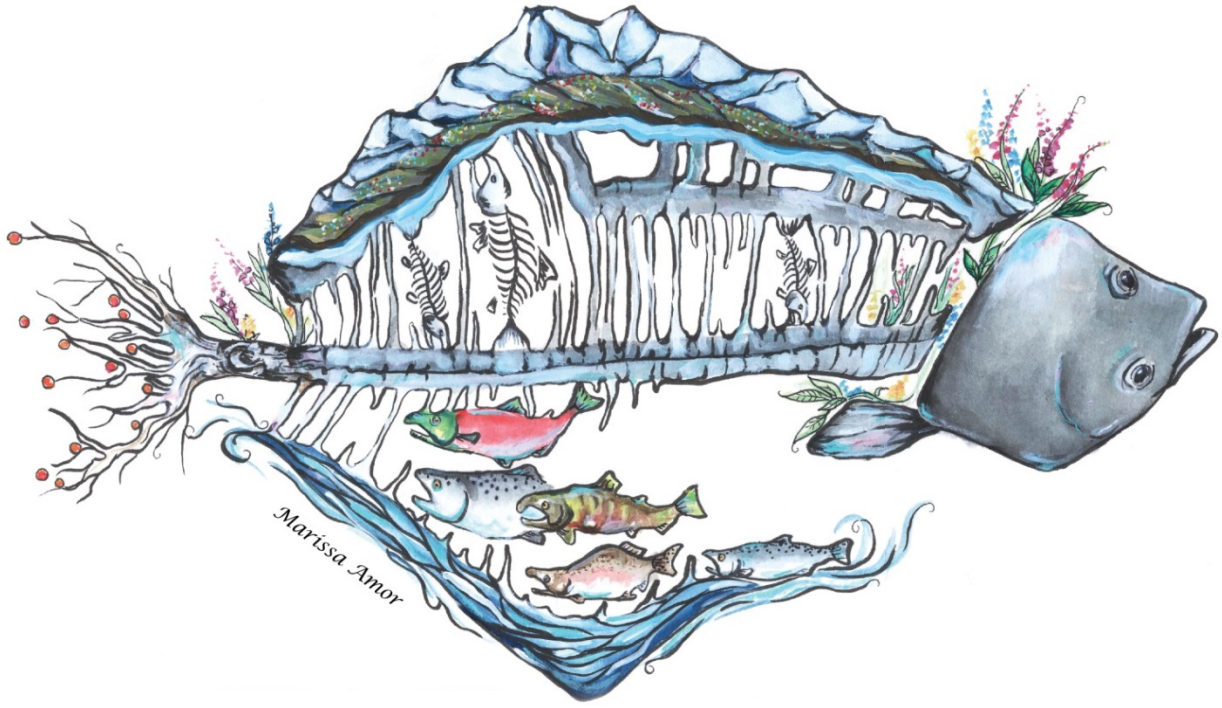
Conference Abstracts

ALASKAN FISHERIES AND WATERS:
SUCCESS, LIMITATION AND INNOVATION IN THE FACE OF DATA SCARCITY AND UNCERTAINTY

Fairbanks, Alaska • March 19-23, 2017



Joint meeting of the

American Fisheries Society, Alaska Chapter

American Water Resources Association, Alaska Section

AWRA

Community, Conversation, Connections

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Program at a Glance

Time	Event		Location/Room
Sunday, March 19, 2017			
8:00 - 16:00	Continuing Education	UAV-based Remote Sensing	University of Alaska Fairbanks campus
		Ice Jam Processes and Ice Discharge Measurements	University of Alaska Fairbanks campus
Monday, March 20, 2017			
10:30 - 17:00	Registration / Information		Westmark Hotel Hallway
8:00 - 17:00	Continuing Education	Electrofishing 2 Part Course	Chena Room
		UAV-based Remote Sensing (cont.)	University of Alaska Fairbanks campus
		Ice Jam Processes and Ice Discharge Measurements (cont.)	Rampart Room
12:00 - 19:00	Vendor Set Up		Minto Room
17:00 - 19:00	Welcoming Social		Westmark Hotel Northern Latitudes Room
Tuesdsay, March 21, 2017			
7:00 - 17:00	Registration / Information / Sales Desk Open / Vendor Set Up		Westmark Hotel Hallway and Minto Room
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7:00 - 17:00	Silent Auction		Yukon Room
8:00 -8:15	Welcoming and Plenary Introductions		Combined Gold Rooms
8:15 - 9:15	AFS and AWRA Plenary Speakers (1 each)		Combined Gold Rooms
9:30 - 12:05	Changing Processes		Middle Gold Room
9:30 - 12:05	Alaska Gems		East Gold Room
9:30 - 12:05	Statewide Chinook Salmon Research		West Gold Room
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13:30 - 17:30	Statewide Chinook Salmon Research (cont.)		West Gold Room
17:00 - 18:00	Poster Session Set Up		Morris Thompson Cultural &Visitors Center
18:00 - 21:00	Evening Social, Poster Session, & Film Festival		Morris Thompson Cultural &Visitors Center
Wednesday, March 22, 2017			
7:00 - 17:00	Registration / Information / Sales Desk Open		Westmark Hotel Hallway and Minto Room
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8:00 - 9:00	AFS and AWRA Plenary Speakers (1 each)		Combined Gold Rooms
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17:30 - 18:30	5K Run/Walk		Downtown Fairbanks - Course TBD
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19:00 - 22:00	Banquet / Awards / Live Auction		Combined Gold Rooms
22:00	After Party @ Lavelle's Tap House		Downtown Fairbanks
Thursday, March 23, 2017			
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7:00 – 16:00	Coffee and Refreshment Service		Westmark Hotel Minto Room
8:00 - 9:00	AFS and AWRA Plenary Speakers (1 each)		Westmark Hotel Gold Room
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15:30 – 16:00	AK-AFS Best Student Presentation and Poster Awards		Middle Gold Room
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18:00 - 20:00	World Ice Art Championship Field Trip		Downtown Fairbanks
Friday, March 24, 2017			
10:00 - 17:00	Chena Hot Springs Field Trip		Transportation Provided

Oral presentations abstracts are in order by session they are presenting. Poster session abstracts are at the end of this booklet. Student presenters are marked with an *.

Plenary Speaker Abstracts

Crowd-sourcing and creating interagency stream databases for broad geographic areas: Lessons learned in the American West with utility for Alaska

Dan Isaak: Research Fish Biologist, Rocky Mountain Research Station, U.S. Forest Service

Conserving and managing aquatic resources across broad geographic areas during times of rapid environmental change are significant challenges that require sound information for decision-making. New sensor technologies, genomics, geostatistics, and digital-social media provide powerful tools for developing that information through collaborative interagency networks, standardized data collections protocols, and centralized database teams that service the needs of many. In this presentation, I share lessons learned in the American West where our small technical team has facilitated coordination of temperature monitoring networks and aquatic biodiversity surveys using eDNA among >100 natural resource agencies across a land area comparable in size to Alaska. Key to efficient coordination at such massive scales is the consistent geospatial framework provided by the National Hydrography Dataset, which is under development for Alaska. Once a working system based on efficient data sharing and monitoring is developed among agencies, it creates synergies and efficiencies of scale as the underlying databases grow.

Clues in the Ice: Understanding Winter Hydraulics

Jon Zufelt: Senior Hydraulic Engineer, HDR

The hydraulics of waterways are defined by the relationships of discharge, depth, and velocity and how they influence sediment transport, scour, floodplain inundation, and assist in assessments of habitat suitability. When designing bridge crossings, culverts to accommodate fish passage, or flood protection for a river community we need physical measurements to properly characterize the hydraulics. In Alaska in particular, we must also consider the effects of ice covers, aufeis, ice jamming, and ice forces on structures. Winter data collection is difficult at best and often impossible for reasons of safety, cost, and logistics. Ice-affected hydraulic data usually has to be gleaned from observations of small changes or the aftermath of dynamic events. In this presentation, I will point out some of the sources of winter data, how to recognize hidden clues, and what these observations tell us about hydraulics under the ice.

Kuskokwim River Chinook Salmon Management and Prototype Structured Decision Framework.

Ken Stahlnecker: Refuge Manager, Yukon Delta National Wildlife Refuge; U.S. Fish and Wildlife Service

The Chinook salmon run on the Kuskokwim River in western Alaska is one of the largest in North America and supports one of the biggest subsistence Chinook salmon fisheries on the continent. Over the last decade, the Chinook salmon run has declined to historic population lows and remained at consistently low levels for an unprecedented numbers of years. The U.S. Fish and Wildlife Service assumed in-season management authority for Kuskokwim River Chinook salmon in 2014, 2015, and 2016 leading to weekly in-season management discussions between decision-makers. This plenary session describes the objective-based, stakeholder-involved decision making process employed during these discussions to provide a transparent and predictable process that uses best available science to determine the most effective management actions to meet salmon harvest and escapement targets on the Kuskokwim River.

Downscaled Climate Data for Alaska

Peter Bieniek: Research Associate, International Arctic Research Center, University of Alaska Fairbanks

Climate variability and change is occurring at an amplified rate in Alaska/Arctic compared to lower latitude regions with significant impacts on numerous local processes. Model projections indicate that these changes will continue

over the next century leading to a warmer climate than present. However, modeled reanalysis and GCM data are typically too coarse (i.e. grid sizes often ~100KM and larger) for addressing local climate impacts, especially in areas of complex topography. Downscaling is a collection of methods that help to bridge the gap between the limited coarse climate data and the need for finer-scale information. Downscaling activities are currently underway for Alaska and we will explore the types of data currently available, their uses and limitations.

Moving beyond point estimates: some challenges and benefits in presenting our scientific uncertainty.

Ian Stewart: Quantitative Fisheries Scientist, International Pacific Halibut Commission.

Fisheries science and stock assessment in particular, are rapidly improving the methods with which uncertainty is characterized and reported for management use. Clear separation of risk assessment and risk management results in a more transparent decision-making process. I will discuss the International Pacific Halibut Commission's process for addressing uncertainty within our stock assessment models as well as the structural uncertainty in how they are constructed. I will also suggest some avenues for further development in multi-model inference and weighting that are applicable to many fisheries applications.

Conserving Adequate Water for Alaskan Fisheries: limitations, innovation, and successes in the face of data scarcity and uncertainty.

Christopher Estes: Aquatic Resources and Habitat Scientist, Chalk Board Enterprises, LLC

Compared to the rest of the nation and many locations on the planet, a large proportion of Alaska's freshwater and estuarine waterbodies remain unaltered or have been subject to limited anthropogenic alterations. Conversely, there is limited inventory data for Alaska's water sources when compared to the remainder of the country. In this presentation, I will summarize opportunities and challenges for conserving (protecting, rehabilitating and enhancing) adequate amounts of water for fish, wildlife and associated habitat purposes. I will argue for increased individual and cooperative state, federal, industrial, academic, tribal, and private participation and investments in collection, analyses, and reporting of strategic hydrologic, hydrographic, and biologic data to improve and facilitate private and governmental outcomes associated with conserving adequate water flows and water levels needed to sustain fish and wildlife production. I will explain why and how these investments will benefit all Alaska's water stakeholders, result in better natural resource management, and contribute to improved socioeconomic benefits for all Alaskans.

