed and ongoing marine research in the Pacific Arctic (www.arctic.noaa.gov/soar). SOAR was initiated in 2011 with funding from the Bureau of Ocean Energy Management (BOEM) to increase scientific understanding of the relationships among oceanographic conditions (physics, chemistry, sea ice), benthic organisms, lower trophic pelagic species (forage fish and zooplankton), and higher trophic species (i.e., seabirds, walrus, whales) in the Pacific Arctic. The first phase of the synthesis resulted in a special issue of *Progress in Oceanography* (volume 136) comprised of 17 papers, published in 2015. The second phase of SOAR built upon the initial synthesis with a second special issue comprised of 16 papers, published in 2018 in *Deep-Sea Research Part II* (volume 152). This second special issue is framed by the same three overarching themes— the 'new state' of the Pacific Arctic sector; responses of mid-trophic species; and responses of upper-trophic species. Also included is an introduction paper that uses the "Arctic Marine Pulses" (AMP) model as a structure to overview results of all the special issue papers through the lens of the AMP model's three ecological domains— Seasonal Ice Zone, Marginal, and Riverine Coastal— and also to further explore the utility of the AMP model for integrating biophysical processes in the Pacific Arctic region. Taken together, publication of these 33 papers and related SOAR project activity aims to have met our primary objectives: to (i) increase scientific understanding of the biophysical environment; (ii) enhance capability to predict future conditions; and (iii) effectively transmit findings of the synthesis to local residents, resource managers, science colleagues, and the general public. On behalf of all participating authors and co-authors, we will present synopses of papers appearing in the *Deep-Sea Research Part II* special issue and an overview of SOAR syntheses across the dynamic marine ecosystem of the Pacific Arctic region.

TUESDAY, JANUARY 29, 2019

WAVE 2
BERING SEA & ARCTIC

(7:30 PM TO 9:00 PM)

POSTER PRESENTATIONS: TUESDAY, WAVE 1 7:30PM - 9:00PM
BERING SEA/ALEUTIANS & ARCTIC

TITLE	PRESENTER	SECTION	LOCATION (row & poster)
Effects of the 2016-2017 eruptions of Bogoslof Volcano on at-sea densities of seabirds	Gary Drew, Nora Rojek, John Piatt	Seabirds	
Quantifying the Abundance and Identity of Microplastics in Breeding Birds of the Bering Sea	Jannelle Trowbridge, Veronica Padula, Douglas Causey	Seabirds	R5 , P84
Crescendos in heavy metal: increasing mercury concentrations measured in Steller sea lion pups at Agattu Island, western Aleutian Islands, Alaska	Stephanie Crawford, Todd O'Hara, J. Margaret Castellini, Julie Avery, Brian Fadely, Mandy Keogh, Michael Rehberg, Lorrie Rea	Mammals	R5 , P85
Summer Haul Out Behavior of A Unique Freshwater Population of Harbor Seals (Phoca vitulina) in Iliamna Lake, Alaska	Kathryn Koo, Donna Hauser	Mammals	R5 , P86
Investigation of the Largest Reported Mass Stranding of Stejneger's Beaked Whales: Adak, Alaska (August 2018)	Sadie K. Wright, Lisa Spitler, Marc Webber, Sonia V. Kumar, Matt Haney, Kate Savage	Mammals	
Steller sea lion diet identification from feces using computer vision based on the neural network VGG 16	Ivan Usatov, Vladimir Burkanov, Thomas Gelatt	Mammals	
Drone aerial photography and image processing to monitor northern fur seal (Callorhinus ursinus) abundance on Tuleny Island	Vladimir Burkanov, Ivan Usatov, Thomas Gelatt	Mammals	
Trends in Non-pup Steller Sea Lion (Eumetopias jubatus) Survey Counts in Russian waters, 2002-2017	Vladimir Burkanov, Devin Johnson, Thomas Gelatt	Mammals	
Relationships among blubber depth, body condition, and morphometric measurements in Alaska phocids	Heather Ziel, Brett McClintock, Peter Boveng	Mammals	
Seeing the northern fur seals from the boulders: developing an UAS approach for abundance assessments	Katie Sweeney, Tom Gelatt, Francis Padula, Monica Cook	Mammals	
Establishing an index of habitat quality and reproductive success for the Northern Fur Seal	Greg Merrill, J. Ward Testa, Jennifer Burns	Mammals	R5 , P90
Food habits of sympatric Steller sea lion (Eumetopias jubatus) and northern fur seal (Callorhinus ursinus) populations on Bogoslof Island and the Pribilof Islands, Alaska 1981-2013	Katie Luxa, Tonya Zeppelin, Pamela Lestenkof, William Walker, Rolf Ream	Mammals	R6 , P92
Oxidative stress and glutathione peroxidase in Steller sea lions: Associations with mercury and selenium status.	Marianne Lian, J Margaret Castellini, Thomas Kuhn, Lorrie Rea, Mandy Keogh, Louise Bishop, Brian Fadely, John Maniscalco, Todd O'Hara	Mammals	R6 , P94
Monomethyl mercury (MeHg+) alters adaptive immune functions upon in vitro and in vivo exposure in Steller sea lion (Eumetopias jubatus) pups	Mandy Keogh, Milton Levin, Todd O'Hara, J. Margaret Castellini, Lorrie Rea, John Maniscalco, Brian Fadely, Jean-Pierre Desforges	Mammals	R6 , P96
Local perceptions of marine debris and its impacts on the environment and subsistence resources on St. Paul Island, Alaska	Veronica Padula, Anne Beaudreau	Humans	R6 , P98
Optimizing protocols for preservation, extraction, and PCR amplification of environmental DNA (eDNA) from seawater	Kimberly Andrews, Anna Elz, Dakota Hunt, Carol Stepien	Ecosystem Perspectives	R6 , P100
Spatial and temporal visualizations of satellite-derived sea surface temperatures for Alaska fishery management areas	Jordan Watson	Ecosystem Perspectives	
Implementing a Next Generation Stock Assessment Enterprise in NOAA Fisheries	Patrick Lynch, Richard D. Methot, Jason S. Link, Jane DiCosimo	Ecosystem Perspectives	
Springtime zooplankton communities of the Northern Bering and Southern Chukchi Seas	Caitlin Smoot, Jennifer Questel, Alexandra Poje, Russell Hopcroft	Lower Trophic Levels	R6 , P102
Growth rates of Calanoid Copepods in the northern Bering and southern Chukchi Seas	Alexandra Poje, Caitlin Smoot, Russ Hopcroft	Lower Trophic Levels	R6 , P103

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Observations of Fishes in the U.S. Continental Shelf Region of the Chukchi Sea from Autonomous Vehicles and Moorings	Robert Levine, Alex De Robertis, Christopher Wilson, Daniel Grünbaum, Calvin Mordy, Christian Meinig, Heather Tabisola	Fishes and Fish Habitats	R6 , P104
Accelerated Decline of Summer Arctic Sea Ice during 1850-2017	Jia Wang, Qiongqiong Cai, Dmitry Beletsky, James Overland, Moto Ikeda	Climate and Oceanography	
Model Study of Wind Influences on Summer Chukchi Sea Ice Retreat	Kofan Lu, Seth Danielson, Thomas Weingartner	Climate and Oceanography	R6 , P107
Circulation and water properties of the northeastern Chukchi Sea in summer	Peigen Lin, Robert Pickart, Leah McRaven	Climate and Oceanography	R7 , P109
Alaska Arctic Observatory & Knowledge Hub: Community-based observations of changes in the seasonal cycle in Alaska's Arctic	Joshua Jones, Billy Adams, Donna Hauser, Olivia Lee, Hajo Eicken, Matthew Druckenmiller, Steven Patkotak, Joe Leavitt	Climate and Oceanography	R7 , P111
The Chukchi Sea in a changing environment: A synthesis of modeling and observations	Claudine Hauri, Katherine Hedstrom, Seth Danielson, Andrew McDonnell, Cristina Schultz, Scott Doney	Climate and Oceanography	R7 , P112
Evaluation of dynamically downscaled winds over the central Beaufort Sea	Peter Bieniek, Jeremy Kasper, Li Erikson	Climate and Oceanography	R7 , P114
Can Changes in the Oxygen Isotope Composition of the Bering Sea Contribution to the Arctic Ocean Upper Halocline Provide an Independent Opportunity for Constraining the Freshwater Flux Through Bering Strait?	Lee Cooper, Cédric Magen, Jacqueline Grebmeier	Climate and Oceanography	R7 , P116
Measuring Wave Forces Along Alaska's Coastal Sea Ice	Mark Johnson, Andrew Mahoney	Climate and Oceanography	R7 , P118
Implementation of the World Meteorological Organization (WMO) Arctic Regional Climate Center (ArcRCC)	Renee Tatusko, Shanna Pitter, John Parker	Climate and Oceanography	
Predicting Optimal Growth Temperature of Marine Bacteria using Genetic Signatures of Cold Adaptation	Anais Gentilhomme, Eric Collins	Lower Trophic Levels	R7 , P121
1000 meters under the Beaufort Sea: Exploring Arctic epibenthic assemblages along a depth gradient	Alexandra Ravelo, Bodil Bluhm, Katrin Iken, Nora Foster	Lower Trophic Levels	R7 , P123
Zooplankton production in Arctic coastal lagoons: preliminary results of biological monitoring in Cape Krusenstern National Monument	Alexei Pinchuk, Martin Robards, Beatrice Smith	Lower Trophic Levels	R7 , P125
Identifying sources of essential amino acids to benthic organisms in the Beaufort Sea using stable isotope fingerprinting	Matthew Wooller, Choy Kyungcheol , Audrey Rowe, Arny Blanchard, Katrin Iken, Diane O'Brien	Lower Trophic Levels	R8 , P127
Feeding of Arctic cod (Boreogadus saida) on the Beaufort Sea shelf break	Justin Suca, Carin Ashjian, Sarah Glancy, Christina Hernandez, Michael Lowe, Jennifer Johnson, Stephen Okkonen, Robert Campbell, J. Michael Jech, Joel Llopiz	Fishes and Fish Habitats	R8 , P129
Is it just me, or are there a lot of sculpin in these Arctic lagoons?	John Seigle	Fishes and Fish Habitats	R8 , P130
Overwintering habitat of Arctic cod and Anadromous fishes in the Arctic nearshore	Leandra Sousa, Todd Sformo, Steve Okkonen, Stephane Gauthier	Fishes and Fish Habitats	R8 , P132
Population structure in Arctic cod and hybridization between cold-water adapted Arctic gadids	Robert Wilson, Sarah Sonsthagen, Sandra Talbot, George Sage, Megan Gravley, Damian Menning, Andrew Majewski, Kate Wedemeyer, Philip Lavretsky, R. John Nelson	Fishes and Fish Habitats	

TITLE	PRESENTER	SECTION	LOCATION (row & poster)
Spatial distribution of acoustic backscatter in Arctic nearshore waters surrounding Elson Lagoon, Alaska.	Savannah La Bua, Ron Heintz, Kevin Boswell, Chunyan Li	Fishes and Fish Habitats	
Interannual and decadal-scale variability in nearshore Beaufort Sea fish assemblages	Vanessa von Biela, Sarah Laske, Randy Brown, Kenneth Dunton	Fishes and Fish Habitats	
Drivers of long-term declines in Red-throated Loon abundance on Alaska's Arctic Coastal Plain: marine ecosystem conditions, or environmental contaminants?	Brian Uher-Koch, Joel Schmutz, Sharon Poessel, Vanessa von Biela, Angela Matz, Courtney Amundson, Daniel Rizzolo, Christopher Latty	Seabirds	
Update on Bowehad Whale Entanglement in Fishing/Crab Gear - Scar Acqusition Rates from Aerial Surveys and Scar Frequencies on Harvested Whales	John C. George, Barbara Tudor, Geof Givens, Gay Sheffield, Raphaela Stimmelmayr	Mammals	R8 , P135
Occurrence of Arctic and saffron cod in the diet of ringed seals, 1975–2016	Louise Biderman, Anna Bryan, Justin Crawford, John Citta, Lori Quakenbush	Mammals	R8 , P137
Interannual variability in the acoustic presence of fin whales (Balaenoptera physalus) in relation to environmental conditions in the Bering Strait	Erica Escajeda, Kate Stafford, Rebecca Woodgate, Kristin Laidre	Mammals	R8 , P139
Comparative Analysis of the Excretion of Sex Steroids and Dehydroepiandrosterone (DHEA) in Wild and Zoo Female Polar Bears	Monica Brandhuber, Shannon Atkinson, Erin Curry, Terri Roth	Mammals	R8 , P141
New data on the use of waters of the Okhotsk sea and Pacific Ocean by spotted seal (Phoca largha)	Maria Solovyeva, Dmitry Glazov, Daria Kuznetsova, Vladimir Burkanov, Peter Boveng, Vyacheslav Rozhnov	Mammals	R8 , P142
Ringed seal productivity in Alaska using harvest-based monitoring, 1975–2016	Anna Bryan, Lori Quakenbush, Justin Crawford, Louise Biderman, Ryan Adam	Mammals	R8 , P144
Pacific walrus (Odobenus rosmarus divergens) mortality at northern Chukotka haulouts, 2017	Natalia Kryukova, Maksim Kozlov, Danila Skorobogatov, Andrei Pereverzev, Ivan Krupin, Alexander Shevelev, Sergei Zagrebelny, Vladimir Burkanov, Chadwick Jay	Mammals	R9 , P146
Toxoplasma Gondii seroprevalence in village sled dogs from the North slope, Alaska.	Raphaela Stimmelmayr, Sarah Coburn, Forrest Neakok , Raymond Valencia	Mammals	R9 , P148
Fin and Humpback Whale Occurrence in the South-Central Chukchi Sea, 2014-2018	Amelia Brower, Megan Ferguson, Janet Clarke, Amy Willoughby, Corey Accardo, Lisa Barry, Nicole Brandt Turner, Marjorie Foster, Katie Jackson, Kate Pagan	Mammals	
Further investigation of blow or exhaled breath condensate as a non-invasive tool to monitor the physiological response to stressors in cetaceans	Tonia Osborne, Laura Thompson, Ebru Unal, Tracy Romano	Mammals	R9 , P151
The Use of Unmanned Aircrafts to Assess Pacific Walrus Abundance on Haulouts in Chukotka Peninsula, Russia	Alexey Altukhov, Natalia Kryukova, Danila Skorobogatov, Sergey Zagrebelny, Anatoly Kochnev, Maxim Chakilev, Vladimir Burkanov, Chad Jay	Mammals	R9 , P153
Using an unmanned aircraft system to more precisely estimate walrus abundance on a coastal haulout in NW Alaska	Chadwick Jay, Anthony Fischbach	Mammals	
Preliminary findings on incidence of cataracts in free-ranging ice seals from Northern Alaska	Raphaela Stimmelmayr, Billy Adams, Mike Pederson	Mammals	R9 , P155
Bowhead whales in the western Beaufort Sea, Summer 2012-2018	Janet Clarke, Megan Ferguson, Amelia Brower, Amy Willoughby	Mammals	R9 , P157

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Polar bears, Plastics, and the Pyloric Sphincter: A volatile combination	Raphaela Stimmelmayr, Billy Adams, Carla Kayotuk, Mike Pederson	Mammals	R9 , P159
Polar Bear TEK: A Pilot Study to Inform Polar Bear Management Models	Stephen Braund, Paul Lawrence, Elizabeth Sears, Raena Schraer, Eric Regehr, Billy Adams, Taqulik Hepa, Craig George, Andrew Von Duyke	Humans	R9 , P161
Two plus two equals five: A need for synergies between Traditional Knowledge & Western Science	Andrew L. Von Duyke, Todd L. Sformo, John C "Craig" George, Stephen R. Braund, Paul Lawrence, Rowenna Gryba	Humans	R10 , P163
Quantifying oil migration in sea ice: Timing, role of ice stratigraphy, and potential ice habitat impacts	Marc Oggier, Hajo Eicken, Chris Petrich	Ecosystem Perspectives	R10 , P165
Recent studies of southern Chukchi Sea lagoons	Marguerite Tibbles, Martin Robards, Andrew Seitz	Ecosystem Perspectives	R10 , P167
Evaluating shifts in pelagic-benthic coupling with sea ice biomarkers in the Pacific Arctic	Chelsea Wegner, Lee Cooper, Jacqueline Grebmeier, Thomas Brown	Ecosystem Perspectives	R10 , P169

Effects of the 2016-2017 Eruptions of Bogoslof Volcano on At-sea Densities of Seabirds

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Poster Presenter: Gary Drew

Bogoslof Island, a submarine stratovolcano in the south Bering Sea, began erupting on 12 December 2016. Prior to its eruption, Bogoslof was a colony site for Fork-tailed Storm-petrels (*Oceanodroma furcata*), Glaucous-winged Gulls (*Larus glaucescens*), Kittiwakes *(Rissa spp*.), Murres (*Uria spp*.) and Tufted Puffins (*Fratercula cirrhata*). Additionally, Bogoslof was a rookery site for Steller Sea-lions (*Eumetopias jubatus*) and the only expanding Northern Fur Seal (*Callorhinus ursinus*) rookery in the Bering Sea. Eruptions over the next eight months reshaped the island multiple times, destroying habitat and depositing large quantities of ash and pyroclastic debris and eliminating all vegetation. The timing of the Bogoslof eruptions, beginning before the 2017 nesting season, and continuing until after its end in Aug of 2017, indicated that 2017 was likely a complete nesting failure for all species, but additional mortality due to eruptive events could not be assessed. We were able to be compare pre- and post-eruption at-sea densities by replicating a 2012 survey using transects arranged in a spoke pattern around Bogoslof originally designed to assess Tufted Puffin populations. We found densities for Tufted Puffin and Glaucous-winged Gulls did not show any changes from the pre-eruption survey in 2012; however, Kittiwake spp. densities were lower and Fork-tailed Storm-petrels disappeared completely. Murre spp. were the only species that showed an increase in at-sea densities following the eruption. No fledglings of any species were observed at-sea, though Glaucous-winged gull fledglings were observed on land. The immediate aftermath of the 2016-2017 eruptions has led to a loss of two breeding seasons for seabirds. Despite this impact, to date, only Fork-tailed Storm-petrels and Kittiwakes appear to have decreased their breeding season abundance at Bogoslof.

POSTER WITHDRAWN:
Winter Distribution of Red-legged Kittiwakes from Two Major Breeding Colonies in the Bering Sea

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The red-legged kittiwake (*Rissa brevirostris*) breeds at just a few colonies in the Bering Sea and may be particularly sensitive to changes in the marine environment due to a small population size, limited range, and specialized diet. Population trends at major breeding colonies in Alaska differ and are not easily explained by reproductive parameters measured during the breeding season. A better understanding of where birds are spending the non-breeding season and what conditions they are experiencing there may help explain these demographic differences. We tracked winter movements of red-legged kittiwakes from breeding colonies in the Pribilof and Aleutian Islands using geolocator tags from 2016-2018. Birds were captured at St. George and Buldir islands during the summer breeding season, fitted with leg-band mounted geolocators, and recaptured 1-2 years later to recover the tags. Analysis of light level data provided a daily location for each bird during the study period. Here we present general winter distribution of tagged birds from these colonies and examine patterns of winter movements between colonies. Differences in wintering location may contribute to varying population trends observed at the breeding sites.

Quantifying the Abundance and Identity of Microplastics in Breeding Birds of the Bering Sea

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Plastic fragments are found in all terrestrial, freshwater, and marine ecosystems, extending from the Arctic to Antarctica. A variety of animals including fish, seabirds, turtles, and marine mammals get entangled in plastics or ingest them. In the case of seabirds, they mistake plastic for prey items, or as food to give to their chicks. Ingestion can result in ulcerations, starvation, or death. Large plastic debris is unsightly, but the most problematic is what we cannot see: the “microplastics.” Plastics degrade through exposure to sunlight and the ocean, and quickly become microscopic. Although unseen by us, the microplastics act as sponges and absorb numerous chemical contaminants, particularly endocrine-disrupting compounds like phthalates, PCBs, and other persistent organic pollutants (POPs). Microplastics can pass through a bird’s stomach and intestine, where chemicals leach off these particles and get incorporated into the animal’s tissue. These effects may be exacerbated in humans through personal and subsistence harvest of these marine organisms, particularly of top-level members of the coastal foodweb--such as salmon and egg harvests.

The majority of studies that have examined microplastics and nanoplastics have identified them visually, either by eye or under a microscope. The problem with identifying microplastics only visually is multifold. Many microplastics, especially in sediment, are covered in a biofilm and resemble biotic material, and can thus be underestimated when being visually sorted. We report here the further results of using advanced UV and IR autofluorescence techniques to characterize the composition and abundance of microplastics in stomach samples and body tissues. We also test the significance of the type of plastics and their association with detectable presence of immunocompromising chemicals.

Crescendos in Heavy Metal: Increasing Mercury Concentrations Measured in Steller Sea Lion Pups at Agattu Island, Western Aleutian Islands, Alaska

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While the precipitous decline of Steller sea lion (*Eumetopias jubatus*) populations described during the latter portion of the last century ceased over most of their U.S. range, rookeries in the western Aleutian Islands continue to decline. Mercury, a heavy metal, in methylated forms has documented neurotoxic effects and potential impacts to reproduction in piscivorous mammals, has been noted at relatively high concentrations in some species foraging in this coastal marine ecosystems.Lanugo (natal fur) samples collected from young pups born on Agattu Island in June of 2011, 2012, 2013, 2015, and 2017 (n=241, all years) were analyzed for total mercury concentration ([THg]).Since lanugo is grown in utero, [THg] reflects the dam's diet during late gestation. Yearly medians (± SD) of [THg] for sample years 2011-17 were, in chronological order: 8.005 ± 2.110 ug/g, 6.567 ± 1.723 ug/g, 11.955 ± 1.690 ug/g, 13.448 ± 1.690 ug/g, and 16.195 ± 2.050 ug/g.Lower medians of [THg] were observed in the earlier years in this study: median [THg] from 2015 was significantly different from 2011 and 2012 ($p=0.013$), while 2017 was significantly different than 2011, 2012, and 2013 ($p=0.004$). Overall, a broad range of lanugo [THg] were found in pups born at Agattu Island:2.55 – 73.74 ug/g. Individuals with [THg] > 20 ug/g (concentration where clinical signs and/or adverse effects have been observed in other studies of piscivorous mammals) were of particular interest.We found a marked increase in the percentage of pups with [THg] above this threshold between the earlier (2011-2013) and recent (2015, 2017) years, doubling from approximately 20% to 40%. This pace of change is concerning and encourages further investigation focused on understanding the pathways of mercury transfer throughout the food web.

Summer Haul Out Behavior of a Unique Freshwater Population of Harbor Seals (*Phoca vitulina*) in Iliamna Lake, Alaska

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Harbor seals (*Phoca vitulina*) in Iliamna Lake, Alaska are a unique population of harbor seals which reside in fresh water year-round, but little is known about them. Information on population size is critical for management of a population and understanding what effects a population may have on fisheries, as well its conservation. This information is especially important for the Iliamna harbor seals because they are a small, data-limited population. It is essential to know when it is expected to see the maximum number of seals hauled out and how environmental conditions affect haul out patterns because population estimates are often based on aerial survey counts of seals hauled out on land. Time lapse camera traps were set up on two known haul out sites in eastern Iliamna Lake during July and August of 2015 to compare numbers of seals hauled out relative to several environmental predictor variables, including day of year, time of day, air temperature, wind speed, wind direction, and sky condition. The highest numbers of seals (maximum=153 seals) were observed on the primary haul out site, most frequently during the evening; while on the secondary haul out site seals were most frequently observed during midday. While numbers of hauled out seals remained consistently high (>50 seals) from late July to early August at the primary haul out site, there was a substantial decline in the number of hauled out seals at the secondary site by early August. Seals generally tended to prefer warmer air temperatures and clear or partly cloudy skies. During conditions of extreme wind speeds (> 30 km/h) fewer seals were on land. Seals were able to find protection from most wind directions at available haul out areas, though the extent of protection varied between the two sites. Information on harbor seal haul out patterns and ideal conditions at haul out sites in Iliamna Lake could improve the accuracy of population estimates and the ecological understanding of the population, especially if used in conjunction with data from individually tagged harbor seals.

Investigation of the Largest Reported Mass Stranding of Stejneger's Beaked Whales: Adak, Alaska (August 2018)

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On August 3, 2018, the National Marine Fisheries Service (NMFS) was notified of a dead beaked whale beached near the town of Adak in the Aleutian Islands, with photos identifying the carcass as an adult female Stejneger's beaked whale (*Mesoplodon stejnegeri*). On August 8, seven more dead beaked whales, also identified as adult female Stejneger's, were observed 1-2 miles from the first beaked whale. As part of its responsibilities under the Marine Mammal Health and Stranding Program established under Title IV of the Marine Mammal Protection Act, NMFS coordinated a response that included partners from the U.S. Fish and Wildlife Service and Alaska Veterinary Pathology Services. Together, these partners conducted necropsies of the carcasses during August 12-14. All carcasses appeared to be in a similar state of decomposition. The animals generally appeared to be in good condition at time of death, and analyses of samples are currently being conducted to search for disease, contaminants, algal toxins, diet, or other potential fitness issues that might elucidate the cause of death. NMFS is also working with partners to try to determine the source of anthropogenic seismic activity that occurred near Adak in advance of this mass stranding event. While it may not be possible to draw a causal link between the seismic activity and the death of the beaked whales, it may be indicative of unauthorized or poorly understood acoustic stressors occurring in the region and impacting marine mammals.

Steller Sea Lion Diet Identification from Feces Using Computer Vision Based on the Neural Network VGG 16

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The traditional method for identifying Steller sea lion (SSL) diet in the past has been the analysis of undigested solid remans extracted from feces or spews. Identification of fish, otoliths, and cephalopod beaks in varying degrees of digestion is a time consuming and expensive process requiring experienced biologists and can include errors which are extremely difficult to identify. Therefore, we tested the feasibility of a neural network-based computer vision test for identifying undigested diet items from a sample of Steller sea lion feces which were previously identified by experts. we examined 19 types of bones and otoliths from 13 species of fish y recovered from SSL scats and precisely identified. Each prey item was placed on a black background and photographed in different projections through a microscope with a +10-15 magnification. We obtained 1,513 photographs. To identify undigested diet parts, we used the neural network model VGG 16 which was previously trained on ImageNet data containing 1.4 million images of animals and plants. The model was trained on 1,469 photographs with various undigested food residues. The training was conducted using R environment with the 'keras' package. The teaching accuracy the model at 60 eras was 99%. Due to the relatively small number of photos, we did not use model validation. We conducted a test of 44 SSL diet object images which were not involved in the training process but were known to contain the same species and type of undigested diet items on which the neural network was trained. The model identified the fish remains with an accuracy of 100%. The main problem in using computer vision to identify fish bones was to obtain a sufficiently large number of photographs of different types of undigested food items at various stages of digestion from all potential SSL diet species. It is very important that they are precisely identified. The results of our test showed that modern models of computer vision are able to identify the remains of fish bones and otoliths with high accuracy. The use of neural networks has the potential to significantly improve the accuracy and efficiency of identifying undigested diet items from feces or spews and ultimately reduce the costs.

Drone Aerial Photography and Image Processing to Monitor Northern Fur Seal (*Callorhinus ursinus*) Abundance on Tuleny Island

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Visual counts by age and sex during the breeding season and pup abundance estimates are the principal method to monitor northern fur seal (NFS) abundance. NFS form dense aggregations on rugged coasts which make visual surveys laborious and difficult to verify. In 2018, we tested the UAV DJI Phantom 4 PRO for aerial photography of the NFS rookery at Tuleny Island to count seals. Surveys were carried out for 66 days from June 3 to August 7; however weather and logistics allowed aerial photography on only 43 days (65%). Restrictions for flight were wind over 8 m/s and rain. The flight technique for counting pups and non-pups was different. Surveys for non-pups were conducted at 25 m altitude with flight speed 3 m/s and shooting interval 1 frame/ 2 seconds which provided 70% overlap of the photographs. Surveys occurred from 8am to 11am while cool air temperature and the majority of NFS were on shore. The drone software application (Litchi) was used to fly the drone and shoot photographs; all surveys were flown with the same flight pattern in automated mode. To photograph the entire island, two flights were required with a total duration of 30 min which yielded 850-900 images. Flights for pup counts were carried out on July 25, 27 and 30 (four surveys total) in sunny hot weather when most of the non-pups were in the water. The drone was flown in manual and automatic mode at an altitude 16-21 m. For each survey, approximately 1,400 photographs were taken. All images were processed using Agisoft Photoscan software into a single orthophotoplan, which was used to place mark for each NSF age-sex category into separate layers. In 2018 the maximum number of non-pups was observed on July 12 when 32,297 were counted of which 75% were females. A total of 40,438±24 (n=4) live and 1,337±19 dead pups were counted at the end of breeding season. The results obtained from aerial photographs are comparable with visual counts performed in previous years, which makes UAV aerial survey method useful and recommended for NFS rookery surveys.

Trends in Non-pup Steller Sea Lion (*Eumetopias jubatus*) Survey Counts in Russian Waters, 2002-2017

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The Steller sea lion (Eumetopias jubatus, SSL) is widespread in the Russian Far East (RFE). Therefore, monitoring of its abundance throughout the region requires significant funding and logistic efforts. This is especially important for surveys of non-pup SSL because their haulouts scattered in a vast area from the Bering Strait to the Sea of Japan. To monitor the abundance of Steller sea lion a six geographically separated regions were identified in RFE, which were surveyed more or less regularly in 2002-2017. During each survey, we intended to visit all known SSL sites, but this was not always possible. In such cases, the calculated data were used to estimate the total abundance for missing sites, the whole region, and entire RFE. To simulate the data, a similar approach was used to estimate the trend in the abundance of non-pup SSL in Alaska and the 'agTrend' package for R with some modifications. A total 48 regional population estimates were obtained (from 4 to 15 estimates/region). The total number of young and adult Steller sea lions on rovers of the FER over the 15 years has decreased from about 17.3 thousand to 13.7 thousand individuals (-21%; 95% CI -38%, -1%). In different areas, the trends were different. The positive trend was observed in two of the six regions of the RFE they are Sakhalin with average annual trend 0.9% (95% CI -2.3, + 5.4), and similar 0.9% (95% CI -2.0, +4.0) in the Sea of Okhotsk. In the Kuril Islands the trend was -4.1% (95% CI -5.4, -2.8), in Kamchatka -0.8% (95% CI -3.0, +1, 4), in the Commander Islands -0.6% (95% CI -2.6, +1.2), and in the western Bering Sea -1.1% (95% CI -16.1, +10.2). The total number of young and adult Steller sea lions in the RFE significantly decreased with the level of approximately 1.3% per year (95% CI -2.6, -0.1). The reduction is mainly due to a decrease in the number of animals in the Kuril Islands (especially in 2015), traditionally the most abundant SSL habitat along the Asian coast.