Changing Processes

Perception and instrumented data, do differences affect ability to adapt?

Williams, Paula University of Alaska Anchorage
Alessa, Lilian University of Idaho
Krupa, Meagan University of Alaska Anchorage
Powell, James University of Alaska Southeast
Kliskey, Andrew University of Idaho

It is the consensus among climate scientists that changes mandating adaptation are happening now and will be a significant influence in the future, particularly at high latitudes. As Alaskans are faced with the need to adapt, whether or how we adapt depends upon our ability to perceive, with reasonable accuracy, what changes are occurring and the nature of those changes. For example, if our perceptions of stream temperature are inaccurate according to instrumented data, the actions we take based on those perceptions may be maladaptive. The difference between human perceptions of change and instrumented measurements of that change (perceived vs. instrumented, or PΔI) is a key driver of system dynamics within social-ecological systems. We thus propose the hypothesis that adaptive capacity is inversely related to delta: for a large delta, or more inaccurate perception of change, adaptive capacity will be lowered. We surveyed natural resource managers in southeast Alaska and in the Kenai River watershed and fishing guides who work on the Kenai River to determine their perceptions of abundance and size of Chinook salmon, and of key ecosystem indicators affecting salmon health. We compared perceptions to instrumented data. Results suggest that Chinook size was accurately perceived, but abundance was not. Perceptions of stream temperature, which is key to salmon survival, were not as nuanced as we expected of natural resource managers. Perceptions of other indicators (precipitation and air temperature) were marginally accurate if effect size

is considered. An important consideration from this research is the importance of observer characteristics, such as length of residence affecting frame of reference, when linking perceptions and instrumented data.

What the heck are random effects?*

Ganz, Phil D. University of Alaska Fairbanks

Biological processes that vary among individuals, populations, or regions, for example, can be expressed as fixed effects or random effects. Random effects are widely used in natural resource modeling endeavors and continue to gain popularity. While many modelers and non-modelers alike may be familiar with the interpretation of random effects in a linear model, fewer people—myself included—are as familiar with the interpretation of random effects in more complex models such as highly nonlinear stock assessments. Random effects can be a useful tool for describing uncertainty and variation over time and space, so a better understanding by all is beneficial. This presentation is an odyssey into the world of random effects: what they are, how they are used, how they should be interpreted, and what unifies their different uses. Scientists with a familiarity or desired familiarity with using random effects are encouraged to attend and join in the conversation.

The Application of Water Policy to Climate Change Adaption Planning for Alaska Native Communities

Shepherd, Hal S., Water Policy Consulting, LLC

Continued climate change in Alaska will cause adverse alteration of the coastal erosion, flooding, watershed hydrology, increased temperatures, altered sediment dynamics, reduced suitable physical habitat for fish, threaten human health and further stress subsistence resources that Alaska rural communities rely on. The session will emphasize the efforts of Alaska Native tribes, tribal consortiums, watershed councils, conservationists and other entities in bringing in an array of stakeholders and expertise, building partnerships, traditional knowledge and other information gathering, critical thinking, and engaged planning, to develop localized, actionable planning efforts that have strengthened their capacity to manage water resources and achieve resiliency to the inevitable impacts of climate change as, potentially, exacerbated by mining and Oil and Gas, Coal and hydropower energy development. The Session will focus on how Native Village and other rural communities in Alaska can apply the federal government's trust responsibility; government-to-government consultation; federal reserved water rights; tribal sovereignty; and human rights to address climate change, and the management and protection of water resources consistent with the cultural and traditional needs of Alaska Native tribes and villages. Continued climate change in Alaska will cause adverse alteration of the coastal erosion, flooding, watershed hydrology, increased temperatures, altered sediment dynamics, reduced suitable physical habitat for fish, threaten human health and further stress subsistence resources that Alaska rural communities rely on. At the same time, the inevitable impacts of climate change on the subsistence practices of Alaska Native Village communities are potentially exacerbated by on-going or proposed oil and gas, mining, hydropower and other energy development within watersheds in which such subsistence practices occur.

Rescuing skippers' logbooks to elucidate king crab distributions under changing temperature regimes. *

Sloan, Leah M. University of Alaska Fairbanks
Hardy, Sarah M. University of Alaska Fairbanks

Spatial distribution of fisheries species must be well characterized to avoid local depletions and to identify closure areas that minimize bycatch in other fisheries. The Bristol Bay red king crab (BBRKC) fishery is one of the largest crab fisheries in Alaska. One important component of BBRKC management is the existence of no-trawl zones, which protect crab from trawl fisheries. Recently there has been concern that these no-trawl zones are in the wrong locations and are not sufficiently protecting king crab. However, these concerns are difficult to evaluate because the survey that measures crab abundance and distribution occurs during the summer, while crab bycatch in trawl fisheries primarily occurs in winter. Daily fishing logs (DFLs), kept by skippers in the king crab fleet since 2005, contain detailed information on the spatial distribution of catch and effort in the fall/winter; however, the data within these hand-written logbooks has not been readily accessible. We have digitized DFLs and are using catch, effort, and catch per unit effort (CPUE) to elucidate fall/winter distributions of BBRKC. The distribution of BBRKC is highly correlated with the temperature regime in the Bering Sea; in warm years crab aggregate in the center of Bristol Bay, while in cold years they are closer to the Alaska Peninsula. These data should aid managers in evaluating whether current locations of no-trawl zones are effective and if they should shift under different temperature regimes. Current closure areas provide the most protection for BBRKC in warm years.

Salmon 2050: Using scenario analysis to develop an integrated understanding of uncertainty.

Trammell, E. Jamie
Krupa, Meagan
Powell, Jim
Rinella, Dan

Changing environmental conditions in Alaska pose a serious threat to salmon resources. However, models of future environmental conditions have significant uncertainty associated with the rate, magnitude, and location of change expected. Scenario analysis is an effective tool to quantify the uncertainty associated with environmental models and place it within a management context. Using a stakeholder-driven scenario framework, we identified critical uncertainties that are likely to impact the abundance of salmon in the Kenai River watershed. The critical uncertainties ranged from climate impacts to freshwater systems to whether participation in the personal use fishery would increase. Using best available data to quantify the uncertainty surrounding these drivers, we explore the range of uncertainties through logical sequences of events that combine to create scenario narratives. Narratives were specifically crafted to reflect different combinations of uncertainty, so that potential management responses can be crafted for different future situations. Five scenarios were developed to capture the complex interactions that comprise the Kenai River's social-ecological system. We utilize and present the scenario framework as a platform for integrating hydrologic, landscape, and cultural change information into actionable decisions, crafted by stakeholders, so that future resource management on the Kenai becomes more coordinated.

Pacific Salmon in the Face of Climate and Landscape Change: Insights from the Kenai River.

Schoen, Erik R. University of Alaska Fairbanks
Wipfli, Mark S. US Geological Survey
Trammell, E. Jamie University of Alaska Anchorage
Rinella, Daniel J. US Fish and Wildlife Service

Pacific salmon (Oncorhynchus spp.) populations face serious challenges from climate and landscape change, especially in the southern portion of their native range. Conversely, as their climate envelope shifts northward, salmon are colonizing Arctic watersheds with intact habitat. Between these geographic extremes, in the Gulf of Alaska region, wild salmon are highly abundant but face an uncertain future. We examined changes in climate (air temperature, precipitation, and river discharge), land cover (glacial melting, wetland loss, wildfire, and human development), salmon (abundance and body size), and fisheries (harvest, participation, and revenue) over the past 30-70 years in this region, with a focus on the Kenai River watershed. The Kenai River supports remarkably productive salmon runs and major fisheries; however, recent declines in the abundance and body size of Chinook salmon (O. tshawytscha) in this system and throughout Alaska have raised concerns about the resilience of these fisheries. Climate models indicate the region will continue to warm and experience drier summers and wetter falls and winters; however, the diverse landscape will 'filter' the effects of these changes on local habitats, which may favor some salmon species, populations, and life histories over others. Lowland salmon streams and rivers are especially vulnerable to many forms of environmental change, and loss of productivity from these populations might compel managers to limit harvest of stronger runs in mixed-stock fisheries. Some fishing communities are well positioned to shift among a portfolio of fluctuating resources, while others have become more specialized over time, potentially limiting their resilience. We discuss critical uncertainties and management decisions facing fishing communities in the Kenai River basin, as identified by local resource managers and policy makers. Finally, we discuss challenges and opportunities affecting these highly productive salmon-bearing ecosystems and their associated fisheries relative to others throughout the North Pacific.

Growth and Foraging Patterns of Juvenile Chinook and Coho Salmon in Three Geomorphically Distinct Sub-Basins of the Kenai River. *

Meyer, Benjamin College of Fisheries and Ocean Sciences, University of Alaska Fairbanks
Wipfli, Mark S. Alaska Cooperative Fish and Wildlife Research Unit, Institute of Arctic Biology, University of Alaska Fairbanks
Rinella, Daniel U.S. Fish and Wildlife Service, Anchorage, Alaska
Schoen, Erik Institute of Arctic Biology, University of Alaska Fairbanks, Fairbanks
Falke, Jeff, Alaska Cooperative Fish and Wildlife Research Unit, Institute of Arctic Biology, University of Alaska Fairbanks

Changes in air temperature and precipitation as a result of ongoing climate warming in South-central Alaska will impact juvenile salmon freshwater rearing habitat differently on the basis of local watershed geomorphic setting. Some South-central Alaskan salmon streams already experience water temperatures above Alaska Department of Environmental Conservation's maximum thermal criteria of 15°C during summer months, however the degree of future warming will vary by individual watershed. We selected three focal Kenai River tributaries – Beaver Creek, Russian River, and Ptarmigan Creek – to represent a lowland to montane spectrum of catchment geomorphic types with differing potential vulnerabilities to warming air temperatures. Water temperature and food resources are considered to be significant controls on growth of juvenile salmon; however, the influence of temporal and spatial patterns in these variables is not well characterized. Along with water temperature data, we collected diet samples (2015, n=452; 2016, n=504) and length/weight measurements (2015, n=1442; 2016, n=3520) from juvenile Chinook and Coho salmon across the three focal watersheds. Temperature, diet, and growth data are being incorporated into bioenergetics models that will allow us to determine the degree to which growth rates of juvenile salmon are limited by consumption rates and water temperature. As water temperature regimes respond to climate change, conditions may shift towards or away from optimal conditions for growth of juvenile Chinook and Coho salmon. Such changes will have long-term implications for productivity, maturation timing, and other demographics. Identification and conservation of different habitats that provide trade-offs in growth and survival may be important for long-term viability of populations in the context of climate change.

Climate and conspecific density trigger pre-spawning mortality in sockeye salmon (Oncorhynchus nerka). *

Tillotson, Michael D.
Quinn, Thomas P.

Pre-spawning mortality (PSM) has been occasionally observed in association with high densities of adult Pacific salmon (Oncorhynchus spp.), but because large escapements are rare, the phenomenon remains poorly understood. A large spawning escapement (~12 times the 54-year median, and 3X the previous maximum) to a small stream in Alaska provided a unique opportunity to explore the factors that contribute to density-driven spawning ground mortality. After comparing patterns of mortality in 2014 with over 20 years of prior abundance and environmental data, we identified low dissolved oxygen (DO) as likely contributing to PSM. We then utilized a fish habitat-DO model to explore the roles of density-dependent and -independent factors in reducing DO. Stream flow and spawning density were identified as primary drivers of oxygen availability. Despite suboptimal oxygen levels the salmon did not die abruptly. Rather, on average they lived as long as in previous years (mean = 9.99 d), but many (55%) failed to complete spawning prior to death. Our results suggest that this mortality was ultimately a density-dependent process, facilitated by low-flow conditions. Given projected effects of climate change on river flows and temperatures, similar events may occur more frequently in parts of the range of salmon where abundances remain high.

Influence of Water Temperature on Synchrony Spawning, Hatching, and Emergence of Coho Salmon on the Copper River Delta.

Campbell, Emily Dept. of Fisheries & Wildlife, Oregon State University
Reeves, Gordon US Forest Service, PNW Research Stn.
Dunham, Jason B. USGS, Corvallis, OR
Wondzell, Steven M. US Forest Service, PNW Research Stn.

Water temperature exerts a strong influence on the development rate of eggs and time of and size at emergence of Pacific salmon fry. We determined the time of spawning, hatch, and emergence, and size of fry at emergence of Coho Salmon in streams with different thermal regimes on the Copper River Delta, AK. Study streams included shallow flow paths (primarily surface water), deep flow paths (ground water), and a combination of these two. Spawning was significantly earlier (mid September – mid October) in the shallow flow path streams compared the streams with ground water (late November – mid December). Preliminary results indicate that the shallow flow path streams were warmer at the time of spawning but cooler during much of embryo development than the deep flow path streams, whose water temperatures were relatively consistent throughout the year. However, hatching and emergence were synchronous in the study streams even though accumulated thermal units (ATUs) differed. The preliminary results also show that the size of fry at emergence were statistically different among the streams, primarily as result of fish in one shallow flow path stream being smaller than those in the other streams. These patterns are consistent with other studies that examined the influence of water temperature on development of

Pacific salmon eggs and suggest that development is temperature specific and populations are adapted to local conditions. The timing of emergence coincides with a period of high productivity of aquatic macroinvertebrates, primarily Chironomids, in off-channel habitats used by recently emerged fry and likely strongly influenced the pattern of synchronization among streams. Changes in water temperature resulting from climate change are likely to be more pronounced in the shallow flow path stream than in the ground water stream, and thus, there may be more selective pressure on populations in those streams to adapt to the changing environment.

An Appraisal of Pacific Salmon's Nest Egg: Warming Climate Reduces Landscape-Scale Variability in Incubation Duration on the Copper River Delta, Alaska.

Adelfio, Luca A.
Reeves, Gordon H.
Wondzell, Steven M.
Mantua, Nathan J.

Increases in water temperature accelerate Pacific salmon (Oncorhynchus spp.) embryo development, impacting juvenile viability. Climate models project increases in air temperature and reductions in low elevation snowpack in coastal Alaska, but the effects of these changes on the salmon incubation environment are poorly understood. We collected hourly surface (stream) and shallow streambed (inter-gravel) water temperatures, year-round, at up to 18 spawning sites on the Copper River Delta. We regressed weekly mean air and water temperatures to determine thermal sensitivity, the increase in water temperature per increase in air temperature. We calculated accumulated thermal units (ATU) during the typical Coho Salmon (O. kisutch) incubation period (Oct-May) and modeled incubation duration during anomalously cool (<-1 °C), warm (>+1 °C), and climatological mean (-1 to +1 °C) incubation periods. We found that differences in catchment geomorphology determined the relative dominance of shallow vs. deep groundwater flowpaths and controlled thermal sensitivity, which varied among streams from 0.1 to 1.2. We observed significant inter-annual variability in monthly mean temperature at shallow flowpath sites, particularly during the spring and early summer (AMJJ), likely due to differences in snow and seasonal ice melt. Shallow flowpath sites accumulated significantly more ATU during warm, as compared to cool, incubation periods, resulting in up to 60% reductions in modeled incubation duration. Sites with upwelling deep groundwater were warmer than shallow flowpath sites during cool incubation periods and were less responsive to atmospheric changes. Thus, incubation duration was significantly more homogenous across the study area during warm incubation periods. This finding suggests that landscape-scale variability in incubation duration may be greatly reduced as air temperature increases and low elevation snowpack dwindles in coastal Alaska. Reductions in incubation duration may, in turn, impact other life history traits including spawn, hatch, and emergence timing as well as mean size at emergence.

Using Lake Trout (Salvelinus namaycush) Otoliths to Recreate Past Patterns of Recent Climate and Growth in Arctic Lakes. *

Torvinen, Eric S. College of Fisheries and Ocean Sciences, University of Alaska Fairbanks
Falke, Jeffery A. U.S. Geological Survey, Alaska Cooperative Fish and Wildlife Research Unit
Arp, Christopher D. Water and Environmental Research Center, University of Alaska Fairbanks
Sutton, Trent M. College of Fisheries and Ocean Sciences, University of Alaska Fairbanks
Zimmerman, Christian E. U.S. Geological Survey, Alaska Science Center, Anchorage, Alaska

The effects of climate change are amplified in high-latitude ecosystems, and due to the remote location of Arctic Alaska long-term spatially and temporally comprehensive climate estimates are needed. We applied biochronology techniques to predict recent (~40 years) climate patterns from annual growth increments imprinted on adult Lake Trout (Salvelinus namaycush) otoliths. Lake Trout were captured from 13 climate-sensitive, monomictic lakes in the Fish Creek watershed in Arctic Alaska during 2014 and 2015. Individual Lake Trout (N=53) ranged from 471-903 mm FL (mean = 589 mm), their readable annuli, representative of age, ranged from 9-50 annual growth increments. Following correction for age-related growth decline, we constructed a growth chronology for the period 1977-2014 and used model selection to identify the best predictive model of relative Lake Trout growth (ring width index; RWI) as a function of climate descriptors. A single covariate model was the best predictor and indicated that RWI tracked mean August air temperature recorded at a local weather station, for the period 1998-2013 ($P < 0.001$; $R2adj = 0.55$; $RMSE = 0.048$). Based on the RWI, no clear warming trend was apparent during the observational record period, consistent with station data. However, when RWI was predicted from modeled mean August temperatures, a clear trend was identified that showed increasing RWI from 1950-2014. Growth increments were

also used to perform length back-calculations, to estimate the growth coefficient K, as described by the von Bertalanffy growth model. We modeled K as a function of biological, physical, and ecosystem predictors. Ultimately, models including physical covariates (depth, distance to river, distance to coast, connectivity class, stream intersections) and sex ranked highest. Using otoliths as a data source provides a valuable opportunity to reconstruct patterns in recent climate and Lake Trout growth, critical data for conservation and management in the warming Arctic.

Are Dolly Varden "a winner" in a changing Arctic?

Seitz, Andrew C, University of Alaska Fairbanks College of Fisheries and Ocean Sciences
DeSanto, Harrison, University of Alaska Fairbanks College of Fisheries and Ocean Sciences
Courtney, Michael B., University of Alaska Fairbanks College of Fisheries and Ocean Sciences

Studies in Arctic Canada have demonstrated that some vertebrate species, including Arctic char, have increased in length, body condition, and maximum age over the last several decades as a result of a changing climate. We hypothesized that Dolly Varden char in Arctic Alaska may show similar trends in size. To test this hypothesis, an analysis was conducted on maximum size data (fork length) from Dolly Varden char captured in or adjacent to the Chukchi and Beaufort seas over the last 47 years. Significant increases in maximum length were found in Dolly Varden char from both the Chukchi ($p<0.001$) and Beaufort ($p<0.001$) seas and adjacent watersheds, as well as when data from both regions were aggregated ($p<0.001$). While data are incomplete and contain many caveats, the increasing trend in maximum length of Dolly Varden over time is believed to be related to increases in the length of the ice-free period, water temperatures and productivity during the Arctic summer. In conclusion, in terms of body length, Dolly Varden appear to benefit from changing conditions in the Arctic. However, several other facets of this species' life history and population dynamics remain unexamined and the true impacts of climate change on this species are unknown.

The influence of geomorphic and landscape characteristics on stream temperature and streamwater sensitivity to air temperature in the coastal temperate rainforest of southeast Alaska. *

Winfree, Michael
Eran Hood
Sveta Stuefer
Daniel Schindler
Christopher Arp

Climate warming is projected to increase the regional air temperature in southeast Alaska and alter precipitation patterns and storage, with potentially important implications for the region's aquatic resources. Streamwater temperature is controlled by energy inputs from the atmosphere and surrounding environment that are modified by a watershed's geomorphic and landcover characteristics. The climate-landcover relationships that influence stream temperature have not been comprehensively evaluated in southeast Alaskan watersheds. Thus, improving our understanding of current streamwater thermal regimes is critical to better assess how these regimes may be altered by climate change on a regional scale. In this study, seasonal streamwater thermal regimes in forty-seven watersheds across southeast Alaska were evaluated, and the influence of watershed geomorphic and landscape characteristics on stream temperature and streamwater sensitivity to air temperature was assessed. Stream temperatures were measured during the 2015 water year and analyzed for winter and summer seasons. Mean summer stream temperature ranged from 4.0°C to 17.2°C, while mean winter stream temperature were less variable across the region, ranging from 0.5°C to 3.5°C. Maximum weekly average temperatures (MWAT) ranged from 4.3°C to 21.5°C. Regression and time series analyses revealed that lower latitude, low gradient watersheds with higher lake coverage experienced warmer maximum and average summer stream temperatures and were more sensitive to air temperature fluctuations compared to higher latitude watersheds with high gradients during the summer. Winter mean stream temperature was warmer in higher gradient watersheds with greater forest and lake coverage. Moreover, higher latitude watersheds with steep gradients were less sensitive to changes in air temperature relative to low gradient / low latitude watersheds during the winter. Findings from this study demonstrate thermal regimes and air sensitivity are moderated by watershed geomorphology and landcover to create streamwater thermal heterogeneity across the coastal temperate rainforest of southeast Alaska.

Transforming AKOATS, the Alaska Online Aquatic Temperature Site, from Metadata to Mega-data without megabucks or mega-apps.

Geist, Marcus A. University of Alaska Anchorage, Alaska Center for Conservation Science

AKOATS, the Alaska Online Aquatic Temperature Site, is a statewide metadata inventory of existing and historic continuous monitoring locations for stream and lake temperature using a common set of attributes. Metadata are gathered from fish biologists, hydrologists, water resource managers, ecologists, and engineers. Users can access the inventory through an online, interactive map, via Google Earth, or import it directly into GIS software. The AKOATS total for sensors meeting minimum collection standards grew 33% from 2014 (n= 161) to 2016 (n= 215). The 2017 update is currently underway. While this metadata map coupled with a collection protocol and the establishment of minimum data standards are critical steps; we must now find reasonable methods to store, share, and analyze actual temperature measurement data in order to understand current and future trends in thermal regimes. By late 2017, the US Geological Survey plans to produce high resolution stream network data (NHD Plus) for portions of Alaska. These hydrographic data will enable analyses formerly restricted to the lower 48 states if we can assemble, process, and store our water temperature data. Building upon the November 2012 Alaska Stream and Lake Temperature workshop and the 2015 Data Storage, Harvest and Dissemination workshop; this talk will examine current opportunities for distributing water temperature data for Alaska. Various regional systems will be presented for consideration as potential solutions to meet our current challenge. This work was originally supported through a grant from the US Fish and Wildlife Service on behalf of the Western Alaska Landscape Conservation Cooperative (WALCC) and is currently maintained by the University of Alaska's Alaska Center for Conservation Science.