Relationships Among Blubber Depth, Body Condition, and Morphometric Measurements in Alaska Phocids

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In marine mammals, the blubber layer is a critical adaptation to surviving in the aquatic environment. It is particularly important for phocid seals because it serves as their primary method of thermoregulation and source of energy when feeding is reduced during key life history events (e.g. pupping, breeding, molting). Blubber content has been used as an indicator of body condition in phocid seals, but measures of body condition based on blubber content in Alaska phocids are limited and primarily from harvested rather than live-captured animals. Obtaining current information about body condition of Alaska phocids is essential, as these populations may be particularly vulnerable to a warming climate and diminishing ice habitat. We used an ultrasound machine to measure blubber depths at four different sites on the body from ribbon, spotted, and harbor seals in Alaska, during capture studies in 2010 and 2014-2018. Using linear regression, we modeled body condition (mass/standard length) and morphometric measurements as a function of blubber depth. Across species, body condition ($F_{9,170}=185.4$, $p<.001$; adjusted $R^2=0.90$), axillary girth ($F_{9,170}=193.0$, $p<.001$; adjusted $R^2=0.91$), and hip girth ($F_{9,170}=122.6$, $p<.001$; adjusted $R^2=0.86$) all were well explained by sex, age class, blubber depth, and year. All three measurements were highest in adult males and lowest in female pups. The best blubber depth predictors for body condition, axillary girth, and hip girth were at the right lateral hip, the dorsal axillary, and the right lateral hip, respectively. Body condition decreased by year, and axillary girth was lowest in 2018 and highest in 2015. For spotted seals only, hip girth was significantly lower in 2018, and spotted seals had greater hip girths than ribbon or harbor seals. We also ran these analyses for only spotted seal pups and YOY from 2014, 2016, and 2018. Body condition for spotted seal pups decreased significantly by year, and both hip and axillary girths were lowest in 2018. As expected, we found blubber depth was positively related to both body condition and morphometric measurements; therefore, it can be a useful predictor of condition, which will be valuable in assessing potential effects of changing environmental conditions for these species.

Seeing the Northern Fur Seals from the Boulders: Developing an UAS Approach for Abundance Assessments

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In 1963, NOAA Fisheres' Marine Mammal Laboratory (MML) began to use the mark-recapture method of shear-sampling northern fur seal pups to estimate pup abundance. Presently, these surveys are conducted biennually on St. Paul and St. George Island (Pribilof Islands, Alaska) and require up to 22 people over the course of 2 and 3 weeks to conduct the surveys on each island. The presence of scientists on the rookery creates some disturbance which is authorized by a Federal permit (NMFS/MMPA 14327 and IACUC ANW2013-3). MML began to use unoccupied aircraft system (UAS; i.e., drones) to augment Steller sea lion surveys in 2014 and have been working towards developing an UAS-based method for northern fur seal abundance surveys. The greatest challenge we experienced with preliminary efforts using high resolution visual imagery is identifying individual northern fur seals from the background. In the summer of 2018, we collected spectral measurements of northern fur seals and the background (rocks, grass, gravel, etc.) with an ASD FieldSpec 3 Spectroradiometer on St. George Island. These ground measurements will be used in modeling and simulation to assess whether multi-spectral imaging (0.35 to 2.25 µm or visible to shortwave infrared spectral region) is feasible for distinguishing northern fur seals from the background. If feasible, these methods will guide sensor and band selection requirements to optimize UAS surveys. MML also used a heavy-lift hexacopter (APH-28) to conduct multiple UAS surveys of a small fur seal rookery with a FLIR DUO Pro R thermal sensor (with lower resolution visual imaging capabilities). UAS surveys were also conducted with a higher resolution mirrorless digital camera to provide a comparison of count estimates from the three types of imagery to estimates from the traditional shear-sampling method. Preliminary data indicates that northern fur seals could be easily distinguished from the background using thermal imagery and spectral signatures appear distinct between northern fur seals and a majority of the background signatures. Assessing optimal imaging capabilities will guide sensor selection and then MML can explore which UAS platforms would be most effective for surveys in hopes of eventually replacing and improving upon the current method.

Establishing an Index of Habitat Quality and Reproductive Success for the Northern Fur Seal

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Northern fur seals (NFS; *Callorhinus ursinus*) support lactation using a central place foraging strategy, alternating foraging trips to sea with shore visits to nurse pups. Prey abundance/availability influence trip duration. The frequency and length of shore-stays influences the rate and amount of milk pups receive. Pup mass, influenced by these factors, is positively correlated with post-weaning survival. Overall, the NFS population on the Pribilof Islands, AK, has declined ~3.5% annually for the past two decades. However, despite continued decline on St Paul Island (SNP), pup production increased ~27% on St George Island (STG) between 2012 – 2016. Maternal females forage in colony-specific areas at sea, each characterized by a distinct prey availability that may explain the inter-island variation in pup production. We hypothesized that the variability in maternal foraging trip durations (MFTD) could provide an index of offshore habitat quality and explain known differences in pup mass; the objective was therefore to identify correlative relationships between colony-averaged MFTD and pup mass between seasons.

Between 2010-2017, the attendance patterns of 239 maternal females were monitored throughout the lactation period using VHF radio transmitters at six Pribilof Island colonies. Additionally, interannual variability in the relationship between MFTD and pup mass was assessed for females at Polovina Cliffs, a SNP colony. Likelihood ratio tests identified factors influencing the variability observed in the colony-averaged MFTD (Colony, Year, & Julian Day; $P <<< 0.01$). Colony average MFTD were longer for SNP females than STG ($P <<< 0.01$). For Polovina Cliffs, there was a negative correlation between average MFTD and average female pup mass ($P = 0.035$, $r^2 = 0.62$), whereby pups lost 0.89kg mass per day mom spent foraging. Regional and temporal variability in colony-average MFTD was consistent with trends in oceanographic environment, pup mass, and pup production. Record-breaking warm ocean temperatures corresponded to decreased biomass of important NFS prey species. Subsequently, MFTD increased and pup mass decreased and corresponded to the observed decrease in pup production on SNP. Interannual and regional correlations between colony-averaged MFTD and pup mass suggests that population-level metrics can be used as a sensitive indicator of habitat quality and reproductive success.

Food Habits of Sympatric Steller Sea Lion (*Eumetopias jubatus*) and Northern Fur Seal (*Callorhinus ursinus*) Populations on Bogoslof Island and the Pribilof Islands, Alaska 1981-2013

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Competition for common resources shapes the distribution, abundance, and behavior of similar species in ecological communities. Competing species must exploit their environment in different ways to successfully coexist, e.g., spatial and temporal segregation of foraging areas or targeting of different prey species. In Alaska, Steller sea lions (*Eumetopias jubatus*; SSL) and northern fur seals (*Callorhinus ursinus*; NFS) co-occur on Bogoslof Island and the Pribilof Islands. Following significant population declines, SSL in the eastern Aleutian Islands and Bering Sea region have increased gradually since the early 2000s and Bogoslof Island NFS have grown exponentially; however, NFS on the Pribilof Islands continue to decline. The extent to which their population trajectories are influenced by prey availability, selection, or competition between the sympatric populations, is unknown. We analyzed hard prey remains (e.g., fish bones and otoliths, cephalopod beaks) from > 9,000 scat and > 700 spew samples that were collected opportunistically between May and October 1981-2013 at SSL and NFS sites on Bogoslof Island and the Pribilof Islands. Based on the timing and locations of collections, we assume the samples are primarily from adult females, but also some juvenile females and males. Although SSL and NFS diets at each location were comprised of many of the same species, differences in relative proportions suggest that the predators partition prey resources spatially. SSL consumed a diverse suite of epipelagic and epibenthic taxa: walleye pollock (*Gadus chalcogrammus*), salmon (*Oncorhynchus* sp.), and gonatid squid (all > 20% frequency of occurrence) on Bogoslof Island, and rock sole (*Lepidopsetta* sp.), walleye pollock, Irish lord (*Hemilepidotus* sp.), and Pacific cod (*Gadus microcephalus*; all > 35%) on the Pribilof Islands. In contrast, NFS diet was dominated by prey which concentrate in the epipelagic zone at night, including northern smoothtongue (*Leuroglossus schmidti*) and gonatid squid (each > 65% frequency of occurrence) on Bogoslof Island and walleye pollock (approximately 70%) on the Pribilof Islands. Additionally, NFS appear to select smaller (mostly age 0-1) walleye pollock than SSL, although SSL prey size data were limited. These results provide valuable insights into the foraging strategies and competition among sympatric predators with differing population trends.

Oxidative Stress and Glutathione Peroxidase in Steller Sea Lions: Associations with Mercury and Selenium Status

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Neurotoxicity of monomethyl mercury ($MeHg^+$), likely caused by oxidative stress, is countered by selenium (Se) via numerous direct binding and antioxidant mechanisms. Increased oxidative stress is associated with a wide range of degenerative diseases, increased morbidity, and decreased longevity. In the Steller sea lion (*Eumetopias jubatus,* SSL), one third of the sampled pups in the central and western Aleutian Islands have total Hg concentrations ([THg]) in hair above levels of concern (>20 µg/g) for increased risk of fetal neurological effects. The marine diet of pinnipeds supports high levels of systemic Se, and relatively high levels of antioxidants as an adaptation to reperfusion injury subsequent to long term dives (hypoxia). However, relatively low molar ratios of TSe:THg are documented for some SSL pups with relatively high [THg] (possible Hg dependent Se deficiency), leading to a possible overall antioxidant deficiency. Pinnipeds may experience similar oxygen- and oxidative-dependent physiological challenges during capture and anesthesia as occurs during diving, including oxidative stress. We captured and anesthetized newborn SSL pups at Agattu, Ulak, Ugamak (Aleutian Islands) and Chiswell (Gulf of Alaska) Islands, to assess the interactions between [THg] and [TSe] and the oxidative stress response in these four groups of SSL with documented relatively high to low [THg]. All animals were anesthetized with isoflurane and 100% oxygen via a facial mask. EDTA whole blood was collected from the caudal-gluteal plexus. Blood samples for biomarkers of lipid (4-HNE and TBARS) and protein (protein carbonyl content) peroxidation were processed on the rookery and plasma frozen immediately on dry ice. Samples for [THg], [TSe] and the TSe:THg molar ratio were kept chilled until processed on the ship. The Se-dependent antioxidant glutathione peroxidase (GPx) was analyzed from intra-erythrocyte content. Here we present data showing associations between animals with relatively high and low [THg], varying TSe:THg molar ratios, GPx levels, and oxidative damage. These results may elucidate how the populations in the western Aleutian Islands are affected by relatively high mercury exposure relative to a key antioxidant.

Monomethyl Mercury (MeHg+) Alters Adaptive Immune Functions Upon *In-vitro* and *In-vivo* Exposure in Steller sea lion (*Eumetopias jubatus*) Pups

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Steller sea lions (*Eumetopias jubatus*, SSL) underwent a population decline of 50-80% prior to being listed under the U.S. Endangered Species Act in 1990 and are managed as two (eastern and western) distinct population segments (DPS). The western DPS declined until 2000 and has since shown regional variability in trends with declines continuing in the western-central Aleutian Islands. The causes of the population decline, and slow recovery for the western DPS remain unknown but environmental contaminants have been hypothesized as a contributing factor. Mercury concentrations in tissues collected from young SSLs in the Aleutian Islands were above concentrations found to negatively impact health in seals and other fish-eating mammals. However, mercury concentrations that may negatively influence the immune system of SSLs are uncertain. We assessed the relationships between monomethyl mercury ($MeHg^+$) concentrations and changes in lymphocyte proliferation for *in vivo* and *in vitro* exposure. Blood was collected from SSL pups (F=42, M=33) from 5 rookeries within the wDPS in 2016 and 2017. Samples were used to determine complete blood cell counts, cytokine and $MeHg^+$ concentrations, and isolation of peripheral blood mononuclear cells (PBMC). $MeHg^+$ in blood ranged from 0.0040 ppm to 0.3578 (mean +/- sd of 0.0543 ± 0.0606 ppm; n=75). PBMCs collected from pups in 2016 were exposed *in vitro* to increasing concentrations of $MeHg^+$ (0-unexposed control, 0.001, 0.01, 0.1, 1, and 10 ppm $MeHg^+$), and lymphocyte proliferation was measured after stimulation with a T cell mitogen. A positive correlation was found betweenT cell proliferation and blood $MeHg^+$ concentrations. Upon *in vitro* exposure, lymphocyte proliferation (without mitogen) increased at 0.01 and 0.1 µg/ml $MeHg^+$ ($p<0.039$). Using ConA, T cell proliferation increased at 0.01 ppm but decreased with *in vitro* exposure at 1 ppm ($p=0.0056$). These data suggest that current concentrations of $MeHg^+$ in SSL pup blood induced T lymphocyte proliferation, a result supported by our *in vitro* exposure experiments. Any significant modulations of immune functions, whether an increase or decrease, may potentially increase susceptibility to infectious pathogens and other immune-based pathologies and dysfunction. Analysis of samples collected in 2017 are underway and will also include a B cell mitogen.

Local Perceptions of Marine Debris and Its Impacts on the Environment and Subsistence Resources on St. Paul Island, Alaska

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Poster Presenter: Veronica Padula

Marine debris pollution poses a large threat to ocean ecosystems and resource-dependent coastal communities. Island and coastal communities in Alaska are particularly susceptible to this form of pollution, accumulating large amounts of marine debris on their shorelines. These communities are often left with the responsibility of cleaning up the debris, which often originated far from the community itself. While many organizations participate in marine debris cleanups and research on marine debris in coastal communities, they have only more recently begun collecting standardized data tracking weights and types of marine debris collected. This leaves a considerable gap in knowledge of trends in abundance and distribution of marine debris over time, as well as gaps in geographic coverage, as many sites are inaccessible for cleanups. This project aims to document St. Paul Island community members' historical and current observations of marine debris on and around St. Paul Island using semi-structured interviews to build a better understanding of marine debris impacts on the environment. We present preliminary findings about people's observations of marine debris trends over time and their perceptions of the impacts of different types of plastic materials on the St. Paul community and the environment. Through this work, we will be able to identify marine debris accumulation sites not previously known (i.e. derelict fishing gear under water at fishing grounds), create more in-depth action plans to tackle marine debris with distant origins and improve educational materials to further community-wide understanding of marine debris. The educational materials will aim to reduce plastic use within the community, as plastic waste that originates locally is also susceptible to becoming marine debris, whether on St. Paul Island's shorelines or on distant shorelines.

Optimizing Protocols for Preservation, Extraction, and PCR Amplification of Environmental DNA (eDNA) from Seawater

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Environmental DNA (eDNA) shed into water from the waste, mucus, and cells of organisms is becoming popular to sample and analyze due to its efficiency, and sometimes accuracy, over traditional methods. eDNA can provide valuable information regarding the presence and relative abundance of target species (i.e., quantitative (q) PCR) and additionally be used to identify and quantify the various members of entire biological communities (using targeted high-throughput sequencing assays). For example, in Alaskan waters, eDNA assays may be used to assess the distribution and abundance of important fisheries species and their prey. However, working with eDNA samples is challenging due to the quantity and quality of eDNA and the presence of PCR inhibitors in some samples. These challenges have begun to be addressed for freshwater systems, but comparable studies for marine systems largely are lacking. Here we compare the performance of two sample preservation methods (95% ethanol and Longmire's buffer), two extraction methods (chloroform and phenol chloroform), two PCR inhibitor cleanup methods (Zymo OneStep PCR inhibitor removal kit and sodium acetate precipitation), and two Taq polymerases (Promega GoTaq Flexi DNA Polymerase and Qiagen AllTaq) after various preservation time lengths (3 days, 16 days, 35 days) for eDNA analyses in marine samples. We discerned clear performance differences across methods, with the optimal performance obtained using ethanol preservation, chloroform extraction, Zymo cleanup kit, and AllTaq. These results have strong utility for the design and implementation of effective marine eDNA studies.

Spatial and Temporal Visualizations of Satellite-derived Sea Surface Temperatures for Alaska Fishery Management Areas

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Poster Presenter: Jordan Watson

A common pursuit in fisheries research is to understand the relationship between fisheries data and the surrounding environment. However, environmental data are often unavailable at similar scales as fishery data. To mitigate this disconnect, more than 5,000 daily satellite datasets (containing > 23 billion individual temperature records) from 2003 – 2018 were rectified with spatial fisheries management areas to facilitate a smoother linkage between satellite-derived sea surface temperatures and the spatial management units often used by state and federal scientists in Alaska. Visualizations of these data help users to explore the spatial (e.g., state and federal management grids) and temporal (e.g., daily, weekly, monthly) scales of the data and allow users to filter, download, and visualize trends. These data have also been linked to fishery landings data within the AKFIN system to create a seamless connection between temperature and fishery data.