Snow persistence and snow regime mapping in Alaska.

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Snow persistence patterns affect the timing and magnitude of the spring freshet and late-melting snow drifts can make important contributions to summer stream flow. The entire archive of Landsat 5 TM, Landat 7 ETM+, and Landsat 8 OLI imagery collected between March 1 and August 31, 1999–2015 was analyzed to map the presence or absence of snow, with consideration given to clouds, cloud shadows, terrain shadows, and canopy cover. Google Earth Engine was utilized to rapidly classify and summarize the entire time-series. The time-series of observations were then pooled across all the years and a binary classification tree determined the day of year that best split the observations into a snow-covered and a snow-free season. The analysis was completed for most of Alaska and covers over 1.7 million square kilometers. The snow persistence product was validated using SNOTEL sites and MODIS time series metrics. We also combined the MODIS and Landsat metrics to develop annual maps of snow persistence at 30 m resolution. The snow persistence patterns are highly correlated with end of winter snow depth patterns in Arctic Alaska. We compared the Landsat snow persistence to the normal snow depth from repeat LIDAR surveys and field snow depth measurements and applied the results to estimate snow distribution over much larger regions. A nonlinear relationship between normal snow-free day of year and mean end of winter snow depth was observed. We developed models using Landsat snow persistence and topographic metrics to generate annual regional maps of end of winter snow depth.

Runoff generation from neighboring headwater basins with differing glacier coverage using a distributed hydrological model, Eklutna, Alaska . *

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Many Alaska glaciers are thinning and retreating, and the role of glacier wastage to catchment-scale runoff is poorly understood. Climate warming is projected to affect the quantity and timing of discharge from glacierized basins. Accordingly, effective management of glacierized watersheds requires quantification of a glacier's role on streamflow generation. The Eklutna catchment (311 km2) supplies water and electricity for Anchorage via Eklutna Lake (13 km2). The Eklutna headwaters include the West Fork (64 km2, 46% glacier), and the East Fork (101 km2, 12% glacier). Alaska Pacific University maintains seasonal weather stations and river stage gages, and measures annual glacier mass balances in the watershed. Total average annual discharge (2009-2016) is similar from the West (42,100 m3) and East (42,200 m3) forks, while specific annual runoff from the West Fork (2940 mm) exceeds that of the East Fork (1500 mm). To better understand what controls runoff, we are simulating the Eklutna annual water budget using a distributed watershed-level hydrological model. We force the Water Flow and Balance Simulation Model (WaSiM) using continuous air temperature, precipitation, wind speed, shortwave incoming radiation, and relative humidity primarily measured in the West Fork basin. We use Eklutna Glacier snow accumulation and ablation to calibrate the snowmelt and glacier sub-modules. Melt season discharge from the West and East forks is used for runoff comparison. Simulated glacier point balances are within 15% of stake observations. Runoff was effectively modeled in the West Fork (NSE=0.80), while being over-predicted in the East Fork (NSE=0.05), which we attribute to a lack of forcing data in the less-glacierized basin. The simulations suggest that 78% of West Fork total runoff is from glacier melt, compared with <40% in the East Fork. Using WaSiM, we can explore the potential implications of continuing negative glacier mass balances on runoff in the Eklutna basin.

Potential changes in stream discharge and ecology at the Arctic-Boreal Transition related to evapotranspiration and permafrost thaw.

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The Arctic-Boreal transition (ABT) zone of Alaska is experiencing rapid change related to unprecedented warming, vegetation encroachment, and permafrost thaw. These processes may alter discharge and nutrient regimes as streams lose water to evapotranspiration or infiltration into thawed soils. We used spatial variations in vegetation, aspect, and elevation to consider how warming may alter discharge, evapotranspiration, infiltration, and stream chemistry at the ABT. We monitored six streams in the southwest Brooks Range and used longitudinal discharge trends and diel variability to quantify stream water loss. While we would expect low-order mountain streams to be gaining, we observed that those with southerly aspects were losing water in at rates up to 103% of total discharge per km stream reach. Nitrate concentrations increased along north-facing/gaining reaches, indicating that that groundwater may serve as a source of nutrients to stream ecosystems. South-facing/losing reaches lost nitrate and gained chlorophyll-a, indicating primary production in the warmer streams. All streams displayed diel variability, but with different daily and seasonal trends related to aspect and elevation. South-facing, low-elevation streams showed discharge minima in the evening, and seasonal declines in the diel signature as the summer progressed, consistent with evapotranspirative demand. North-facing streams showed discharge minima in the morning, and seasonal increases in the diel signature as the summer progressed, possibly reflecting changes in water viscosity and/or freeze-thaw and exchange between the stream and riparian aquifer. These dueling diel signatures indicate that the two processes are competing for stream water in south-facing catchments. With continued warming, north-aspect streams may eventually act like today's south-facing streams, while south-facing streams may become increasingly productive, but at higher risk of desiccation due to the increased ET and infiltration potential. These findings have direct implications for lotic habitat and food webs, and for predicting how they may change in a warming Arctic.

Transport of CH4 through open-talik lakes in discontinuous permafrost aquifers. *

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As northern regions of the world experience warming climate, scientists look to permafrost, a crucial component of arctic and subarctic ecosystems, as a source and sink of atmospheric carbon. It is well-known that the thawing of permafrost from above as a result of warming climate is a considerable source of greenhouse gases. However, few

studies have considered the production of methane, a potent greenhouse gas, beneath the permafrost. A rugged permafrost bottom is proposed to favor the storage of gas in "pockets" that have been formed through permafrost thaw and degradation from below. Sub-permafrost methane can migrate to reach the atmosphere when connections between the sub-permafrost and supra- permafrost (open taliks) form or when changing permafrost morphology opens pathways from the pocket to the bottom of an open-talik lake. We hypothesize that the migration of methane into open-talik lakes from the sub-permafrost can occur through advection and diffusion as a dissolved gas and by movement as an immiscible fluid. Two lakes with varying degrees of talik formation within Goldstream Cr. Basin, Fairbanks, Alaska, serve as the major study sites. To distinguish advection and diffusion of dissolved-phase methane we analyze dissolved methane concentrations, stable isotopes and major ions as tracers and monitor hydraulic gradients. Monthly collection and analysis of water samples from surface, subsurface, and benthic sources allow for observation of seasonal changes in composition and flow dynamics. We test the occurrence of immiscible-phase flow through measurement of displacement pressures and aging methane captured in desaturated pore channels beneath the lake bottom. Results to date also bring attention to the complexity of open-talik systems that has previously not been observed. Data obtained in this study will aid in the understanding of greenhouse gas fluxes, and thereby improve research in climate change predictions.

Glaciated streams in Interior Alaska recharge aquifers.

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Stream discharge is typically measured at only one location of the same stream. Here we measured discharge continuously at two locations of an Interior Alaska stream that drains the glaciated north slopes of the Alaska Range. Glacier cover in the Alaska Range has decreased in the last decades (-12%), while winter discharge of the groundwater-fed Tanana River, Fairbanks, increased (+22%). We explored the role of glaciated headwater streams in recharging the aquifer, which, in turn, feeds the Tanana River. Our field measurements in Jarvis Creek (634 km2, 3% glacier cover), a headwater of the subarctic Tanana River, show that glacier runoff is a key component of total summer streamflow (33% in 2015 and 42% in 2016) and that this glacierized headwater stream is influent, where 23 (2015) to 30% (2016) of total summer streamflow is lost to the underlying aquifer. The decreasing mountain glacier cover may therefore have contributed to the observed long-term increase in winter discharge of Tanana River and possibly also the documented increase in winter flow of other larger Arctic rivers too.

Assessing the Risk of Marine Invasive Species in the Bering Sea.

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The Bering Sea generates half of the seafood harvest in the United States and sustains the subsistence culture of dozens of coastal Alaskan communities. Potential introductions of marine invasive species through ballast water exchange and hull fouling from global and regional vessel traffic is a heightened concern in Alaska and throughout the Arctic. The Bering’s history of geographic isolation has kept the potential for marine invasive species introductions relatively low, but new patterns in global shipping traffic and an expanding footprint of development in the Arctic may heighten the risk of introductions. The region’s climate has also changed, supporting in a northward range expansion of warm water species. The Bering Sea is a high volume corridor for international shipping, is central to expanding Arctic commerce, and hosts substantial commercial fishing traffic from the northwest coast of the U.S. and Canada. These vectors, combined with its range of marine environments, make it a bellwether for more broadly assessing risk from marine invasive species in Alaska. To assess the risk of invasive species to the Bering Sea we have developed a quantitative invasiveness ranking system and have applied it to a list of more than 50 marine species that may threaten commercial fishing and subsistence activities vital to the region’s communities. Using species-specific biological characteristics in relation to shipping traffic pathways and water temperature profiles for the Bering Sea, we spatially illustrate regions in the Bering Sea that are most likely to experience future increases in invasive species abundance. Our work, including the ranking system, the identified

species of greatest risk, spatial depiction of high-risk infestation areas, and resulting outreach efforts are a useful model for managers elsewhere in the state to evaluate risk and raise awareness of the threat from marine invasive species.

It's what you don't know that gets ya - Implementing an early detection rapid response plan for aquatic invasive species in data poor environments.

Martin, Aaron, U.S. Fish and Wildlife Service
Stewart, Heather, Alaska Dept. of Natural Resources Davis
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Due to the effects of heightened tourism and population growth among other pressures, Alaska is highly vulnerable to the introduction and expansion of aquatic invasive species (AIS). Preventing AIS introductions and controlling established populations is a serious and urgent challenge in Alaska because many aquatic systems still have few or no invasive organisms. However, unwanted invasions are a rapidly increasing threat to maintaining self-sustaining fish populations and their habitats, and as a result are a threat to Alaska's economy, subsistence cultures, and quality of life. Although preventing the introduction of AIS is the highest priority, we recognize that, with the connectivity and reliance of outside commerce and the tourism in Alaska, too many introduction pathways exist to completely prevent invasion. The sooner an invasion is detected, the more cost effective the management actions will be. This presentation will focus on a shared vision of what a statewide comprehensive early detection rapid response consists of, how it is being implemented now, and what opportunities exist for collaboration to assist state, tribal, and federal land managers in conserving and restoring our aquatic resources.

Elodea Eradication: The Good, the Bad, and the Needed.