Implementing a Next Generation Stock Assessment Enterprise in NOAA Fisheries

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In 2001, NOAA Fisheries published the Stock Assessment Improvement Plan, a strategic document that guided the advancement of stock assessments in the U.S. over the past 15 years. This document provided a basis for regular funding increases for stock assessments, which translated into expanded data collection programs, increases in assessment capacity, and investments in research, education, training, and cooperative programs. As a result, there has been a notable increase in the quantity and quality of stock assessments that directly support successfully and sustainably managed U.S. fisheries. NOAA Fisheries has now developed a new Stock Assessment Improvement Plan that builds upon decades of research and development, as well as current stock assessment capacity, to address the challenges facing NOAA's stock assessment programs today. There are three important focal elements of this new Plan: 1) striving for a more holistic approach to stock assessments with increased consideration of ecosystem and socioeconomic factors; 2) better use of innovative science, including advanced sampling and assessment techniques; and 3) establishing a stock assessment process that is more timely, efficient, and effective. These objectives will only be achieved through strong collaborations throughout the stock assessment and fishery management communities to evolve long-standing approaches and achieve more interdisciplinary research and development for stock assessments.

Springtime Zooplankton Communities of the Northern Bering and Southern Chukchi Seas

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Knowledge of summer zooplankton communities of the Bering and Chukchi Seas has expanded greatly over the past decade as a result of several multi-year field campaigns. However, observations of these communities outside of summer months remain relatively scarce. Springtime data collected as part of the Arctic Shelf Growth, Advection, Respiration and Deposition (ASGARD) project during 2017 and 2018 help fill this gap for the northern Bering and southern Chukchi Seas. Here we present information on the zooplankton communities collected with 150 µm vertically-hauled nets. Copepods generally dominated abundance and biomass; dominant taxa in both 2017 and 2018 included *Oithona similis*, *Pseudocalanus* spp., and *Calanus* spp., with greater contributions of more neritic species near the coast. Species composition was similar to summer surveys in the region; however, we observed a relatively higher proportion of male calanoid copepods, and surprising contributions by Pacific-affinity copepods. Dominant non-copepods included various meroplanktonic taxa, the arrow-worm *Parasagitta elegans*, and several species of larvaceans of both Arctic and Pacific affinity. These results shed light onto poorly-known phenological progression of zooplankton communities, and provide context for the process and rate-oriented studies that were conducted concurrently during the ASGARD cruises.

Growth Rates of Calanoid Copepods in the Northern Bering and Southern Chukchi Seas

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Calanoid copepods are a key component of secondary production in pelagic marine habitats; therefore, determining their growth rates aids in our understanding of the fundamental dynamics of these ecosystems. Artificial cohort experiments were conducted during June 2017 (9 stations) and June 2018 (10 stations) in the northern Bering and southern Chukchi Seas to determine growth rates of dominant copepod species. Size fractioned plankton samples were incubated for 10 days, and then examined to determine changes in size and copepodite stage. The incubations averaged ~4°C over a wide range of chlorophyll concentrations. *Calanus* spp. and *Pseudocalanus* spp. were numerous enough at all copepodite stages to determine growth rates. Weight-specific growth rates for *Calanus* were estimated to be between 2 and 15% day^{-1}, and were typically half of that for *Pseudocalanus* spp., with growth rates decreasing with increasing copepodite size. These estimates compare favorably to estimates made for the Gulf of Alaska, but differ notably from those predicted using the Hirst equations. Clearly, direct rate measurements are still essential to understand production dynamics in high latitudes.

Observations of Fishes in the U.S. Continental Shelf Region of the Chukchi Sea from Autonomous Vehicles and Moorings

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Acoustic-Trawl (AT) surveys conducted in 2012, 2013, and 2017 in the Chukchi Sea determined that pelagic fishes were dominated by large numbers of age-0 Arctic cod (*Boreogadus saida*). These and other surveys suggest that adults are comparatively scarce. Thus, survivorship of age-0 Arctic cod is either very low or these juvenile Arctic cod emigrate to other areas as they grow. In 2017, acoustic backscatter attributed to Arctic cod was higher than observed in 2012 and 2013, though it is unknown if this observation is anomalous or part of a trend. The 2017 survey was part of the Arctic Integrated Ecosystem Research Program (AIERP), which will repeat the AT survey in summer 2019. However, no AT surveys were planned for summer 2018. To determine the distribution of pelagic fishes during the 2018 gap year, two autonomous Saildrone vehicles equipped with echosounders conducted an acoustic survey of fishes on the Chukchi Sea shelf. The Saildrones completed two passes of the AIERP survey region; the first from mid-July to mid-August, and the second from late-August to mid-September. Data from the Saildrones showed low fish abundance in areas of low surface water temperatures resulting from recent ice melt. Multiple surveys of a subset of transects in the northeast Chukchi Sea indicated that fish populations moved from onshore to offshore areas over the course of the summer. To describe longer-term (seasonal) changes in abundance and track movement patterns of individual Arctic cod to understand the role of the Chukchi as a nursery for this species, two bottom-moored echosounders collected acoustic observations of the water column from August 2017 to August 2018. Observations from the moorings indicated that fish abundance in the Chukchi Sea decreased considerably with the formation of sea ice in the northeast surveyed area, and backscatter in August 2018 did not return to the high levels observed in 2017. Together, these autonomous systems provide novel data to describe the distribution of fishes in the region and to investigate the fate of the relatively high numbers of juvenile Arctic cod present in the Chukchi in late summer.

Accelerated Decline of Summer Arctic Sea Ice During 1850-2017

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The 168-year trends of summer (July-September) sea ice area (SIA) variations in six Arctic regions during 1850-2017 are presented and analyzed. The negative trends of Arctic SIA since 1850 were significantly accelerated. The rate of retreat for the period of 1948-2017 is accelerated multi-fold. For the last nearly four decades since 1979, all Arctic regions except for Greenland Sea were experiencing the highest reduction rate. The key drivers of the accelerated summer SIA decline in the Arctic are the combination of global warming and internal variability of climate system particularly on the multidecadal timescales, which lead to Arctic temperature amplification and anomalous atmospheric and oceanic circulation patterns over the pan Arctic. These thermodynamical and dynamical factors directly and indirectly accelerate the positive ice/ocean albedo feedback loop/cycle.

Model Study of Wind Influences on Summer Chukchi Sea Ice Retreat

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In summer, the warm, moderately salty Bering Sea Water (BSW) intrusions derived from the Bering Strait inflow provide an oceanic heat flux to the Chukchi Sea ice cover that is comparable to the atmospheric heat flux and thus influences the sea ice distribution on the Chukchi shelf. The wind is another important factor that can enhance the oceanic heat flux and/or directly advects ice over the shelf. Our model study integrated a set of ice models under wind conditions using the Regional Ocean Modeling Systems (ROMS) to show that ice conditions are extremely sensitive to the wind directions either by advecting ice or enhancing the ocean-to-ice heat flux associated with BSW, especially beneath the ice. Intra-pycnocline eddies induced by BSW are significantly strengthened by wind stress. Winds enhance the ocean eddy kinetic energy and promote a large sub-surface heat flux vertically from the BSW to the surface melt water layer. The increased vertical heat flux arises because the winds weaken the ocean stratification. Wind-induced horizontal convergence and divergence at the ice edge affects the BSW/meltwater frontal stratification and causes variations in the oceanic heat flux transported by Bering Strait inflow.

Circulation and Water Properties of the Northeastern Chukchi Sea in Summer

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Shipboard measurements spanning a 37-year period are used to characterize the general hydrographic structure and circulation patterns in the northeastern Chukchi Sea during summer, including the effects on the distribution of nutrients. The data come from eight synoptic surveys of the region from 2003-2017, which include velocity measurements, and from the Pacific Marine Arctic Regional Synthesis (PacMARS) historical data base from 1981-2013. We track the spreading of both Pacific summer waters and Pacific winter water as they progress northward from Bering Strait into Barrow Canyon over the summer months. Using the vessel-mounted acoustic Doppler current profiler data, a background circulation pattern is deduced in the absence of wind-forcing. This is contrasted to conditions when there are strong northeasterly winds, which fundamentally alters the background flow. Nitrate concentrations are generally higher on the southeastern side of Hanna Shoal due to the character of the Pacific winter water there. This helps explain the enhanced biological activity observed in this region.

Alaska Arctic Observatory & Knowledge Hub: Community-based Observations of Changes in the Seasonal Cycle in Alaska's Arctic

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Community of Utqiagvik

Poster Presenter: Joshua Jones

The Alaska Arctic Observatory & Knowledge Hub (AAOKH) is a network of local, Indigenous Experts making environmental and ecological observations across seven northern Alaska coastal communities, and provides a framework for sharing these observations with other community members, scientists, policy makers, and other stakeholders. Observations typically include weather information, oceanographic conditions, sea ice processes (freeze-up, break-up, specific incidents, etc.), tundra conditions, wildlife sightings, hunting reports, and community events. Anomalous events and conditions are particularly noted and help to catalogue changes to the seasonal cycles around which many subsistence and community activities revolve. Repeated observations from each community allow environmental changes in that area to be monitored, while observations taken along most of the Alaskan Arctic coast gives insight as to how change is varying temporally and spatially across the larger area. Since it is local experts in the coastal communities who make the observations, the archive of observations provides a relevant viewpoint important to local and regional policy and planning, as well as a holistic viewpoint from which science can progress in a meaningful way.

The Chukchi Sea in a Changing Environment: A Synthesis of Modeling and Observations

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Poster Presenter: Claudine Hauri

The Chukchi Sea is an important biogeochemical gateway into the Arctic Ocean. Rising temperatures, loss of sea ice, enlarged freshwater input, increases in frequency and magnitude of storms, and ocean acidification are likely to transform the biogeochemistry and ecosystem of this pristine shelf sea. However, due to limited spatial and temporal data coverage in this remote and often inaccessible area, little is known about the present day carbon dynamics in fall, winter, and spring. Frequent but poorly studied late-season mixing episodes on the Chukchi Shelf may be important drivers of the marine carbon budget and the intensity and duration of ocean acidification events as they alter the degree to which carbon is retained on the shelf, released to the atmosphere, or mobilized and transported into the Arctic Ocean. While loss of sea ice could increase productivity and temporarily increase surface aragonite saturation state, melt water dilutes the carbonate ion concentration and thereby decreases the aragonite saturation state. Here, we integrate results from a 3-D ocean circulation, sea ice and biogeochemistry model ROMS-COBALT (Regional Ocean Modeling System-Carbon, Ocean, Biogeochemistry and Lower Trophics) hindcast simulation with observations from the new Chukchi Ecosystem Observatory to get a better understanding of the seasonal to interanual variability and underlying drivers of the regional inorganic carbon system. The model is used to expand the observational timeseries in time and space to shed light on the impact of global climate variability and trends on the Chukchi Sea CO2 system.

Evaluation of Dynamically Downscaled Winds Over the Central Beaufort Sea

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Poster Presenter: Peter Bieniek

The northern coast of Alaska is experiencing significant climatic change initiating hazards from reduced sea ice and increased coastal erosion. This same region is home to significant offshore oil/gas activities and future development plans need to account for the changing climate. To better understand potential hazards that incorporate climate change, downscaled climate data are needed that can resolve the detail of the coastal zones while effectively capturing climate variability and trends. Reanalysis and Global Climate Model (GCM) data have been dynamically downscaled to 20km and hourly resolutions for all of Alaska using the Weather Research and Forecast (WRF) model over 1979-2100. The wind speed and direction from these data will be used to drive wave, hydrodynamic, and sediment transport models for regions of the Beaufort Sea coast. The output from these models can then be used to quantify the threat posed by coastal erosion and sediment transport on future oil development activities.

In this work, winds from the dynamically downscaled ERA-Interim reanalysis (1979-2015) and GCM future projections from RCP8.5 for NCAR CCSM4 and GFDL CM3 over 1970-2100 are analyzed. Historical winds were compared with the Chukchi-Beaufort High-Resolution Reanalysis (CBHAR) and point stations in key areas along the Beaufort Sea coast for the reanalysis period as an initial validation. Results show similar wind speeds in terms of monthly means and daily extremes over the Beaufort Sea. Additional analysis of winds at stations and buoys is being undertaken and an evaluation of the future projections will be explored.

Can Changes in the Oxygen Isotope Composition of the Bering Sea Contribution to the Arctic Ocean Upper Halocline Provide an Independent Opportunity for Constraining the Freshwater Flux Through Bering Strait?

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Poster Presenter: Lee Cooper

The oxygen isotope composition of the Bering Sea contribution to the upper Arctic Ocean halocline was established as early as the late 1980's as having a $\delta^{18}O$ value of approximately -1.1‰. This estimate was consistent with isotopic measurements made throughout much of the 1990's and into the current century of the water that contains the nutrient maximum present in the Arctic Ocean, which has a salinity of 33.1. More recent sampling however, of the upper Arctic Ocean halocline (2010-2017) indicates that Arctic Ocean water with a salinity of 33.1, including that in the upper halocline has shifted to a more negative isotopic composition (~-1.6‰), but with some year-to-year, seasonal and regional variability. This shift is consistent with observations of added freshwater storage in the Canada Basin, and mooring-based estimates of increased freshwater inflows through Bering Strait. These isotopic time-series observations suggest that change in the oxygen isotope composition of the upper halocline can be used as an independent index of freshwater flux changes through the Bering Strait. Several reasonable assumptions must be satisfied: Sea ice melt contributions at the depth of the upper halocline must remain negligible, 33.1 must remain the salinity of the brine-injected and influenced nutrient maximum, and the isotopic composition of the freshwater end-member (-21.5‰) present in Bering Strait is not significantly changed. Given those conditions, balancing a simple end-member mixing model requires the volume of freshwater (including runoff and other meteoric water, but not sea ice melt) flowing through Bering Strait to have increased by ~37% over the past two decades to account for a change in the isotopic composition of the 33.1 salinity water from a $\delta^{18}O$ value of approximately -1.1‰ to -1.6‰. This estimate is comparable with independent published measurements (Woodgate et al. 2012) made from mooring arrays in the Bering Strait (freshwater fluxes rising from 2000–2500 km^3 in 2001 to 3000– 3500 km^3 in 2011) and indicates that these trends are continuing through at least 2017.

Measuring Wave Forces Along Alaska's Coastal Sea Ice

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Poster Presenter: Mark Johnson

Sea ice often serves as a platform for subsistence hunting, as a base for small vehicle transport and, if sufficiently strong, as a surface for aircraft landings. When ice is not strong enough, risk increases to equipment and people. During subsistence whaling, for example, sea ice occasionally breaks from the grounded region nearshore and drifts free, carrying with it people and gear. Such events, while rare, can result in injury and loss of life. Our goal is to measure the forces acting on sea ice under a range of conditions, and then determine whether such forces are sufficient to initiate sea ice "break out" events. We may then be able to deploy sensors capable of providing "early warning" to relevant stakeholders about potentially significant ice events. To acquire the necessary measurements of ice motion, we constructed a prototype instrument using the latest micro-electro-mechanical systems (MEMS) technology, the VectorNav VN-100, a high-performance Inertial Motion Unit that contains 3-axis accelerometers, 3-axis gyros, 3-axis magnetometers, a barometric pressure sensor, and a temperature sensor. Four units, dubbed Ice Wave Riders (IWRs), successfully measured vertical and horizontal accelerations and other parameters at 10Hz. IWRs were deployed on free-floating sea ice in the Arctic Ocean as part of ICEX 2018, on landfast ice off Point Barrow during breakup, and on relatively stable ice in Elson Lagoon, near Utqiagvik. More than 3300 hours of data have been collected. Additionally, we collected nearly 2400 hours of data under extremely stable conditions on land where low-threshold tests of the sensor were conducted. We are now focusing on analysis of two specific periods of interest. First, when accelerations in sea ice were forced by impacts to the ice from aircraft landing at the ICEX camp, and second, at a time when concurrent accelerations were recorded from two IWRs deployed 0.2 km apart on the fastice north of Point Barrow. At that time, locals reported small leads, distorting ice, and the formation of pressure ridges. We examine these events in the context of coastal ice conditions and local weather observations.