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Elodea is still at the forefront of freshwater aquatic invasive species management in Alaska. After setting the stage for successful management with herbicides on the Kenai Peninsula in 2014, other areas are following suite. To date, Elodea on the Kenai Peninsula has not been detected since 2015, and lakes are in a monitoring status while the rest of the Peninsula is still being continually surveyed. Anchorage started their first herbicide applications in 2015, including in the world's busiest floatplane base: Lake Hood. In 2016 no Elodea in the treated lakes was found, but a newly discovered infestation in Potter Marsh delays Anchorage from getting an Elodea eradication success "stamp". In the Matanuska-Susitna, Alexander Lake is the only known infestation, and is currently being treated after an unprecedented spread in two years; 10 to 500 acres. However, not enough surveys have given a clear picture of Elodea's distribution in vulnerable areas. A recent study shows that the Mat-Su as well as the Interior's Yukon watershed are the most vulnerable habitats for Elodea. Herbicide treatments in Interior Alaska are approved by State and Federal agencies by awarded permits and collaborative efforts, however, lack of funding for management would further delay or even make eradication impossible. More is needed for statewide Elodea eradication success. More on-the-ground surveys are needed in areas where habitat vulnerability studies and floatplane pilot destination investigations demonstrate a high likelihood Elodea is capable of being present. A fully collaborative approach where all agencies agree to meet the goal of eradication is needed, so that one area's efforts aren't going to have to be repeated. And finally, pursuits of funding and shared resources is needed for the whole State to be successful reaching our goal.

Trophic plasticity of a renowned piscivore: Dietary patterns of Northern Pike in its native and introduced range of Alaska.

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While native to large parts of Alaska, introductions of Northern Pike (Esox lucius) to the Southcentral region have resulted in variable effects on native fish communities with extreme cases being extirpation or severe declines of native stickleback and Pacific salmon populations. The potential for Northern Pike to broadly impact aquatic communities relates to its dietary capacity that can include various invertebrate and vertebrate prey sources. However, the trophic ecology of Northern Pike in its native or invaded range of Alaska is not well known. Using Canonical Correspondence Analysis to analyze diets from native (3 lakes) and nonnative (25 waterbodies) we characterized trophic patterns of Northern Pike populations in Alaska by testing for differences in diet composition (frequency of occurrence) based on Northern Pike size class, location, Northern Pike origins, taxa consumed, and

prevalence of cannibalism. This enabled a characterization of trophic orientation (i.e., generalist, specialist) among diet types (i.e., invertivorous, piscivorous, cannibalistic) across different size classes of predators (small, medium, and large). Common gradients identified among populations of all size classes involved 1) diet compositions that ranged from piscivory to macroinvertebrate-dominated omnivory and 2) trophic orientation indicated by specialization or generalization of taxa consumed. These results highlight the trophic plasticity of Northern Pike populations and potentially enable them to act as key predators, especially in novel environments.

Electrofishing and Kick Seining Efforts for Invasive Signal Crayfish (Pacifastacus leniusculus) on Kodiak Island, Alaska.

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Signal crayfish (Pacifastacus leniusculus), which are not indigenous to Alaska, were first recorded in the Buskin River Watershed on Kodiak Island in 2002. Since then, several organizations have noted the presence of signal crayfish within the watershed. In 2015, trapping efforts by Kodiak Soil and Water Conservation District found gravid female signal crayfish, indicating a breeding population. In 2016, the Bureau of Indian Affairs Invasive Species Program provided funding for Sun'aq Tribe of Kodiak to survey for signal crayfish within the watershed. To enhance the success of signal crayfish detection and removal from the watershed, this project utilized capture methods not previously used by others, including kick seining and electrofishing techniques. Trapping and kick seining for crayfish resulted in few specimens captured. However, electrofishing for crayfish proved more effective in numbers captured and in variety of age classes. Based on anecdotal information, the general public increased utilization of signal crayfish for consumptive uses in 2016. In particular, snorkeling/free diving has proven to be most successful. Survey results, partnerships and collaboration with the public will be discussed in this presentation.

Trophic Ecology of Heavy Metals in Lake Atitlán, Guatemala. *

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Lake Atitlán is a volcanic lake in the southwestern highlands of Guatemala, located in the Sololá Department. It is the biggest inland water body in Central America and one of Guatemala's top touristic attractions. Lake Atitlán has undergone dramatic ecological changes during the last decade. It experienced cultural eutrophication that triggered a cyanobacteria bloom (Limnoraphis robusta) in 2009 (Rejmankova et al., 2011). The Tropical Storm Agatha washed in sediments from the watershed that increased Phosphorus (P) concentrations temporarily in the lake by over 60% in 2010 (Corman et al., 2015). The lake has a record of invasive fish species; like the Black Bass (Micropterus salmoides) that contributed to the extinction of the endemic Atitlán Grieve (Podilymbus gigas), the Carp (Cyprinus carpio) that raises the trophic level of the lake, and the South American devilfish (Pterygoplichthys disjuctivus) appeared for the first time in 2017. Lake Atitlán suffers from an extensive use of agrochemicals in its watershed, such as fertilizers with high levels of Phosphorus and Nitrogen, and pesticides with high concentrations of heavy metals (OIRSA, 2006). The first part of my study reveals the new fisheries structure and the lake trophic web using diets and stable isotopes of Carbon (13) and Nitrogen (15). I expose the relative dominance of the invasive fishes over the native species, and the differences in the lake biochemistry regarding location. The second part of my study elucidates the heavy metal ecotoxicology of the lake's snails, crabs and fishes, showing that the aquatic invertebrates have higher levels of toxic metals than the fishes. In this study, I elaborate a modern fish inventory for Lake Atitlán, set a base for invasive species management and elucidate the toxicity risks for the locals, who consume the snails, crabs, and all fish species as their main source of protein.

Alaska Gems

Where Do They Go and How Do They Get There? Juvenile Coho Salmon Overwinter Habitat Selection.

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The amount and quality of in-stream rearing habitat can influence the survival and growth of juvenile Pacific salmon. While seasonal habitat use of juvenile Coho salmon (Oncorhynchus kisutch) in freshwater has been examined in open-water environments, understanding of overwinter habitat use in ice-bearing systems remains nascent. Juvenile Coho Salmon (JCS) remain in their natal streams for 1 - 4 years before smolting and demonstrate seasonal changes in habitat occupancy. Generally, fish occupy higher-flow main stem habitats in the summer and move to lower-flow off channel habitats in the winter. To date, there has been a lack of work focused on the habitat use and overwinter seasonal dispersal strategies of this species in regions with prolonged periods of freezing temperatures and persistent ice cover. In this study, passive integrated transponder (PIT) tags were used to track the seasonal movement of 3,305 JCS in two sub-drainages (Meadow Creek and Fish Creek) within the Big Lake watershed, located in Southcentral Alaska. Seven off-channel overwintering areas were identified, the majority of which were lakes. The importance of distance from the estuary, dispersal direction, and fish length on overwintering area choice was examined using a classification tree framework owing to its flexibility in assessing the relationship between predictor variables and dispersal pathways in predicting overwinter area selection. Fitted models were successful at describing overwinter location selection, producing low misclassification rates ranging from 9 – 13%. Dispersal direction was the most important predictor of overwintering area choice for fish tagged in the Meadow Creek sub-drainage for both years, and distance from the estuary was the most important for the Fish Creek sub-drainage. The consistency of model results across years and drainages demonstrated that overwinter redistribution behavior of JCS was regular and predictable, emphasizing lakes as strongly preferred overwinter habitats.

Water Faucets, Back Alleys and Haul Outs: Groundwater Guiding Salmon Through Warm Streams.

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Mauger, Sue Cook Inletkeeper

Life is challenging for juvenile Coho Salmon growing up in the creeks and connected lakes of the Big Lake basin in upper Cook Inlet. Summer temperatures are warmer than cold-water fish like and, with many predators lurking about and high flows to contend with, getting big enough to make a dash for marine waters is not easy. Fortunately, scattered throughout the basin are unique groundwater–fed habitats bringing in colder water and providing spaces to escape from predators and faster flows. For a fish biologist, these groundwater faucets, back alleys and haul outs are not always easy to find instream but by using thermal infrared imagery (TIR), we can locate these refugia that may be critical for juvenile salmon survival. In 2015, we used TIR to guide site selection within the Big Lake basin to determine if Coho Salmon preferentially use cold-water habitats for summer rearing. We selected sites in Fish, Herkimer and Lucille creeks and sampled reaches with measurable influence from cold-water inflows and compared them with control reaches. Our results reinforce the value of groundwater-fed habitats and offer insight for targeted protection of salmon habitat within the Big Lake basin in the face of rising stream temperatures.

A remote sensing and occupancy estimation approach to quantify spawning habitat use by fall Chum Salmon (Oncorhynchus keta) along the Chandalar River, Alaska. *

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Groundwater upwellings provide stable temperatures for overwinter salmon egg development and this process may be particularly important in cold, braided, gravel-bed Arctic rivers. Aerial counts and remote sensing were used during 2013-2015 to estimate fall Chum Salmon spawner abundance states (e.g., low or high), classify river segments by geomorphic channel type (primary, flood, and spring), and map thermal variability along a 25.4 km stretch of the Chandalar River in interior Alaska. We delineated 330 unique river segments (mean length = 536 m) and used a multi-season multistate occupancy model to estimate detectability, occupancy, and local colonization and extinction rates. Triplicate surveys performed in 2014 allowed us to estimate detectability and the influence of observer bias. We found that detectability did not vary by observer, channel type, or segment length, but was better

for high abundance (0.717 ± 0.06 SE) relative to low abundance (0.367 ± 0.07 SE) aggregations. After correcting for imperfect detection, the proportion of segments occupied by spawning fall Chum Salmon was highest in 2014 (0.41 ± 0.04 SE), relative to 2013 (0.23 ± 0.04) and 2015 (0.23 ± 0.04). We found that unoccupied segments were likely to remain so from year to year (2013→2014 = 0.67; 2014→2015 = 0.90), but low abundance spawning segments were dynamic and rarely remained in that state. One-third of high abundance sites remained so, indicating the presence of high quality spawning habitat. Mean segment temperatures ranged from -0.5 to 4.4°C, and occupancy varied positively with temperature. We predicted a 50% probability of occupancy in segments with temperatures of 3°C. Because the Chandalar River supports 30% of the fall Chum Salmon run in the Yukon River Basin, information such as this study has provided will be critical to allow resource managers to better understand the effects of future climate and anthropogenic change in the region.

Generalist feeding strategies of Arctic fishes stabilize lentic food webs.