Implementation of the World Meteorological Organization (WMO) Arctic Regional Climate Center (ArcRCC)

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Poster Presenter: Renee Tatusko

Climate change in the Arctic is taking place at a much more rapid rate than in other regions. In Alaska, indigenous peoples and communities, industry, and flora and fauna are experiencing significant and direct impacts. Currently, climate products at a circumpolar/pan-Arctic scale (i.e. International Panel on Climate Change and Arctic Council working group assessments) are not available in near-real time for Arctic decision-makers. To meet growing Arctic adaptation and decision-making needs, an Arctic Regional Climate Center Network (ArcRCC-Network) has been established. The purpose of the ArcRCC is to provide biannual seasonal assessments and forecasts of temperature, precipitation, and sea-ice conditions each October (for the upcoming winter season) and May (for the upcoming summer season).

The ArcRCC-Network is based on the World Meteorological Organization (WMO) Regional Climate Center (RCC) concept. Active contributions to the seasonal assessments come from the meteorological and ice services of all Arctic Council member countries and are based on a mutually agreed upon structure of three sub-regional geographical nodes, namely, (i) North America Node, (ii) Northern Europe and Greenland Node, and (iii) Eurasia Node.

As part of the ArcRCC-Network implementation and ongoing engagement strategy, an inaugural user's forum was held in Ottawa, Canada, from 15 to 16 May, 2018, hosted by the Environment and Climate Change Canada (ECCC) and co-sponsored by the WMO. This first annual forum focused on meeting with Arctic commercial shipping users and circumpolar indigenous organizations to discuss initial ArcRCC climate products and user needs. This presentation will further expand on: the structure and objectives of the ArcRCC; initial climate products; feedback received from circumpolar climate users during its first face-to-face forum; and its follow-up on-line forum held in October 2018.

Predicting Optimal Growth Temperature of Marine Bacteria using Genetic Signatures of Cold Adaptation

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Poster Presenter: Anais Gentilhomme

The great majority of the world's ocean volume is found at temperatures below 5°C, and marine microorganisms have adapted to these low temperatures by various evolutionary pathways. Many of these bacteria are not yet able to be cultured in the lab due to unknown growth requirements, making it impossible to measure key phenotypic characteristics such as optimal growth temperature. However, high-throughput DNA sequencing of environmental communities ("metagenomics") can provide insight into the phenotypic characteristics of as-yet uncultured taxa. To enable predictions of complex phenotypes like growth temperature in an environmental context, we propose to use *Colwellia* as a model organism. *Colwellia* is a genus of cosmopolitan gammaproteobacteria found in cold waters around the world, and has often been implicated in the biodegradation of crude oil. We hypothesize that complex phenotypes like optimal growth temperature can be predicted from complete genomic sequences by identifying conserved molecular signatures for growth at low temperature. These signatures, e.g. genes that affect the fluidity of the membrane, amino acid substitutions that affect the flexibility of proteins, etc., will be characterized in up to 75 genomes of *Colwellia* with temperature optima ranging from psychrophilic to mesophilic. We will then use multivariate phylogenetic models to predict optimal growth temperatures of uncultured microorganisms in marine metagenomes. These models may then be incorporated into forecasts of microbial production in the warmer waters expected in the future around Alaska.

1000 Meters Under the Beaufort Sea: Exploring Arctic Epibenthic Assemblages Along a Depth Gradient

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Benthic communities change drastically in both biomass and community structure with increasing water depth on a global scale, attributed to a combination of physical and biological factors. Alongside, in the Arctic, benthic biogeographic patterns are additionally thought to be a result of the region's glaciation history. Oceanographically, the Beaufort Sea is characterized by distinct water masses that vary along the depth gradient, from nearshore to the deep slope. Here, we investigate epibenthic biomass and assemblage structure and biogeographic affinity turnover with varying water masses in the central Beaufort Sea. The biomass distribution of benthic epifauna varied by three orders of magnitude from 4 to 3,968 g ww/1000 m^2 at 136 stations sampled over a depth range from 3 m to 1163 m with beam trawl hauls between 2013-2015. Biomass differed statistically among water masses, with high benthic biomass mostly found under the influences of the Polar Mixed Layer and Arctic Halocline on the outer shelf and upper slope, respectively. Stations in the shallow Coastal Zone and in the Canada Basin Deep Water had the lowest epibenthic biomass. Taxon richness was high in shelf water masses but decreased considerably in water masses at greater depths. Assemblage structure also differed significantly among water masses, with echinoderms dominating the biomass at all water masses except the coastal assemblage that was characterized by arthropods. Taxa with Boreal Pacific affinity was essentially limited to the shelf waters. In contrast, Boreal Atlantic taxa in all taxonomic target groups occurred in all water masses across a broad depth range. The strong association of benthic assemblages with water masses is consistent with the water mass-associated community structure described for zooplankton and fishes in our study region. Alongside, this study confirms the absence of Boreal Pacific taxa from deep waters and a very strong Atlantic-Arctic deep-water connectivity reaching into the Arctic Pacific region.

Zooplankton Production in Arctic Coastal Lagoons: Preliminary Results of Biological Monitoring in Cape Krusenstern National Monument

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Coastal lagoons play an important role in the functioning of a highly productive southeastern Chukchi Sea ecosystem. They provide critical habitat for anadromous fish (e.g., salmon, whitefish) and other ecologically important forage fish (e.g., herring, smelt, and stickleback), as well as staging habitat for migratory shorebirds and waterfowl. The food webs in Arctic lagoons are often dominated by benthic detritovores dependent on microbial processing of terrestrial carbon delivered by river flux as dissolved and/or particulate organic carbon. As a part of our Cape Krusenstern National Monument long-term monitoring through the National Park Service's "Vital Sign" program, we investigated zooplankton communities in three intermittently open lagoons along the Alaskan southern Chukchi Sea Coast during summer 2017. Despite apparent environmental similarities, two lagoons supported drastically different zooplankton communities dominated by high abundances (up to 5,000 individuals per cubic meter) of brackish water copepods *Acartia hudsonica* and *Eurytemora raboti*. While total abundance of copepod nauplii decreased from July through August, the copepod population age structure did not change, which suggests a continuous spawning throughout the summer, albeit at a lesser magnitude as the season progresses. Under relatively warm (11-15° C) temperatures observed in the lagoons, the copepods finish their development in about 20-30 days, which allows for at least two generations during summer and results in the lagoons being a relatively productive environment for higher trophic level consumers.

Identifying Sources of Essential Amino Acids to Benthic Organisms in the Beaufort Sea Using Stable Isotope Fingerprinting

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Benthic invertebrate communities are an essential component of food webs in the Arctic, in terms of mineralization and energy transfer to higher trophic levels. Particulate organic matter sources sustaining these organisms could theoretically originate from sea ice algae, phytoplankton, terrestrial organic matter eroded from the coastal environment, or microbially reworked organic matter. However, the proportional contributions of each of these sources to benthic organisms are not clear and could be altered with future environmental changes. We applied stable carbon isotope fingerprinting of essential amino acids (EAA) to a range of benthic invertebrate taxa from the Beaufort Seawith the aim of estimating the proportional contribution of primary production sources of EAA to these organisms. EAAs have specific stable carbon isotope "fingerprints" that differ between marine, terrestrial, and bacterial sources, which are then incorporated into and conserved within consumers. Benthic taxa analyzed from the Beaufort included *Eualus* spp., *Sabinea septemcarinata*, *Bathyarca glacialis,* and *Astarte spp. (A. crenata, A. montagui, A. borealis).* To determine the proportional contribution of EAA sources we used a stable isotope-mixing model to compare the EAA fingerprints from the invertebrate specimens with those from different primary production sources. We found that bacterial EAAs were an important source for many of the specimens analyzed. However, *A. montagui* sampled closer to the coastline showed higher proportions of macroalgal and terrestrial derived EAAs, compared to those further offshore, which typically had a higher proportion of bacteria-derived EAAs. *Astarte* spp. and *S. septemcarinata* also showed a marked increase in a bacterial amino acid index (stable carbon isotope values of Isoleucine-Leucine) with water depth. Overall the essential amino acids in benthic invertebrates from the Beaufort Sea were dominated by a bacterial source.

Feeding of Arctic cod (*Boreogadus saida*) on the Beaufort Sea Shelf Break

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Arctic cod are an important forage fish species throughout the Arctic, where they represent a critical prey source for seabirds, pinnipeds, and beluga whales. While multiple studies exist on the diet of Arctic cod in the Barents Sea and the Canadian High Arctic, information on the diet of Arctic cod near the shelf break of the Beaufort Sea, particularly with respect to physical oceanographic processes and sea ice cover, is rather limited. Seasonal upwelling events near the slope of the Beaufort Sea have increased with warming conditions and decreased sea ice extent. These events may in turn provide more offshore, lipid-rich prey to Arctic cod, resulting in changes of energy flow in the Beaufort Sea food web. Data were collected on the diets of 154 Arctic cod from the slope of the Beaufort Sea shelf in September 2017. During this time, two upwelling events occurred, as evidenced by the shoaling of Atlantic water on the slope and onto the shelf. Diet composition of Arctic cod varied among stations but *Themisto* spp. amphipods and the copepods *Calanus glacialis* and *Paraeuchaeta* spp. represented the most abundant prey by both number and biomass. Larger individuals also exhibited a moderate degree of cannibalism. There were no noticeable differences in diet among fish collected during and between each upwelling event. This suggests that the seasonal upwelling events on the Beaufort Sea shelf break may not lead to a change in diet of the large concentration of Arctic cod located at the shelf break. Limited upwelling occurred on our recent cruise in August of 2018, but a substantial amount of sea ice was present. The density of Arctic cod along the shelf break was also much lower and occurred ~50 m deeper than in 2017. We expect the stomach content data from 2018 to provide insight on how the feeding of Arctic cod varies based on oceanographic and sea ice conditions.

Is It Just Me, or Are There a Lot of Sculpin in These Arctic Lagoons?

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Poster Presenter: John Seigle

The North Slope Borough Department of Wildlife Management (NSB-DWM) is collecting data to inform policy and management decisions regarding fish assemblages, food security, and resource development in nearshore waters of the Beaufort and Chukchi seas. NSB-DWM is particularly interested in marine and brackish water fishes in lagoon waters near Utġiagvik and Wainwright, Alaska. These waters are highly productive systems that provide residents of the area with an abundance of marine organisms important in local subsistence harvests, including marine and anadromous fishes. Despite rich traditional knowledge, significant gaps in quantitative data continue to be an issue for managing the resources of these areas. These gaps include the need for data on presence, density, behavior, and timing of habitat use by nearshore fishes in coastal lagoon systems. ABR, Inc. is collaborating with the NSB-DWM to conduct field surveys to provide information on fishes of the region. Project objectives are to: (1) describe nearshore fish communities in the shallow lagoons of Utgiavik and Wainwright using seining and fyke net methods; (2) describe changes in fish assemblages between years; and (3) communicate these results with local communities. We present preliminary findings from field surveys conducted during summer months 2007–2018. Field surveys included seine and fyke net efforts in shallow lagoon waters at locations that were surveyed during multiple field seasons. During these surveys, we detected annual changes in fish species richness and density between sampling during open water surveys, indicating the importance of the timing of surveys as well as the influence of aquatic conditions (e.g., salinity and temperature) in determining fish assemblages. Young-of-the-year and juvenile fishes in found nearshore coastal waters are an important food source for marine birds and mammals in the region, which in turn provide food security to coastal communities. These results will provide direction in developing future investigations in other subsistence communities in the NSB, with the ultimate goal of providing baseline information important to assessing the potential impacts of changes in ocean conditions on subsistence resources and continued development in the region.

Overwintering Habitat of Arctic Cod and Anadromous Fishes in the Arctic Nearshore

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Poster Presenter: Leandra Sousa

The goal of this project is to investigate the overwintering ecology of Arctic fishes from freeze-up to the break-up season in the Arctic nearshore. While intense research efforts have been conducted during the Arctic open-water season, little is known about fish distribution and their movements between Arctic lagoons and the nearshore marine environment during the ice-covered period. Species of particular interest are Arctic Cod (*Boreogadus saida*) and Salmonids, including Whitefishes. While Arctic Cod are an important prey for marine mammals, birds and fishes—making them a critical component of the Arctic food web—their spawning grounds remain unknown in U.S. Arctic waters, despite the fact that scientific literature indicates that they spawn under ice. The North Slope Borough Department of Wildlife Management (NSB-DWM) deployed a mutifrequency (38, 125, 200 and 455 kHz) Acoustic Zooplankton Fish Profiler (AZFP) in the nearshore Beaufort Sea at an Arctic lagoon pass near Utqiagvik/Barrow, Alaska (USA), in July 2018. The AZFP was mounted on a low profile mooring frame and oriented to look upwards. It will record data continuously for a year, and it is also equipped with a CTD and an adjacent current meter. The data will be used to determine the presence of fish and plankton under ice and their potential movements between the marine and lagoon environments especially during freeze-up and break-up seasons. Jigging and net sampling will be conducted to collect fish and plankton samples throughout the year-long AZFP deployment period in order to verify acoustic targets and to determine if the nearshore environment is an important overwintering habitat for Artic cod and neritic plankton.

Population Structure in Arctic Cod and Hybridization Between Cold-water Adapted Arctic Gadids

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The two small gadids, *Boreogadus saida* and *Arctogadus glacialis*, are adapted to cold water habitats. Widely distributed, marine organisms such as *B. saida* and *A. glacialis* generally show limited genetic structure, however environmental heterogeneity can result in nonrandom distribution of genetic diversity. Arctic gadids live in an ecosystem undergoing rapid change. As the Beaufort and Chukchi seas warm, distributions of *B. saida* and *A. glacialis* will likely shift. Such changes in the distribution of these two species may result in new areas of secondary contact, increasing opportunities for competition as well as hybridization. An understanding of current population connectivity within species and genetic makeup is needed to better understand how these species may respond to environmental disturbances. To describe population structure, we characterized variation in mitochondrial DNA, and at microsatellite and restriction site-associated DNA (RAD) loci among *B. saida* located in the Bering, Chukchi and Beaufort seas. Across seas, we uncovered little geographic structuring but we did uncover slight but significant genetic heterogeneity of *B. saida* found in the eastern region of the U.S. Beaufort Sea. This heterogeneity was not associated with kin-associated groups, suggesting larvae cohorts are not remaining together throughout development. We hypothesize that this pattern reflects the intermixing of Pacific- and Arctic-origin lineages of Arctic cod. Analyses of RAD loci uncovered the presence of two lineages in the eastern Beaufort Sea, one lineage found in Bering, Chukchi, and Beaufort and second found only in the eastern Beaufort. This region may represent a transition zone as seen in the microsatellite dataset. Based on the analysis of 127 samples, we found scant evidence of hybridization between Arctic and Polar cods. However, we did find what we conclude was an F5 backcross into Arctic cod, as indicated by the possession of a Polar cod mitogenome and Arctic cod nuclear genome. This result indicates that hybrids are fertile, but that hybridization appears to be a rare event.