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Variation in food resource availability is common in cold climate regions and fluctuation in resource density favors generalist species that can feed across multiple habitat types and trophic levels. Further, consuming prey from different sources imparts stability on food webs through the use of readily available, alternative energy pools. In lakes, generalist fish species take advantage of fluctuating prey availability by switching from benthic macroinvertebrates to pelagic zooplankton to meet their bioenergetic demands. We examined the feeding habits of fish species in lakes of the central Arctic Coastal Plain (ACP), Alaska, to determine the prevalence of their generalist feeding strategies as a mechanism for persistence in harsh environments with short growing seasons. Generalist feeding strategies were evident in adults of five common fish species: Alaska Blackfish Dallia pectoralis, Ninespine Stickleback Pungitius pungitius, Least Cisco Coregonus sardinella, Broad Whitefish C. nasus, and Arctic Grayling Thymallus arcticus. Analysis of diet composition suggested these fish switch food items, feeding on benthic and pelagic prey and across trophic levels. Diptera (mainly Chironomidae) and Cladocera consistently appeared in the diets of all fish, and 70% of the variation in diets between fish could be demonstrated with 12 prey taxa, yet all pairwise comparisons between fish species showed dietary differences exceeded 65%. For example, Alaska Blackfish fed on a higher proportion of benthic invertebrates than Ninespine Stickleback, which consumed greater proportions of pelagic prey. However, Alaska Blackfish also regularly consumed fish, often Ninespine Stickleback, thereby indirectly consuming pelagic energy sources. The use of diverse prey from multiple energy sources by Arctic fishes creates redundancy in ACP lentic food webs, making them more resistant to perturbations or stochastic events. Therefore, the generalist feeding strategies employed by ACP fish should maintain energy flow and food web stability in the face of landscape and climate change.

Predation on Salmon smolts by Dolly Varden in estuaries near Juneau, Alaska.*

Douglas Duncan
Anne Beaudreau

Estuaries in Southeast Alaska play an important role in the life histories of commercially important Chum Salmon (Oncorhynchus keta), and recreationally important Dolly Varden (Salvelinus malma). For Chum Salmon smolts, estuaries serve as transitional habitats that allow them to physiologically adapt to saltwater, feed, and grow before moving offshore. Anadromous Dolly Varden also use these same estuaries as movement corridors and feeding grounds in the spring and early summer. The spatial and temporal overlap of Dolly Varden predators and potential smolt prey in these habitats has contributed to historical controversy and research about the importance of salmon smolts in Dolly Varden diets. However, there have been few recent assessments of this question or more general inquiries about Dolly Varden food habits in marine waters. This project seeks to quantify the diet composition of Dolly Varden in estuaries with varying salmon smolt densities. We used beach seines to sample the fish community composition at 4 estuaries near Juneau, AK, from May to September of 2016. Catch data from seining provided information about the relative density of predators, salmon smolts, and other potential prey fish at each site. Dolly Varden (N =156; 120-516 mm FL) captured in the seine were retained for stomach content analysis. Our diet data

indicated that smaller Dolly Varden tended to consume invertebrates such as gammarid amphipods and cumaceans, while larger individuals ate substantially more fish including salmon smolts (Oncorhynchus spp.), Pacific Sand Lance (Ammodytes hexapterus), and Snake Prickleback (Lumpenus sagitta).

Characterizing the diet of Arctic lamprey Lethenteron camtschaticum using Next-generation sequencing (NGS) .*

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Documenting predator/prey interactions is essential to help build our understanding and guide our management of marine ecosystems. The overarching goal of this study is to improve our understanding of Arctic lamprey Lethenteron camtschaticum predation in the Bering Sea ecosystem. To accomplish this goal, evaluations have been initiated to (1) characterize the diet of marine-phase Arctic lamprey using next-generation sequencing (NGS); and (2) assess if predation varies with body size or location. Adult, marine-phase Arctic lamprey were collected in 2014 (n = 128) and 2015 (n = 129) during the Northeast Bering Sea Trawl Survey (NOAA). A visual examination of gut contents revealed the presence of: scales, otoliths, eggs, vertebrate, fin rays, and pyloric caeca, suggesting a predatory feeding approach. The remaining gut contents were homogenized and total genomic DNA was extracted. The 12S ribosomal DNA sub-unit was targeted during PCR amplification. Pooled PCR products were used to prepare next generation sequencing libraries for the Illumina MiSeq platform. The run yielded 9.5 million raw reads. The reads were processed through a bioinformatics pipeline to form a final sequence library, which was compared to the Mitochondrial Genome Database of Fish (MitoFish) using the Basic Local Alignment Search Tool (BLAST). Recovered sequences were assigned to nine taxonomic ranks that included seven genera (Pacific salmon Oncorhynchus spp., cod Gadus spp., sand lance Ammodytes spp., herring Clupea spp., stickleback Pungitius spp., fathead Malacocottus spp. and prickleback Leptoclinus spp.), and two families (Osmeridae and Pleuronectidae). Investigations are ongoing to assess if predation varies with body size or location. The results from this research will inform researchers and management agencies about the ecosystem roles and interactions between Arctic lamprey and prey species.

Assessing a role for environmental DNA occurrence data in modeling species distribution: A case study of wood frogs in Alaska. *

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The detection of aquatic species in landscapes using environmental DNA (eDNA) assays is increasingly applied as a monitoring tool in fisheries and wildlife biology. In addition to detecting rare, cryptic, and invasive species in complex landscapes, the eDNA approach has been applied to studies of site occupancy, species abundance, and biodiversity assessments. Lingering uncertainties regarding the technique's sensitivity to environmental variables and human error have prevented its widespread adoption in studies of species distribution. We assessed the ability of eDNA occurrence data to inform species distribution models under four scenarios of data interpretation. We sampled 60 wetlands for eDNA in the Fairbanks metropolitan area during summer 2015. Genomic DNA was extracted from eDNA filters using a phenol-chloroform isolation method. We targeted a 115 base-pair region of the wood frog cytochrome B gene for qPCR amplification. A qPCR score was assigned to each sample based on the number of resulting positive amplifications (four technical replicates). By designating each score (1-4) as the minimum required threshold for species occurrence, we analyze four different scenarios of data interpretation. Occurrence data under each scenario was modeled using the Salford Predictive Modeler suite of algorithms with 42 environmental layers covering the Fairbanks North Star Borough. Predictions from these models were then assessed with seventy open-access wood frog occurrence data points within the study area. Our models suggest that a relaxed approach to data interpretation (1 of 4 technical replicates implies species present) results in the highest performance (ROC = 0.89, var = 0.0020). This highlights the importance of weak signals in eDNA data and the need to implement strict lab hygiene and quality control practices. By analyzing eDNA data with machine learning techniques, we show a powerful new way to study aquatic species distribution in Alaska and beyond.

Vertical movement and temperature experience of Greenland turbot in the Eastern Bering Sea

Coutre, Karson M. Earth Resources Technology, Inc. Alaska Fisheries Science Center, National Oceanic and Atmospheric Administration

Greenland turbot are a cold water flatfish species with a circumpolar distribution. In the North Pacific Ocean they are found in highest densities in the Bering Sea and Aleutian Islands, two regions in which they are commercially exploited. The horizontal and vertical migration of Greenland turbot have not been extensively studied, however turbot are generally found in shallower waters on the shelf as juveniles and migrate onto the continental slope as they mature. Describing turbot movement and depths and temperatures inhabited in the Bering Sea can provide insight into the impacts of shifts in climate and fishing behavior on the turbot population. This study analyzed adult Greenland turbot vertical movement and the relationship between movement and temperatures encountered in the Bering Sea using archival tag data. Archival tag detections from 12 Greenland turbot spanned 2003–2014 with mean depths for individual fish from 450 – 725 meters and mean temperatures from 3.2–3.7 °C. The average distance between fish release and recapture location was 64 nautical miles with a maximum of 306 nautical miles and the majority of releases and recaptures occurred near or on the shelf break. All of the tagged fish that were at liberty for 1+ years (n=8) exhibited seasonal differences in depth and vertical movement with an overall trend of shallower depths in the summer, suggesting movement on or towards the shelf. In winter months there were more occurrences of deep dives. For example, one fish descended from 850 to 1500 meters within a span of 15 hours. The range of temperatures experienced increased as depth decreased and there is evidence that some tagged turbot were on the continental shelf experiencing Bering Sea cold pool conditions in the summer months. Future work will investigate the relationship between vertical activity and diel and lunar cycles.

Movement Patterns and Habitat Use of Juvenile Sablefish in Southeast Alaska. *

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Beaudreau, Anne H. UAF-CFOS
Green, Kristen M. Stanford University

Sablefish (Anoplopoma fimbria) is one of the highest valued groundfish species targeted in Alaska's commercial fisheries. A declining trend in sablefish relative abundance has been observed since 1988, and few strong year classes were identified after 2000. With high abundance of age-1 juvenile sablefish indicative of a strong year class, it is crucial to gain a more comprehensive understanding of the spatial and temporal extent that juvenile sablefish use nearshore habitats, where they settle for one to two years before emigrating to offshore waters. Acoustic telemetry allows for a long-term, fine-scale study of fish movement and habitat use along with the ability to relate behaviors to habitat conditions and environmental factors. To investigate juvenile sablefish movement patterns and habitat use within a nearshore bay, 40 age-1 and age-2 individuals were captured, measured, weighed, surgically implanted with acoustic tags and subsequently monitored on an acoustic array of eight acoustic receivers during 2015-2016 in St. John Baptist Bay, Baranof Island, Alaska. Of the 40 tagged juvenile sablefish, 30 individuals were detected moving throughout the receiver array and were used in analysis (18 individuals in 2015 and 12 individuals in 2016). Coarse-scale spatial distributions and horizontal movements, as well as variation among individuals, were analyzed to identify site fidelity and home-range of each fish. Results from the Residence Index analysis show tagged juvenile sablefish were detected more often near the head of the bay during the early summer, while during late summer, their movements at the mouth of the bay became more frequent. As one of the first long-term acoustic telemetry studies to monitor the fine-scale movements of juvenile sablefish over two years, this study provides new insights into the movement patterns and habitat use of juvenile sablefish and allows for a better understanding of their early life history.

Science in Support of Alaska's Future

Integrated Ecological Assessments: Quantifying Intactness and Cumulative Change throughout Alaska.

Trammell, E. Jamie
Geist, Marcus A.
Aisu, Megumi

Alaska is largely considered pristine, yet faces increasingly complex biophysical and socioeconomic threats to its intact ecosystems. Understanding the context, rate, magnitude, and location of potential changes is essential for

resource managers making decisions today. Building off several large-scale efforts, we present here a new model of landscape intactness that provides context for current landscape functionality, and a new index of environmental stressors that quantifies the cumulative nature of expected broad-scale changes. Using best available geospatial information on human land use and activities, we have developed a statewide landscape condition model that quantifies the human footprint in Alaska, and summarizes by watershed the relative of level intactness. We then utilized an ecoregional conceptual model to identify ecosystem-specific stressors and summarize significant potential changes by watershed. By combining the two, managers now a spatially-explicit tool for understanding ecological integrity that can be applied to both terrestrial and aquatic resources. By identifying watersheds that are most likely to change due to non-local decision making, managers can better understand the cumulative effect of local land use decisions on watershed health.

A Review of Hydrologic and Fish Studies in the National Petroleum Reserve – Alaska (NPR-A) Prior to Petroleum Development.