Spatial Distribution of Acoustic Backscatter in Arctic Nearshore Waters Surrounding Elson Lagoon, Alaska

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Poster Presenter: Savannah LaBua

During the summers of 2013-2015, acoustic data was collected in three locations near the outlet of Elson Lagoon, Alaska (Beaufort Shore, Plover Inlet, Elson Lagoon) to examine the spatial distribution of fish biomass. Identifying areas of high production along Arctic shorelines is important if we are to understand the changes occurring in the Arctic nearshore. Elson Lagoon is an important feature of the nearshore area around Pt. Barrow, an oceanographically dynamic location where the Beaufort Sea meets the Chukchi Sea. Flow through Elson Lagoon is typically driven by easterly winds making the western outlet of Elson Lagoon a potential hot spot for fish production. Acoustic backscatter was measured at 120 kHz using a calibrated split-beam Simrad EK60 echosounder with a downward oriented transducer mounted to an autonomous survey vessel. Current velocity profiles were measured with a 600 kHz Acoustic Doppler current profiler (ADCP). We found that during the three year sampling efforts of Plover Inlet, biomass present was greatest in 2014. Further, we observed that within the three habitats during 2015, the highest aggregations of biomass occurred in Elson Lagoon (84% and 89% greater than Beaufort Shore and Plover Inlet respectively).Using generalized additive models (GAMs), we will further examine the effects of temperature, salinity, current velocity and material transport on the spatial distribution of fish in Plover Inlet. The goal of this study is to identify fish hotspots and provide insight as to how fish utilize local flow regimes as materials are transported into and out of the inlet. Given that Arctic ecosystems are at risk of increased vulnerability due to a combination of rapidly changing climate, increased interest in oil and gas exploration and reduced sea ice, it is essential to distinguish the driving processes between the growth, development, distribution and community assemblage in Arctic ecosystems.

Interannual and Decadal-scale Variability in Nearshore Beaufort Sea Fish Assemblages

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The nearshore fish community of the Beaufort Sea is highly dynamic, and species composition and abundance vary on both interannual and decadal timescales. To examine fish assemblage change, we revisited fyke net sampling locations during August 2017 and 2018 in two adjacent lagoons within the Arctic National Wildlife Refuge near Kaktovik, Alaska, and compared fish assemblages to those observed from annually 1988–1991 and 2003–2005 for a total of nine sampling years across three decades. In both Kaktovik and Jago lagoons, interannual variation in presence age-0 Arctic cisco (*Coregonus autumnalis*) and, to a lesser extent, polar cod (previously known as Arctic cod *Boreogadus saida*) result in catch rates that differed by an order of magnitude from 100s to 1,000s of fish captured per day. Decadal-scale comparisons reveal long-term declines in abundance of Arctic-specialists (e.g., fourhorn sculpin *Myoxocephalus quadricornis*) and increased abundance of Arctic-Boreal Pacific species (e.g., saffron cod *Eleginus gracilis* and Arctic smelt *Osmerus dentex*). Interannual variation appears to be largely a function of wind-driven recruitment of Arctic cisco from the nearshore eastern Beaufort Sea and advection of Arctic cod from offshore habitats. Decadal-scale increases in Arctic-Boreal species likely reflects the changes in summer water temperatures and lengthening of the ice-free season characteristic of recent decades. Shifting assemblages alter the availability of forage fish for piscivorous predators such as Dolly Varden (*Salvelinus malma*) or red-throated loons (*Gavia stellate*) across years and decades, potentially changing the structure of food webs or energy flow.

Drivers of Long-Term Declines in Red-Throated Loon Abundance on Alaska's Arctic Coastal Plain: Marine Ecosystem Conditions, or Environmental Contaminants?

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Red-throated loons (*Gavia stellata*) are a species of conservation concern due to the sensitivity of breeding individuals to disturbance and population declines, including a current decline on the Arctic Coastal Plain in northern Alaska where oil and gas development is slated to increase. Concurrently, populations of two sympatric loon species are either stable or increasing on the Arctic Coastal Plain, highlighting the need to determine drivers of the population decline in red-throated loons. Possible drivers include marine ecosystem conditions or environmental contaminants. From 2000 – 2010, we deployed 14 satellite transmitters on red-throated loons in northern Alaska and present preliminary data on the use of nearshore marine habitat in the Beaufort Sea. Unlike sympatric loon species that feed in freshwater, red-throated loons exclusively catch fish in nearshore marine environments to feed themselves and their chicks. Thus, unfavorable shifts in nearshore fish communities may contribute to population decline of red-throated loons if preferred prey species are less abundant or have lower body condition. Ongoing research has revealed long term shifts in fish community composition and catch rates; therefore, identifying red-throated loon prey fish species, their nutritional quality and availability in northern Alaska, and links to loon energetic costs of flight and diving may allow assessment of how marine conditions impact loon breeding success. Red-throated loon eggs collected in northern Alaska over 15 years ago exhibited elevated levels of toxic polychlorinated biphenyls (PCBs). Other contaminants, such as mercury, influence reproduction for other loon species, but have not been examined in red-throated loons. Determining contemporary contaminant levels, in conjunction with migration information from satellite telemetry data, may provide additional information on contaminant level trends and sources. We present recent information on two possible drivers of loon abundance and discuss new research that addresses hypotheses related to red-throated loon population declines in northern Alaska.

Update on Bowehad Whale Entanglement in Fishing/Crab Gear - Scar Acqusition Rates from Aerial Surveys and Scar Frequencies on Harvested Whales

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Fisheries bycatch is now considered the greatest threat to cetaceans worldwide by the IWC. Entanglement scarring has been observed on Bering-Chukchi-Beaufort Sea (BCBS) bowhead whales even though their high-latitude distribution is mostly north of commercial fishing operations; however, some spatial overlap occurs in winter. We have examined aerial photographs of all inter-year matches (between 1985, 1986, 2003, 2004, 2005 and 2011) from a multi-year photo mark-recapture study and identified whales that had acquired entanglement injuries during the study period. The black skin of the bowhead heals as a white scar leaving a permanent record of past injury. We estimated the probability of a bowhead acquiring an entanglement injury using two statistical methods. Both methods give similar results suggesting a 2.2% (1.1% and 3.3%) annual probability of acquiring an entanglement-scar, suggesting that about 40% of adult whales will be scarred after ~25 years. This estimate is consistent with the percentage of harvested whales 50 years and older that carry entanglement scars. Similarly, in our recently published work on harvested bowheads by Alaska Native hunters, we noted that 12.2% had evidence of entanglement scarring, likely associated with Bering Sea commercial fisheries. Similarly, our analysis of a fully independent dataset of aerial photographs (from 2011, n = 693) with adequate photo quality of the caudal peduncle indicates that 12.6% (n = 87) show evidence of entanglement scarring. These various estimates are quite consistent and provide a good indication of the current status of bowhead entanglement rates. While the BCBS bowhead population is increasing at a relatively strong rate, these independent datasets indicate that fish/crab gear entanglement is a more serious concern for BCBS bowheads than previously thought. The Alaska Eskimo Whaling Commission, UA Fairbanks, and North Slope Borough have engaged with the Alaska Bering Sea Crabbers to discuss specifics about gear types, range overlap, and the goal of stabilizing and/or reducing entanglement.

Occurrence of Arctic and Saffron Cod in the Diet of Ringed Seals, 1975–2016

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A warming climate is expected to alter the marine food web by favoring species of fish that prefer warmer water to the detriment of those that favor cooler water. We used data from a long-term study of ringed seals (*Pusa hispida*) to investigate trends in the occurrence and size of the two most common fish found in their stomachs in Alaskan waters, Arctic cod (*Boreogadus saida*) and saffron cod (*Eleginus gracilis*). Arctic cod are strongly associated with sea ice and cooler waters, and may be displaced by saffron cod, which prefer warmer water and may become more prominent in ringed seal diet. Cod are identified in seal stomach contents by their otoliths (ear bones) which are proportional in size to fish length. The frequency of occurrence (FO) of Arctic cod in the diet of ringed seals harvested near Shishmaref, remained relatively constant for pups between 1975–1984 and 2003–2016 (29%), but increased between time periods for all other ages from 22% (1975–1984) to 45% (2003–2016).During those same time periods the FO of saffron cod did not change significantly; the FO for pups was 56% and the FO for all other seal ages was 72%. We also measured the lengths of cod otoliths from stomach contents collected in 2013–2016 and found no difference in otolith length for either cod species by age of seal, indicating that seals of all ages consumed fish of similar sizes. Average length of Arctic cod otoliths did not differ over time from 2013 to 2016. However, average length of saffron cod otoliths increased significantly from 6.13 mm in 2013 to 8.26 mm in 2016. Contrary to our predictions, we have not seen the occurrence of Arctic cod decrease or that of saffron cod increase. The trend towards larger saffron cod may indicate environmental conditions are improving for them. Continued monitoring is needed to detect changes in the occurrence and size of prey species.

Interannual Variability in the Acoustic Presence of Fin Whales (*Balaenoptera physalus*) in Relation to Environmental Conditions in the Bering Strait

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Fin whales (*Balaenoptera physalus*) are common visitors to the Alaskan Arctic during the summer, migrating through the Bering Strait and into the southern Chukchi Sea to feed on seasonally-abundant prey. The abundance and location of fin whales in the Chukchi Sea exhibits high interannual variability and may reflect varying environmental conditions. Using acoustic recordings from three moored hydrophones in the Bering Strait region, we identified fin whale calls during the open-water season (July–November) from 2009–2015 and investigated environmental drivers of interannual variability in fin whale presence. We examined in situ data from other sensors on the same moorings, including near-surface/near-bottom temperature and salinity, and water velocity and direction, as well as considering satellite-derived sea surface temperatures and sea ice concentration. In addition, we estimated the water mass presence at each mooring using published temperature and salinity boundaries.

Detections of fin whale calls were highest in 2012 and 2015, and the vast majority of detections (96%) were recorded at the mooring located at the confluence of the nutrient-rich Anadyr and Bering Shelf water masses, ~35 km north of Bering Strait (site A3). Interestingly, the two years with the highest fin whale detections had very different environmental conditions at this site. Colder temperatures, low salinities, and slow water speeds prevailed in 2012 while high temperatures and salinities, faster water speeds and thus higher transport through the Bering Strait prevailed in 2015. Additionally, the results of a chi-squared test of independence suggest that the occurrence of fin whale calls is dependent on the occurrence of water masses at the mooring site ($p < 0.001$).

The disparity between 2012 and 2015 suggests there may be multiple combinations of environmental factors that draw fin whales into the Alaskan Arctic. There also may be other contributing factors to variability in fin whale presence that we did not examine. The results of our study corroborate previous observations of interannual variability in the presence of fin whales and contribute to our understanding of environmental influences on fin whale presence in the Chukchi Sea.

Comparative Analysis of the Excretion of Sex Steroids and Dehydroepiandrosterone (DHEA) in Wild and Zoo Female Polar Bears

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Polar bear (*Ursus maritimus*) populations in both wild and zoo settings are under threat due to climate change and poor reproductive success. They are a seasonally polyestrous species that exhibit embryonic diapause and pseudopregnancy, complicating characterization of reproductive function. Whereas excretion of testosterone and progesterone have been studied extensively in female polar bears in human care, many questions remain about polar bear reproductive endocrinology. Dehyroepiandrosterone (DHEA) is a steroid hormone precursor that has been correlated to reproductive success, age, and body condition in other species. However, it has not been characterized in the polar bear. Additionally, longitudinal characterization of polar bear endocrinology in wild populations is lacking in general. The purpose of this study will be to 1) validate an assay to detect the sulfated form of DHEA, DHEAS, in polar bear fecal samples, and 2) elucidate longitudinal excretion patterns of DHEAS in both wild and zoo bear populations to complement existing research on the sex steroids progesterone and testosterone, which are typically used to define reproductive status. Research on immature, non-breeding, parturient, and breeding non-parturient adult female polar bears will be necessary to determine the full range of DHEAS excretion as it relates to reproductive function. With rapid changes in the Arctic environment, it behooves researchers to have multiple tools available, such assays to better understand reproductive function, to assess a population's status and growth. This study would be helpful in ascertaining the reproductive parameters of polar bear populations.

New Data on the Use of Waters of the Okhotsk Sea and Pacific Ocean by Spotted Seal (*Phoca largha*)

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The spotted seal (SS) is a common species along the Asian coast and forms several local populations. It has been assumed by some authors that the seals in the Sea of Okhotsk and in the Bering Sea are isolated one from another. We studied SS migration and haul-out patterns using satellite telemetry. A total of 10 SS of various ages and both sexes were captured and tagged at the mouth of Bolshaya River, in the Sea of Okhotsk, Kamchatka, in August-October of 1992, 2011, and 2017. Average tag transmission duration was 133 days, and maximum was 182 days (July 24, 2017 to January 22, 2018).

Individuals were recorded near the shores of both coasts of Kamchatka during the feeding period (late summer and early autumn), and widely dispersed across the waters in the second half of autumn. Five seals remained in the Okhotsk Sea and moved into Penzhinsky and Tauisk bays and into the waters northwest of Cape Utkholoksky. The other five seals migrated into the Pacific Ocean: two were registered near eastern and southern coasts of Paramushir Island; three moved along the eastern coast of the Kamchatka Peninsula towards the north (two reached the Kronotsky and Kamchatka bays). All movements occurred close to the shore within the 200 m isobath. No confinement of animals of a specific sex or age to a specific water area was observed. It was previously considered that SS that feed on the western coast of Kamchatka during summer do not leave the Okhotsk Sea. However, five out of ten tagged seals rounded the Kamchatka Peninsula from the south and ended up in the Pacific Ocean, marking the first time such movements have been documented. Comparing the data with movements of tagged SS in the Bering Sea, we discovered that Kamchatka Bay was used by the seals from both the Bering and Okhotsk Seas.

Ringed Seal Productivity in Alaska Using Harvest-Based Monitoring, 1975–2016

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Declines in sea ice are predicted to negatively affect ringed seals (*Pusa hispida*) by reducing their time to rest, pup, nurse, and molt on sea ice. Concurrent with declines in sea ice are predicted reductions in snow cover used by ringed seals to construct pupping lairs on top of sea ice. Less snow is expected to lower ringed seal productivity and pup survival by providing less protection from weather and predators. Estimates of ringed seal abundance cannot be used to detect population trends in Alaska; however, the Alaska Department of Fish and Game has worked with Alaska Native hunters to collect data from subsistence harvested ringed seals that can be used as an index of population health and status. Indices include pregnancy rate, age of maturity, and proportion of pups in the sampled harvest. We published an examination of these indices to determine if declines in sea ice have affected ringed seals between 1975 and 2012 and subsequently updated them through 2015. Pregnancy rates did not change between 1975–1984 and 2000–2015 (range 84%–85%); however, the average age of maturity decreased from 6 years in 1975–1984 to 3.3 and 3.7 in 2000–2009 and 2010–2015, respectively. Additionally, pups were harvested in greater proportions during 2000–2009 (55%) and 2010–2015 (51%) than during 1975–1984 (15%) indicating that pups are being produced, weaned, and surviving to be harvested. Through 2015, we have not detected the negative effects in ringed seal reproduction as has been predicted to occur to due to climate warming. We are continuing our monitoring program and will update our 1975–2015 results to include data from 2016.

Pacific Walrus (*Odobenus rosmarus divergens*) Mortality at Northern Chukotka Haulouts, 2017

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In recent years there has been a significant reduction in the ice period and ice cover in the Arctic during the summer-autumn period. Such changes have a significant impact on the life of pagophilous animals, including Pacific walruses (*Odobenus rosmarus divergens*). Mortality is an important population demographic index. Therefore, we counted and examined walrus carcasses on haulouts and washed onto the coast in summer-fall 2017 at Cape Shmidta (575 individuals), C. Vankarem (409 individuals), C. Inchoun (16 individuals), Kolyuchin Island (12 individuals), and near the villages of Vankarem, Inchoun and Lorino (3 individuals). When possible, we marked the carcasses to avoid double counting, and the sex, approximate age, preservation, and possible causes of death were determined. A total of 1015 carcasses were recorded. The sex of 734 (72%) carcasses was identified and the sex ratio was close to 1:1. Both age and sex was identified for 654 (64%) individuals, of which 465 (71%) were dependent young (age 0-2 years), and among these, 389 (84%) were calves (0 years). The number of juveniles (age 3-5 years) and adult (age 6+ years) walruses were about equal, 95 (15%) and 94 (14%) respectively. A total of 13 (1%) carcasses were aborted fetuses (sex was not determined). The majority (97%) of the carcasses were observed on haulouts or in close proximity to C. Shmidta and C. Vankarem. We suggest the main causes of walrus mortalities were from injuries sustained during disturbances on the haulouts caused from polar bears and unleashed dogs. Thus, we found that high Pacific walrus mortality continues at haulouts in Chukotka, especially among calves. To reduce mortality, additional walrus haulout protection measures must be taken.