Arp, Christopher D. University of Alaska Fairbanks*
Whitman, Matthew S. Bureau of Land Management

After almost two decades of planning for new oil development in the eastern NPR-A, a major permanent road and production pad are being built during the winter of 2016-17 with scheduled completion within the next year. Stream and lake monitoring and fish ecology studies conducted in this area were designed to provide a process baseline prior to development, such that changes caused by new industrial activities can be separated from responses to climate change. The focal unit for these studies is the catchment of Crea Creek, a beaded stream draining a 23 km2 area composed of tussock tundra, thermokarst lakes, and drained thermokarst lake basins, where a major portion of new infrastructure is being built. This intensively monitored and studied catchment, along with five other catchments selected as reference sites or in response to other completed or plan development, is located in the lower portion of the 4500 km2 Fish Creek Watershed (FCW). This drainage is one of the largest entirely coastal plain watersheds in Arctic Alaska and has long been an important region for subsistence activities because of its proximity to the Native Village of Nuiqsut. Broader landscape-scale research on environmental responses to climate change in Arctic Alaska have been integrated with baseline studies in the FCW and Crea Creek, in part to give essential context for assessing coupled responses to land-use and climate change. This framework provides a valuable case study for adaptive management in the NPR-A, which will soon be put to the test. A review of an eight year baseline of stream hydrology data will be given along with results from fish foraging, habitat, and migration studies in the context of observed and modeled climatic responses of relevant arctic systems.

Streambed Scour Monitoring in Alaska, Successes, Challenges, Data, and Debris.

Beebee, Robin A. U.S. Geological Survey

The U.S. Geological Survey Alaska Science Center has continuously monitored streambed elevations at bridges around Alaska since 2001 using underwater sonars. The monitoring network grew from two sites in 2001 to a maximum of 19 sites in 2007. All monitored bridges are considered “scour critical”, which means that an engineering analysis predicted that the bridge foundation could be undermined by removal of streambed material during the design flood. Monitoring bridges directly provides an early warning for the Alaska Department of Transportation and Public Facilities that a bridge closure might be needed, and also provides real world data with which to compare the engineering equations, which are partially empirical and based on flume experiments. This presentation introduces the Alaska scour monitoring network (currently 16 bridges with sonars) and the data derived from it. Some of the programs successes include the timely closure of the Copper River Highway Bridge 339 in 2011, determination of deep seasonal scour and fill cycles at Knik River, recognition that the design flood at Sheridan River is an underestimate. However, some of the more valuable, if less exciting results are the cases where scour measured during floods is significantly less than the design analysis predicted. AKDOT&PF can recode these bridges as not scour critical, and focus resources where problems actually exist. Some of the challenges inherent in instrumenting Alaska’s rivers include protecting sonars from ice and debris, measuring scour around debris-covered piers, and accessing sites during flood events to confirm sonar and stage readings.

Improving ADCP Measurements by Maintaining an Upstream Boat Heading.

Brailey, David E, Brailey Hydrologic

"During moving-bed conditions, ADCPs require accurate compass headings for both bottom-track andGPS positioning. Inaccurate headings can cause imprecision and bias in GPS-based flow data, and invalid moving-bed corrections for bottom-track discharge data. Accurate headings require on-site compass calibration to eliminate the effects of local and on-board magnetic interference. However, even well-calibrated compasses are usually accurate only to within 1-2 degrees. A one-degree compass error forms the basis for OSW Informational and Technical Note 2016.16, which limits the application of loop moving bed tests on large rivers. In addition, accurate compass calibrations are sometimes not possible due to on-board magnetic interference, electric currents, and historic software and hardware problems.
Because compass errors vary with vessel heading, they can be reduced by minimizing boat rotations. This can be accomplished by maintaining an upstream ferry angle in swift current, and by walking the boat sideways in shallow water. A floorless solo cataraft facilitates walking the boat and holding stationary positions for edge estimates. In conjunction with an outboard motor, a single oar can be used to ferry the boat sideways in fast water, and both oars can be used to control the boat orientation in slow water. These techniques were used to obtain repeated valid loop tests at Susitna Station, with higher boat speeds and shorter durations than those recommended by OSW Technical and Informational Note 2016.16. The Susitna Station measurements also show improved loop test precision at lower bed velocities."

Statewide Chinook Salmon Research

Overview of the Chinook Salmon Research Initiative.

Jones, Ed

Recent downturns in Chinook salmon Oncorhynchus tshawytscha productivity have created social and economic hardships across Alaska. In 2013, a research plan was developed by the state in collaboration with federal and academic partners to guide efforts towards better understanding of Chinook salmon production trends. The plan focused on twelve indicator stocks spread across the state with recommended studies designed to address knowledge gaps using the most cost-effective and reasoned approaches available. Stemming from this plan were approximate annual costs with the understanding that implementation to the fullest extent would provide the most meaningful information to aid management especially during periods of poor production. As a result, the Chinook Salmon Research Initiative was born, a five year, $30M plan, and one of the largest and most comprehensive fisheries research programs in Alaska's history. In turn, the Alaska legislature appropriated $15M through 2014; however, due to the state's recent fiscal crisis, no further appropriations have occurred. Regardless, over three dozen detailed stock assessment projects have been implemented through this endeavor; some have become long-term using various alternative funding sources. Projects in general focused on increasing confidence in estimates of Chinook salmon spawning abundance, juvenile abundance and stock-specific harvests in the various marine fisheries. Subsistence studies of local and traditional knowledge and harvest were also conducted and funding was provided to the University of Alaska Fairbanks to conduct comprehensive process studies of growth, feeding and survival. The state's recent investments are worthy endeavors as increased confidence in estimates of abundance allow for more timely and prudent management measures. When productivity allows, fishers are afforded opportunity; but when productivity is poor, fish are passed through fisheries to meet necessary spawning requirements. Our actions today have a great bearing on future fish production and fishing opportunities for generations to come.

Chinook salmon stock assessment on the Taku and Stikine rivers, a half century of methods and results.

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Jaecks, Troy A. Alaska Department of Fish and Game, Division of Sport Fish, Juneau Alaska

Estimating spawning abundance of salmon is the foundation of abundance-based management. Intensive, full stock assessment programs for wild Chinook salmon Oncorhynchus tshawytscha in the transboundary Taku and Stikine rivers of Southeast Alaska not only estimate spawning abundance by age, sex and length, but also estimate inseason abundance, smolt abundance, marine (smolt-to-adult) survival, and marine harvest by area and fishery. Information from these projects allows managers to respond to inseason and annual stock assessment data. Researchers also use these detailed data for population modelling and assessing production and survival trends. These projects collectively produce some of the most accurate stock assessment data available for wild Chinook salmon stocks

coastwide. Projects take place in large, glacially-fed rivers originating in British Columbia and terminating in Southeast Alaska. Each system supports Chinook salmon runs averaging around 40,000 "large" (≥age-1.3) fish. About 2 million smolt emigrate from each system annually and fish generally rear in the Gulf of Alaska and Bering Sea. Adults return to Southeast Alaska from March to June and are harvested in U.S. marine troll, net, and sport fisheries and in Canadian inriver commercial, sport, and subsistence fisheries. Adult Chinook salmon are captured inriver using gillnets, fish wheels, weirs, and hook and line to generate mark-recapture abundance estimates. Smolt are captured with minnow traps and seines and marked with adipose clips and coded wire tags. Coded wire tagging smolt allows for detailed marine harvest, exploitation rate, and smolt abundance estimates. Precision of escapement and smolt estimates averages a coefficient of variation of ≤15%, which meets Pacific Salmon Commission standards. Estimates of abundance and exploitation are used by the Chinook Technical Committee of the Pacific Salmon Commission for coastwide population modelling.

Chinook salmon stock assessment on the Chilkat and Unuk rivers, how intensive, long-term projects provide precise deliverables for management and research needs.

Frost, Nathan, Alaska Department of Fish and Game, Division of Sport Fish, Juneau Alaska
Richards, Phil, Alaska Department of Fish and Game, Division of Sport Fish, Juneau Alaska
Elliott, Brian W., Alaska Department of Fish and Game, Division of Sport Fish, Haines Alaska

Intensive, full stock assessment programs for wild Chinook salmon provide managers and researchers the information to respond to inseason and annual management needs but over time also provide in depth data for region-wide modelling and trend analyses. For nearly 20 years, Chinook salmon assessment projects conducted by the Alaska Department of Fish and Game in the Chilkat and Unuk rivers in Southeast Alaska have successfully estimated overwinter freshwater survival (parr to smolt), marine survival (smolt to adult), and spawning abundance by age, sex and size. Juvenile coded wire tag operations also allow for high resolution marine harvest and exploitation rate estimation. These projects collectively produce some of the most precise data available on wild Chinook salmon stocks on the West Coast. The estimated parameters are used by the Chinook Technical Committee of the Pacific Salmon Commission for coastwide modelling with the Chilkat and Unuk Rivers serving as designated exploitation rate and escapement indicator stocks for populations that reside within the inside waters of Southeast Alaska, Gulf of Alaska, and Bering Sea. Projects take place in moderately-sized, glacially-fed rivers that support Chinook salmon runs averaging around 4,000 to 5,000 "large" (≥age-1.3) fish each. Juveniles are captured using baited minnow traps and adults are captured using gillnets, fish wheels and hook and line angling. Precision on escapement estimates is less than the Pacific Salmon Commission benchmark of 15% and juvenile adipose fin clip and coded wire tag marked fractions average around 8%, the highest rates known for any wild Chinook salmon populations coastwide.

The decline of Southeast Alaska Chinook stocks and population trends for four Southeast Alaska rivers: Chilkat, Taku, Stikine, and Unuk.

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Since 2007, Chinook salmon Oncorhynchus tshawytscha escapements to the four Southeast Alaska rivers with full stock assessment programs, including the Chilkat, Taku, Stikine, and Unuk stocks, have declined sharply. Prior to 2007, these four stocks met or exceeded the lower bound of biological escapement goals >95% of the time, however since 2007, this rate has plummeted to 45%. The failure of these stocks to reach goals in the past 10 years has increased the need for investigation about causes of decline. Three principal components are considered here; including marine harvest, maturation rates, and brood year marine (smolt-to-adult) survival. Marine harvest of these Southeast stocks, as estimated through a combination of coded-wire tag recoveries and genetic stock identification in commercial troll, gillnet, seine, and sport fisheries, has been within healthy levels and does not account for the poor escapement performance in the past ten years. The exception is Unuk River Chinook, which has the highest harvest rates in the region; reduced harvest could have helped achieve escapement goals. Maturation rates for each stock were considered for two time periods: brood years 1991-1998 and brood years 1999-2010. When comparing these two time periods for each stock, there were significant increases in the amount of age-1.2 fish in the return, and significant decreases in age-1.4 fish. This maturation rate change causes returns and escapements of large (≥age-1.3) Chinook to become increasingly comprised of a single, younger age class, which reduces the population's elasticity and shifts towards younger and less fecund spawners. Marine survival, measured as the

estimated number of smolt leaving each drainage annually that survive to be recruited into fisheries or escapements, has declined substantially since brood year 2001 for each stock. Smolt abundance estimates, however, have either remained near the historical average or have increased over the past 5 brood years.

Sampling of the Chinook Salmon Marine Sport Fishery in Southeast Alaska.