Toxoplasma Gondii Seroprevalence in Village Sled Dogs from the North Slope, Alaska

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The coccidian *Toxoplasma gondii* is a zoonotic pathogen of significant public health concern but Its role in wildlife health is not well understood. In Alaska, antibodies against T. gondii have been demonstrated in various wildlife species including aquatic mammals. Seroprevalence was highest among wild carnivores (>10 < 50 %), and generally low among terrestrial subsistence species and marine mammals (< 7 %). In the absence of definitive hosts (felidae) additional transmission mechanisms, e.g. vertical, dietary exposure, or remote sources via migration are proposed to be responsible for T. gondii persistence and cycling (sylvatic cycle). Village sled dogs are suitable sentinels for preliminary environmental and food web based exposure disease investigations as they are often being fed a mixed traditional foods diet (caribou, fish, marine marine mammals) that spans both marine and terrestrial ecosystems. Serum from village dogs (2013-2014; n=23; female 8; male 11; uk = 4; age distribution < 1 y 11; < 5 y 9 > 5 y 2; uk 1) from 2 North Slope coastal villages (Point Lay; Point Hope) were tested for antibodies to T. gondii. Life history and husbandry data (diet; vaccination, cats per household, etc.) was collected. Prevalence was 100% (23/23) for IgM titers. Zero percent were positive on the IgG titer. No cats were present within households. 96 % of the dogs were fed a mixed raw traditional foods diet. Toxoplasmosis usually causes no signs in healthy dogs. The current study using sled dogs as a sentinel provides corroborating evidence for the hypothesis that T. gondii life cycle in the North depends on alternative transmission mechanisms. Future work will focus on molecular detection of *T.gondii* from fresh tissues of Arctic marine and terrestrial wildlife to better understand the role various intermediate hosts play in the life cycle of Toxoplasma gondii in the Arctic.

Fin and Humpback Whale Occurrence in the South-Central Chukchi Sea, 2014-2018

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Poster Presenter: Amelia Brower

The Aerial Surveys of Arctic Marine Mammals (ASAMM) project, funded by the Bureau of Ocean Energy Management (BOEM) and co-managed by BOEM and NOAA Fisheries, conducted line-transect aerial surveys from July through October in the south-central Chukchi Sea (67°-69°N, 166°-169°W) in 2014-2018. Fin whales (*Balaenoptera physalus*) and humpback whales (*Megaptera novaeangliae*) were documented each year in the study area. Fin and humpback whale sightings in 2018 (n=135 and n=86, respectively) were higher than in any previous year; the next highest year for both species was 2014: n=33 and n=44, respectively. In 2018, the majority of fin whales were sighted in September and the majority of humpback whales in July. Fin and humpback whales were sighted in close proximity to each other every year and, in some years, were also near gray whales, minke whales, or harbor porpoises. Fin whale calves (n=5) were sighted in 2016-2018, and humpback whale calves (n=5) in 2015-2018. The behavior most often documented for both species was traveling; for humpback whales, feeding was recorded nearly as frequently. Fin and humpback whales were documented engaged in feeding behaviors (e.g., lunge feeding, throat grooves expanded, water streaming from mouth, etc.) in all years. Except for a few northern outlier sightings, the south-central Chukchi Sea is the northern end of Pacific fin and humpback whale migrations, and they probably migrate to this area to feed. It is likely that fin and humpback whales were feeding subsurface in the water column, which is impossible to detect from aerial surveys. The regular appearance of fin and humpback whales in the south-central Chukchi Sea in recent years may be due to increased marine mammal surveys, population recoveries from commercial whaling, climate change and associated changes in prey distribution, or, most likely, a combination of factors.

Further Investigation of Blow or Exhaled Breath Condensate as a Non-Invasive Tool to Monitor the Physiological Response to Stressors in Cetaceans

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Poster Presenter: Tonia Osborne

The Arctic is “ground zero” for climate change. Arctic marine mammals such as the beluga whale are at risk due to potential shifts in prey and threats such as oil spills and increased shipping. Belugas are important to study because they are apex predators and sentinels of the health of the oceans. Using non-invasive methods like blow, or exhaled breath to assess health, offers an alternative method to collecting blood, the ‘gold standard’ which requires capture and restraint. Exhaled breath can reveal health information on reproductive status, stress (i.e. cortisol) and metabolism (i.e. thyroid hormones) in wild and aquarium belugas. Further validation of this technique is required (e.g. to standardize starting material). The overall purpose of this study is to standardize multiple approaches to collecting and validating blow. The specific objectives are to 1) determine how volume and cortisol vary with number of exhales and 2) determine sex by utilizing DNA in the same blow sample as the hormone measurements. Two belugas (one male and one female) under professional care at Mystic Aquarium were trained to exhale into a petri dish containing a nitex membrane. Blow samples were collected over three sessions with varying number of exhales (e.g. 1, 2, 4 exhales). Volume and DNA in the blow was measured, then analyzed for cortisol by enzyme immunoassay (EIA) or used in Polymerase Chain Reaction (PCR) to amplify zinc-finger (Z*fx*and Z*fy*), sex related genes. The results show higher exhales yield more supernatant ($P<0.05$); however, cortisol levels were consistent and independent of exhale numbers and blow volume. Sex was able to be determined by utilizing DNA from the same blow sample as the hormone measurements. Blow sampling demonstrates to be a promising technique to monitor health in beluga whales.

The Use of Unmanned Aircrafts to Assess Pacific Walrus Abundance on Haulouts in Chukotka Peninsula, Russia

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Poster Presenter: Alexey Altukhov

After ice melts, walruses hauled out on land in large aggregations. Many haulouts are located in areas with little elevation for viewing, which may result in inaccurate walrus counts but difficult to verify. An alternative approach is to count walruses from aerial photographs obtained with small unmanned aircraft. Vertical photographs significantly reduce the bias caused by overlapping walruses and photographs also make it possible to make counts from the same images by several observers to estimate observer variability in counts. However, a significant amount of time is required to count walruses in the images. Therefore, we used information from the aerial photographs to model the relationship between the number of walruses and area they lay on in different types of surface; sandy beach, rocky surface, plateau, and sea surface. Mixed effects linear regression models allowed us to determine these dependencies and predict the number of walruses on land or in water near haulout. Using parameters of this model we estimated the number of walruses for haulouts at Cape Vankarem and at the Keniskin Bay in Chukotka, Russia. The results of the model predictions were in accordance with the results of total counts from the aerial photographs, but required considerably less time to derive. The traditional approach to counting walruses from land, which includes several counting techniques, results in biased estimates (up to 30-35%) and are clearly not adequate for walrus abundance estimates on coastal haulouts. The number of walruses in Keniskin Bay significantly changed during the survey period. The maximum number of walruses of all age and sex groups on land, on October 18, was 93,797 (95% CI 88,908-98,780) walruses. The total number of walruses, including those on the sea surface, was 100,798 (95% CI 88,278-113,945) walruses. A recent estimated overall abundance of Pacific walruses is 283,000 walruses. Thus, walruses in Keniskin Bay may represent 1/3 of the entire species population, highlighting the bay's extreme importance as critical habitat and the need for urgent conservation measures to protect it.

Using an Unmanned Aircraft System to More Precisely Estimate Walrus Abundance on a Coastal Haulout in NW Alaska

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Currently, there are no precise estimates of walrus population size in the northeastern Chukchi Sea during summer–early autumn. Typically, a large portion of the northeastern Chukchi Sea population moves to a coastal haulout on the northwest coast of Alaska after offshore sea ice disappears in autumn. Onshore aggregations are more easily counted because their distribution is denser and more localized than offshore distributions. A previous study evaluated a method to estimate the size of the population at the haulout in 2014 using walrus tag data and counts of hauled out walruses from images obtained from manned aerial surveys. In 2018, we endeavored to improve on the previous method by using counts from images obtained from an unmanned aircraft system (UAS). The main objectives were to reduce the risk of disturbance to walruses and potential mortalities stemming from herd stampedes and to complete a substantially greater number of aerial surveys to obtain more precise abundance estimates. Prior to the UAS surveys, we tagged 30 walruses with radio transmitters to estimate walrus availability on the haulout when surveys were flown. We flew 13 surveys at altitudes of 112 to 121 m using a small quadcopter (1.8 kg, 3DR Solo) with a GoPro Hero4 camera mounted on a gimbal with a 41° horizontal field of view lens (PeauPro41). The survey areas ranged in length from 1.4 to 2.4 km and in width from 112 to 190 m. The development of methods to adequately estimate the size of regional walrus populations using onshore haulout sites in U.S. and Russian territories will contribute to more viable means of estimating the range-wide size of the Pacific walrus population as the exclusive use of coastal haulouts increases with the continued loss of summer sea ice.

Preliminary Findings on Incidence of Cataracts in Free-Ranging Ice Seals from Northern Alaska

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Poster Presenter: Raphaela Stimmelmayr

Cataracts are well documented eye diseases occurring in diving mammals (e.g. otarids, odobenidae, small cetaceans) under human care and extended life span among other risk factors (e.g. diet, genetics, environmental and husbandry factors) have been implicated in cataract formation of captive aquatic species. Northern pinniped species including ringed seal (*Phoca hispida*), bearded seal (Erignathus barbatus), spotted seal (*Phoca largha*), ribbon seal (*Phoca fasciata*) and Pacific walrus (Odobenus rosmarus) have relatively long life spans ranging between 30-45 years. The incidence of congenital and acquired cataracts including age -related cataracts in free-ranging ice seals is unknown, but nuclear cataracts have occasionally been observed in subsistence harvested and found dead ice seals (Stimmelmayr unpubl. data). The objective of this study was to conduct a systematic survey of archived eye-globes (frozen and formalin fixated) from subsistence harvested and found dead ice seals for the incidence of cataracts. Ecological significance of vision impairment in free -ranging ice seals is discussed. In addition, dimensions and weights of bearded and ringed seal eye globes and lenses with relevance for clinical vision examination are provided

Bowhead Whales in the Western Beaufort Sea, Summer 2012-2018

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Poster Presenter: Janet Clarke

The Aerial Surveys of Arctic Marine Mammals (ASAMM) project, funded by the Bureau of Ocean Energy Management (BOEM) and co-managed by BOEM and NOAA Fisheries, conducted line-transect surveys in the western Beaufort Sea (140°W-157°W) in summer (mid-July through August) from 2012-2018. Bowhead whales (*Balaena mysticetus*) were observed each year, but encounter rates (number of whales per km surveyed) varied considerably. The highest encounter rate occurred in 2016. By early August 2016, sea ice had receded offshore to approximately the 50-m isobath, coinciding with the offshore extent of bowhead whale preferred habitat in the western Beaufort Sea in late summer 2012-2017. Oceanographic and atmospheric conditions in summer 2016 were frequently favorable for upwelling; hundreds of bowhead whales were observed feeding. The lowest encounter rate occurred in 2018, when high (>50%) sea ice concentrations, consisting of old, multi-year ice, persisted through late August. Unsurprisingly, sea surface temperatures were also colder in summer 2018 compared to summer 2012-2017. Sea ice and related environmental phenomena likely negatively impacted productivity in the western Beaufort Sea in 2018, allowing fewer summer feeding opportunities for bowhead whales. Although there is little empirical evidence, most bowhead whales may have remained on productive feeding grounds in the eastern Beaufort Sea through late August 2018. This is a pattern similar to that observed ~35 years ago, when sea ice remained in the western Beaufort Sea throughout summer, and different from that observed from 2012-2017, when sea ice has been largely absent by late August.

Polar Bears, Plastics, and the Pyloric Sphincter: A Volatile Combination

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Polar bears primarily hunt ice seals for food and scavenge on beached marine mammal carcasses. However, pending opportunity, health status, age, time of year polar bears can rapidly habituate to other food sources such as found at dumps and landfills, and around human settlements. We report on the incidence of plastic and other non - food items ingestion from stomach content analysis of subsistence harvested SBS polar bears (1996 - 2018) and present 2 case reports with likely pyloric outlet obstruction from bulky non-food items. Plastic debris was present in 13/51 examined stomachs. Plastic was intermixed with wildlife food items including walrus, beluga, caribou, bowhead, and birds. Plastic material originated mostly from black heavy duty garbage bags and local store shopping bags. Additional plastics of unknown origin included clear plastics, food wrappers etc. Size of ingested plastic pieces ranged from a few centimeters to entire bags. One male subadult bear had also consumed half a towel. Polar bears have a large single chambered stomach and can ingest between 10-20% of their body weight in a meal. In bears, the pyloric sphincter similar to pigs is very well developed. In fully contracted post mortem stomach specimens from polar bears considerable force is needed to dilate the sphincter, maximum diameter measured is 2 cm. Bulky non-food items therefore can lead to pyloric gastric outlet obstruction. Clinical signs observed in captive black and brown bears with pyloric outlet obstruction included, painful abdomen, vomiting, weight loss, inappetence, gastric dilation etc. Pre-harvest observation on the behavior of 2 bears with significant amount of plastics in their stomachs were characterized as aggressive and irritable bears that did not respond to polar bear deterrent measures. Both bears were in fair body condition. Plastic ingestion can directly and indirectly (e.g. uptake of pollutants) impact the health of free-ranging polar bears. Good waste management practices in polar bear country are important wildlife management aspects for the protection of polar bear health.

Polar Bear TEK: A Pilot Study to Inform Polar Bear Management Models

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In 2000, the U.S. and Russian Federation signed an agreement stipulating that reliable scientific data, including traditional ecological knowledge (TEK) of the Native people, be used to determine the annual sustainable harvest level for the Alaska-Chukotka (AC) population of polar bears. At the request of the North Slope Borough Department of Wildlife Management (NSB DWM), Stephen R. Braund and Associates (SRB&A) initiated TEK research in January 2018 with a small sample of harvesters from the four communities of Point Hope, Point Lay, Wainwright, and Utqiaġvik related to the AC population of polar bears. The purpose of this study was to collect TEK about polar bears, which could be incorporated into a Bayesian integrated population model (IPM) and harvest risk assessment model, which may be used to inform future management decisions. This study was a first step in the process of determining the relationship between TEK information and model parameters.

From the indigenous perspective, the study team learned that, while scientific information was viewed as valuable in certain contexts (e.g., health surveys, population estimates), participants insisted that local input and TEK was vital to helping guide research efforts, interpreting results, and management decision-making. Participants explained that successful management with outside agencies would only occur when **communication** was made a priority, TEK was **adequately** included in decisions, **local** enforcement was emphasized, the **entire ecosystem** was considered, and when Natives had **equal** decision-making authority (and not just input).

Comparing the TEK and western science regarding polar bears demonstrated that there was overall concurrence between the two knowledge systems. However, in order to integrate TEK with current modeling and risk assessment efforts the pilot study showed there needs to be a greater sample size (e.g., more harvesters) with sufficient spatial (e.g., more communities) and temporal (e.g., more observations over time) coverage in TEK observations. Other TEK not directly input into the IPM or harvest risk assessments (e.g., as data or constraints on parameters) is useful for confirming overall interpretations or highlighting the need for additional information to resolve apparent inconsistencies.

Two Plus Two Equals Five: A Need for Synergies Between Traditional Knowledge & Western Science

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Traditional Knowledge (TK) shows a depth of ecological understanding at scales often not addressed by Western Science. Yet, TK is frequently consigned to the role of supplemental information. However, several case studies demonstrate the value that TK can add, particularly in identifying trends that are not easily detected by Western Science. For example, at a time when bowhead whale (*Balaena mysticetus*) numbers were perceived by Western Science to be very low, a moratorium was imposed on aboriginal whaling in Alaska—to the detriment of subsistence communities. TK holders convinced Western scientists that many whales had gone undetected and a subsequent abundance estimate indicated that the bowhead whale population was sufficient to allow a modest subsistence harvest. More recently, subsistence fishermen in Nuiqsut, AK, expressed concern over an emerging infection that they had never seen before in broad whitefish (*Coregonus nasus*). The cause of infection is a ubiquitous species of freshwater mold (*Saprolegnia sp.*). While its presence was not alarming to Western Science, TK unequivocally noted the abrupt and novel appearance of the infection. Consequently, work is now under way to monitor a suite of environmental covariates that may be related to this recent outbreak. These examples demonstrate how TK led to meaningful ecological insights by correcting missteps and guiding further research. Meanwhile, new statistical methods are being developed that integrate TK into more quantitative analyses. This was recently demonstrated when a TK study—narrowly focused on generating informed priors—both verified and influenced the results of a Bayesian integrated population model for Chukchi Sea polar bears (*Ursus maritimus*). This ultimately led to an increase in the subsistence harvest quota. TK holder participation in this analysis improved results and promoted greater engagement with the science used to manage an important subsistence resource. The book entitled *The Earth is Faster Now* suggests that our ability to comprehend Arctic ecology is being outpaced by changes within the ecosystem. As such, collaborations between Traditional Knowledge and Western Science will become more important as decision makers try to keep pace in monitoring and mediating the effects of an ever more dynamic Arctic.

Quantifying Oil Migration in Sea Ice: Timing, Role of Ice Stratigraphy, and Potential Ice Habitat Impacts

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Poster Presenter: Marc Oggier

Receding Arctic perennial sea ice and the potential for substantial oil and gas reserves in the Arctic are likely to drive an increase of oil extraction and transport throughout the maritime Arctic. In the past decade, traffic through the Bering Strait has more than doubled and is expected to grow in the subsequent years. Despite a decrease in sea ice extent, Arctic waters remain covered with sea ice, which represents a major hazard for commercial activities. Sea ice is a key factor with respect to a potential oil spill in Alaskan waters, as it can trap substantial amounts of oil as a result of a pipeline leak, vessel accident, or blowout. Sea ice serves as an important habitat for microbial communities and supports Arctic food webs. Porosity and microstructure evolution in sea ice is dominated by the combination of ice temperature and bulk salinity. During warming events the brine volume fraction tends to increase and pores interconnect, leading to a higher permeability.

We investigated the temporal and spatial distribution of oil and the constraints on oil migration imposed by ice stratigraphy across a range of ice thicknesses. In three under-ice oil release experiments simulating the transition from ice growth to melt season for two different oils, the macroscopic movement and distribution of oil in the sea ice pore space was quantified with the following key findings. (1) The potential for oil movement in ice is constrained by ice permeability, pore space connectivity, and type and amount of oil spilled. (2) In growing ice, oil swiftly penetrates the bottom-most ice layer while upward migration is limited to small quantities of oil in large brine channels. (3) In warming ice with increasing porosity, oil pervades larger volumes of ice until connected, invadable pore space is fully saturated. (4) The presence of granular atop columnar ice hinders oil migration. This work informs development of an oil migration model. It also highlights the importance of ice stratigraphy in spill response and resource damage assessments.

Recent Studies of Southern Chukchi Sea Lagoons

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Poster Presenter: Marguerite Tibbles

Coastal lagoons and adjacent waters located in the southern Chukchi Sea represent critical productive habitats for a wide variety of fish, bird and marine mammal species in the region. Further, lagoons support subsistence fishing by local residents. Recent work which we highlight here has been associated with development of the National Park Service's Vital Sign program looking at lagoons in this region has aimed to increase our baseline understanding of the seasonal dynamics of these highly variable systems. In the summer months, southern Chukchi Sea lagoons often have a free connection to the ocean, allowing for water exchange between the two water bodies. This allows the migrations of fishes into the lagoons where they take advantage of the productive, and relatively safe waters found there. Depending on the salinity, there are various fish communities found in the lagoons at this time. These fishes are grouped in four primary feeding groups: planktivores, microbenthivore/zooplanktivores, macrobenthivore/piscivores, and piscivores. Collectively, these fishes feed heavily on chironomids, mysids, and ninespine stickleback. There is evidence for resilience through redundancy in the lower trophic levels that is lacking in the upper trophic levels of the food web. In the fall, the lagoons frequently close as onshore wave action moves sediments across openings to the ocean, trapping fishes remaining in these systems for the winter. Fishes overwintering here are subject to marginal conditions for survival, encountering cold temperatures, high salinities, and low dissolved oxygen levels, where water is still available. It is important to understand the seasonal variability that these lagoons encompass for effective management planning. For example, with limited spill response resources available- we must prioritize critical lagoon habitats for protection and conservation in the case of oil spills.

Evaluating Shifts in Pelagic-Benthic Coupling with Sea Ice Biomarkers in the Pacific Arctic

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Poster Presenter: Chelsea Wegner

Seasonal sea ice in the Bering and Chukchi Seas is retreating earlier and forming later, each as part of a declining trend over the past two decades. Sea ice is important for many life history functions, such as habitat for the benthic-feeding Pacific walrus (Odobenus rosmarus divergens), which use sea ice as a resting platform. The benthic invertebrate communities on this shallow (~50 m) continental shelf utilize an early season pulse of food descending to the benthos that results from sea ice algae formation in the spring during ice break up and limited water column grazing by zooplankton. Changing sea ice dynamics may be driving significant changes in the food web, with a shift to a more pelagic-dominated system, diminishing importance for benthic invertebrates in the food web. Increased open water periods will favor phytoplankton blooms and water-column grazing by zooplankton and fish. To investigate whether this shift is already evident, we used sea ice algae biomarkers including a highly branched isoprenoid (HBI) termed the Ice Proxy with 25 carbons (IP25) and other HBIs consistent with sympagic (ice-associated) and pelagic phytoplankton sources. This “H-Print” methodology traces the relative flow of organic carbon through the food web. We constrained the assimilation of HBIs into arctic clam tissues through an HBI-labeled algae feeding experiment. The assimilation of HBIs by these organisms was used to help evaluate their effectiveness for estimating the sea ice carbon contribution to walrus diets on a seasonal basis. We followed up these laboratory studies by measuring the HBI content of walrus livers harvested from Gambell and Savoonga, Alaska by local hunters. The results provide data on relative contributions of sympagic versus pelagic organic carbon sources since the 1990s and follow general declines in seasonal sea ice persistence. Initial results show a strong pelagic dependence in low sea ice years. We are planning to expand this work to include: 1) the analysis of HBI content in additional walrus prey items, including epifauna, benthic invertebrates and seals, 2) paired carbon and nitrogen stable isotope measurements that track trophic levels and carbon sources, and 3) extending the geographical coverage of samples.

WORKSHOPS

All Week

Lactation Station
8:00 a.m. – 5:00 p.m., Women's Restroom Next to Quarter Deck

Media Room
8:00 a.m. – 5:00 p.m., Resolution Room

EVOS 30th Anniversary Film Loop & Display (Mon. – Thurs.)
8:00 a.m. – 5:00 p.m., Adventure Room

Sunday 1/27

AMERICAN GEOPHYSICAL UNION (AGU) COMMUNICATIONS WORKSHOP
All Day, 1007 W 3rd Ave, Suite 100

This year, the Alaska Marine Science Symposium is partnering with the American Geophysical Union and their "Sharing Science" group to deliver a 1.5 day science communication workshop. Open to all scientists, science communicators, media, and other audiences. One-on-one consultation sessions will be available Monday morning for critque and evaluation of materials, products, and project ideas. Visit their website at: https://sharingscience.agu.org/

Monday 1/28

COMMUNICATING OCEAN SCIENCES WORKSHOP FEATURING JUDE ISABELLA
9:00 a.m. – 12:00 p.m., Ballroom | AGU Office Hours 2:00 p.m. – 4:00 p.m., Library

Each year, the Communicating Ocean Sciences Workshop provides practical information, great speakers and information on current best practices in education, outreach and media. In this hands-on workshop, Jude—author, editor-in-chief at *Hakai Magazine*—will focus on scientific writing, crafting compelling narrative, all the while paying particular attention to sentence structure. This workshop is free and space is not limited.

Tuesday 1/29

JUPYTER NOTEBOOK BOOTCAMP
1:00 p.m. – 5:00 p.m., Quadrant Room

Join the Python gurus from Axiom Data Science for a 4-hour session designed to get you excited about using Jupyter notebooks for reproducible analysis in the Research Workspace and beyond. This workshop will include a hands-on example of how to create and write a notebook that analyzes a simple dataset and creates publication-ready plots, as well as everything you need to know to get up and running with Jupyter notebooks. No experience necessary, though familiarity with Python or R is suggested.

OCEAN EDUCATOR NIGHT
5:00 p.m. – 7:00 p.m., Anchorage Hilton

Educators and scientists - Please join us Tuesday, 5:00 p.m. - 7:00 p.m. at the Anchorage Hilton Hotel for the third annual Ocean Educator Night. Details to follow as the symposium draws closer.

Wednesday 1/30

METADATA 411

1:00 p.m. – 5:00 p.m., Quadrant Room

This workshop will provide an overview of how to write metadata to describe scientific datasets. Presenters will demystify the content and scope of scientific metadata, describe its value to funders and scientists, and guide attendees on best practices for writing standards-compliant metadata. Attendees will gain a practical understanding of the information that makes up a metadata record while practicing by using the Research Workspace Metadata Editor. This workshop is aimed at scientists and technicians tasked with writing metadata or who want to better understand metadata and its creation. Attendees should bring a laptop and dataset of their own that they want to begin documenting. For more information, email your questions to metadata@axiomdatascience.

ALASKA MARINE ISOTOPE (AMI) WORKING GROUP

2:00 p.m. – 5:00 p.m., Whitby Room

Stable isotope techniques are widely applied to understanding organism and ecosystem-scale trophic and nutrient cycling processes. The increase in use of stable isotopes over 40 years in Alaska's terrestrial and marine systems highlights the need for centralizing methods and results that can better support future studies and enhance collaborations to address larger-scale questions. We propose the Alaska Marine Isotope Working Group (AMI) to bring together all investigators using stable isotopes within Alaska's marine systems. The goals of AMI will be to discuss potential connections in current and future work, standardize methods and collections, and to develop a centralized repository of isotope data for past, current, and future studies. The first meeting of AMI will occur as a breakout session within the 2019 Alaska Marine Science Symposium.

HARMFUL ALGAL BLOOMS (HABS) IN THE BERING SEA

5:00 p.m. – 7:00 p.m., Endeavor Room

The workshop will convene active researchers, local community members, and interested public to present results of current findings of occurrence and effects of HABs on marine life, humans, and subsistence hunting in the Bering Sea region. We will plan to engage all participants in discussing what next steps for research and monitoring need to be taken.

ARCTIC RESEARCH PLANNING NIGHT

7:00 p.m. – 9:00 p.m., Quarter Deck

Fairweather Science is hosting the annual Arctic Research Planning Night at the Quarterdeck. This event is held to facilitate collaboration, networking, and knowledge sharing among Arctic researchers. Please either send in advance or bring a thumb drive with a few slides that outline your research plans for 2019 and beyond. Include research platform (vessel, aircraft, etc), location of study, duration, objectives, types of data to be collected, available space, and length of contract. Send slides to Sheyna Wisdom at Fairweather Science (sheyna.wisdom@ fairweather.com). The Arctic Research Consortium of the U.S. (ARCUS) will have a resource table at the event.

30TH ANNIVERSARY OF THE *EXXON VALDEZ* OIL SPILL

7:00 p.m. – 8:00 p.m., Fore Deck

This year marks 30 years since the *Exxon Valdez* ran aground and the Alaska Marine Sciences Symposium is perhaps it's greatest legacy. Presenters at this session will examine how these observations informed damage assessments following two other major spills: the 2007 Hebei Spirit spill near Taean National Park, South Korea and the 2010 Deepwater Horizon spill in the Gulf of Mexico.

Thursday 1/31

NATIONAL GEOGRAPHIC SOCIETY EARLY CAREER GRANTS PROGRAM

11:30 a.m. – 1:00 p.m., Quadrant Room

The National Geographic Society invites current graduate students and recent graduates to attend a presentation on the National Geographic Grants Program, which provides grants to early career scientists, conservationists, storytellers, technologists, and educators. This presentation will provide an introduction to our grants and the application process, as well as share a unique opportunity for funding for Early Career Grant projects in Alaska. Following the presentation, there will be time to discuss questions, projects, and ideas with a National Geographic Grants Program Officer.

METADATA 411: OFFICE HOURS

1:00 p.m. – 5:00 p.m., Library

An open session for help writing metadata and preparing data to be archived. This is a BYOD (bring your own dataset) session with no formal instruction. Bring your laptop, your data, and your questions, and spend some time working on your metadata with some of the nerds from Axiom Data Science.

Friday 2/01

COOK INLET BELUGA WHALE MANAGEMENT, RESEARCH, AND PARTNERSHIP OPPORTUNITIES

8:00 a.m. – 5:00 p.m., Endeavor Room

Does your work involve studying, monitoring, managing, permitting, or funding projects related to Cook Inlet beluga whales? Do you want to share your knowledge, collaborate with, or develop partnerships with others conducting similar activities? If so, consider participating in the Cook Inlet Beluga Whale Management, Research, and Partnership Opportunities session during the 2019 Alaska Marine Science Symposium. This year, the Cook Inlet Beluga Whale Recovery Implementation Task Force will also meet during this session and will share progress to date. The session is scheduled for 8:30am-4pm on Friday February 21st, 2019.

PCCRC PI SYMPOSIUM

8:00 a.m. – 5:00 p.m., Adventure Room

Principle investigators and their graduate students will give 30 minute presentations on the status of research projects funded by the Pollock Conservation Cooperative Research Center.

ARCTIC INTEGRATED ECOSYSTEM RESEARCH PROGRAM (IERP)

9:30 a.m. – 12:30 p.m., Aft Deck

We invite you to join us to learn about the preliminary results of the Arctic Integrated Ecosystem Research Program and to discuss your ideas for new collaboration opportunities. We anticipate approximately one hour of presentations and plenty of time for collaborative discussions.

ALASKA COASTAL MARINE INSTITUTE, ANNUAL STUDIES REVIEW

12:00 p.m. – 4:00 p.m., Quadrant

This workshop presents updates on 10 current environmental research projects, including graduate student work, funded through the CMI Program. The CMI, a collaboration between the University of Alaska, the Bureau of Ocean Energy Management, and the State of Alaska, works to inform management of petroleum resources in Alaska's Outer Continental Shelf regions. The public is encouraged to attend and participate in learning about ongoing research programming.

GEOFENCES & WATCHDOGS: TOOLS FOR MONITORING AND MEASURING VESSEL TRAFFIC

12:30 p.m. – 1:30 p.m., Resolution Room

On any given day, there are 100-400 large vessels operating within the Alaskan Arctic. As sea ice continues to retreat for longer periods each year, managers and communities are increasingly interested in understanding traffic patterns. This project is funded by the Arctic Domain Awareness Center and is a collaboration between the Alaska Maritime Prevention and Response Network, Marine Exchange of Alaska, the Aleutian and Bering Initiative ("ABSI"), and the University of Alaska, Anchorage. We are developing a watchdog tool to report on vessel movements to parties who want to better understand large vessel traffic in particular areas. We are also developing another tool to create virtual fencing or "geofences" that can automatically send 'alerts' when large ships enter sensitive areas like waters around marine mammal haulouts. Please come offer your insights on how these tools can be designed to meet the needs of managers and communities working in Alaska's Arctic.