Jaenicke, Mike

The sport fishery for Chinook salmon in Southeast Alaska is managed to stay within a sport fish allocation set each year by the Pacific Salmon Commission. The allocation can range from under 30,000 Chinook salmon during periods of poor production to over 70,000 during years of high production. From April through September each year, Alaska Department of Fish and Game personnel sample Chinook salmon sport harvests in the ports of Yakutat, Elfin Cove, Gustavus, Haines, Skagway, Juneau, Petersburg, Wrangell, Craig/Klawock, and Ketchikan. Fish are inspected for the absence of the adipose fin, an indication the fish may possess a coded wire tag. Heads are collected on these fish and sent to the Mark Tag and Age Laboratory in Juneau for coded wire tag analysis. This includes extraction and reading of any tags and entering the information into a web accessible database available to the public. The Pacific Salmon Commission has a target sampling rate of at least 20% of the sport harvest. In addition to sampling for coded wire tags, field technicians also collect a variety of other data including tissue for genetic stock identification, otolith samples from Sitka and Craig in coordination with the Chinook salmon genetic study, coded wire tags from coho salmon harvest, biological data from harvested bottomfish, and sport fishery information on spatial and temporal fishing effort and catch from anglers sport fishing for Chinook salmon and other important sport fish species being managed in the Southeast Alaska region.

The influence of environmental and biological factors on the freshwater and marine survival of Chinook Salmon in two Southeastern Alaska rivers. *

Berkman, Stephanie A.
Sutton, Trent M.
Mueter, Franz
Elliott, Brian

Highly variable recruitment and declines in productivity and abundance of Chinook Salmon Oncorhynchus tshawytscha have created economic and cultural hardships for communities throughout Alaska. As a result, it is necessary to better understand factors influencing the freshwater and marine survival and production of Chinook Salmon stocks. This study utilized principle component analysis and principle component regression to determine how parr length, fall and spring air temperature, and discharge influenced freshwater overwinter survival and smolt production in the Chilkat River (brood years [BY] 1999-2009). Similar methods were used to determine the influence of smolt body size (i.e. length and weight), June and July sea surface temperatures, spring discharge and river temperature (Chilkat River only), and migration timing (Chilkat River only) on marine survival in the Chilkat (BY 1999-2009) and Stikine rivers (BY 1998-2009). No significant relationships were uncovered between overwinter survival and explanatory variables. Freshwater smolt production had a significant negative relationship with parr length and fall discharge ($P = 0.05$) and a significant positive relationship with spring temperature and discharge ($P = 0.03$), indicating smaller parr, lower fall discharge, and higher early spring temperatures and discharge increase smolt production in the Chilkat River. These results emphasize the importance of environmental factors, rather than biological, on freshwater smolt production. Marine survival on the Stikine River was significantly related to biological factors, indicating that brood marine survival was higher when smolts were larger ($R2 = 0.39$; $P = 0.03$). On the Chilkat River, marine survival was most strongly related to migration timing, with increased marine survival when smolt migrations ended later in the season ($R2 = 0.58$; $P = 0.006$). These results reiterate the importance of the early marine period in determining year-class strength and highlight the variation in mechanisms that influence the survival of Chinook Salmon stocks.

Migration patterns of adult Chinook Salmon in two Southeast Alaska transboundary rivers.*

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Falke, Jeff U.S Geological Survey, Alaska Cooperative Fish and Wildlife Research Unit
Nichols, Jeff Alaska Department of Fish and Game
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Chinook Salmon undertake extensive migrations between food resources in the ocean and their freshwater spawning habitats, requiring them to adopt behavioral and physiological traits that will allow them to reach their spawning locations at the optimal time. Such adaptations may be shaped by factors such as the flow regime of the home river, distance upstream to spawning location, sex, and body condition at river entry. The Stikine and Taku rivers in Southeast Alaska are two of the largest producers of Chinook Salmon in the state, and have been designated as indicator stocks by the Alaska Department of Fish and Game to monitor the status of this species. Adult Chinook salmon (> 660 mm mid-eye to fork [MEF]) returning to the Stikine (N = 474) and Taku (N = 554) rivers were sampled using drift gillnets from May - June 2015 and 2016 and outfitted with a uniquely coded radio tag. Within the two rivers, 354 males and 674 females ranged from 660 – 980 mm MEF (mean = 762 mm ± 61 SD). Spawning locations were estimated for radio tagged fish using basin wide aerial telemetry surveys and stationary telemetry towers; spawning location distances ranged from 5 – 286 km (mean Stikine River = 168 ± 82 SD; Taku River = 154 ± 55 SD). Using tagging date to represent migration timing, we assessed how timing varied as a function biotic and abiotic factors including sex, body size, spawning site distance, and river discharge using linear mixed effect models. Our study of the behavioral aspects of Chinook Salmon upriver migrations will help to ensure sustainable harvest of this economically important species through an improved understanding of the attributes that make successful spawners. This information will be useful for fisheries managers to better understand why many Alaska Chinook Salmon populations are currently in decline.

Chinook and coho salmon mark recapture abundance estimates in the Susitna River drainage, 2013-2015.

Cleary, Peter M. Alaska Department of Fish and Game, Division of Sport Fish

Chinook and coho mark-recapture studies were conducted in the Susitna River drainage from 2013 through 2015. First event sampling and tagging was conducted using fish wheels and gill nets on the lower Susitna and Yentna Rivers. Project design was revised each year to improve second event sampling. Radio tags, dart tags and dart/PIT tags were used as marks contingent on the study year. Second event data collection methods included fish wheels and gill nets, weir sites, radio towers, PIT tag arrays and ARIS sonar. Project design will be described and Chinook and coho salmon abundance estimates will be presented.

Coded Wire Tagging of Chinook Salmon on the Copper River; laying the groundwork for estimating smolt abundance and marine survival.

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Savereide, James ADF&G-DSF
Evenson, Mathew ADF&G-DSF

The Copper River is one of 12 indicator stocks in the Chinook Salmon Stock Assessment and Research Plan (ADFG Chinook Research Team 2013) as a stock for which additional information on stock productivity is desired, and the absence of smolt abundance and survival data has been identified as an information gap. To address this gap we developed a coded wire tag (CWT) project to estimate the abundance and marine survival of Copper River Chinook Salmon smolt. Coded wire tagging projects employ a mark-recapture experimental design to estimate the abundance and marine survival of salmon smolt by marking juveniles as rearing parr and outmigrating smolt and sampling adult returns (escapements and harvests) for the presence of tagged fish. In 2014, a pilot study was performed to understand run timing and catchability of smolt. In 2015, a full scale project was undertaken that included marking both migrating smolt in the spring and rearing parr in the fall. In 2015 11,035 smolt from brood year (BY) 2013 were marked in the spring in major spawning tributaries and in the mainstem Copper River from Chitina to the Copper River Delta. In the fall 35,425 parr from BY 2014 were marked with CWTs in four major spawning tributaries. The highest 2015 catch rates for smolt were in the tributaries and on the delta and 2016 spring sampling was modified accordingly. In 2016, a total of 21,576 BY 2014 smolt and 40,381 BY 2015 parr were marked. The tagging operation will continue in 2017 and adult sampling will also begin as age 1.2 Chinook Salmon from BY 2013 return to the Copper River. Adults will be sampled in the Cordova commercial fishery and in the Baird and Wood Canyon fish wheels used for estimating Copper River Chinook Salmon inriver abundance.

Genetic Stock Identification of Chinook Salmon Harvested in Marine Waters of Cook Inlet.

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Eskelin, Anthony Division of Sport Fish, Alaska Department of Fish & Game, Soldotna
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St. Saviour, Adam B. Division of Sport Fish, Alaska Department of Fish & Game, Palmer

Habicht, Christopher Gene Conservation Lab, Alaska Department of Fish & Game, Anchorage

One of the key knowledge gaps identified as a priority for the Chinook Salmon Research Initiative was stock assessment of indicator stocks. Inherent to this priority was the need for stock-specific harvest information of these indicator stocks in relevant marine fisheries. Chinook salmon are harvested in Cook Inlet marine fisheries where two indicator stocks, Susitna and Kenai rivers, are present. Little information existed on the harvest of these stocks in several Cook Inlet fisheries, including the Eastside set gillnet fishery, Northern District set gillnet fishery, Tyonek subsistence fishery, and the year-round marine sport fishery. We sampled harvests from these fisheries over several years and used genetic mixed stock analysis to estimate stock composition and stock-specific harvests. We found some consistent patterns of stock compositions within each fishery among years. In the Eastside set gillnet fishery, the Kenai River stock dominated harvests closer to the mouth of the Kenai River and both Kenai and Kasilof river stocks contributed to the harvests closer to the mouth of the Kasilof River, while Susitna stocks were harvested at low levels throughout and contributed less than 3% to total harvests. In the Northern District and Tyonek subsistence fisheries, harvests were dominated by west side of Cook Inlet, Susitna River, and Knik and Turnagain Arms stocks. In the Cook Inlet marine sport fishery, outside of Cook Inlet stocks dominated the harvests in both winter and summer, with small harvests of Cook Inlet stocks in the most northern catches in early summer. These stock-specific harvest estimates improve understanding of productivity and harvest patterns of key stocks of Chinook salmon and inform management of Cook Inlet fisheries.

Monitoring Chinook Salmon smolt in Western AK to evaluate freshwater density dependency.

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Boersma, James USFWS Kenai Fish and Wildlife Conservation Office
Coggins, Lew USFWS Yukon Delta National Wildlife Refuge

Kuskokwim River Chinook Salmon management relies heavily on a manager's ability to anticipate a populations stability and growth rates. Many AYK adult Chinook salmon spawner-recruit relationships have shown evidence for strong density dependence and are used to predict their respective populations' productivity. Because the long-term variation and recent declines in AYK Chinook Salmon stocks are thought to be at least partially caused by this strong density-dependent effect, partitioning density dependent effects between the freshwater and marine life history phases may highlight the relative importance of the two periods and may help anticipate the overall productivity of the population. We are currently in the second year of monitoring Chinook Salmon smolt emigrating past the Kwethluk River Weir. Our objective is to monitor the relationship between smolt abundance, total returns, and spawning escapements, evaluating the importance of the freshwater juvenile life history phase. We are using a rotary screw trap and mark-recapture techniques to estimate smolt numbers. A pilot study was completed in 2015 with smolt estimates from the 2013 brood year the lowest on record. Spawner abundance has increased 10 fold from 2013 -2015, providing a unique opportunity to monitor a wide range of potential subsequent changes in smolt abundance which may inform the relative roll of density dependence in freshwater and marine environments.

Expanding the Nushagak River Chinook escapement index: a comparison of two methods.

Buck, Greg B. ADF&G

The Nushagak River in Southwest Alaska has major runs of several commercially important species of salmon including the largest Chinook salmon (Oncorhynchus tshawytscha) run in Bristol Bay, Alaska. The Alaska Department of Fish and Game (ADF&G) uses sonar 50 km upriver from the mouth to enumerate salmon escapement. Sonar deployed from both banks provide coverage sufficient to consider counts of shore oriented migrating salmon species such as chum and sockeye to be estimates of abundance. However, the Chinook count is considered an index of abundance as an unknown proportion of upriver migrating Chinook travel beyond the counting range of the sonars positioned on either bank. In recent years two projects attempted to estimate total Chinook escapement in the Nushagak. Between 2011 and 2014 total Chinook escapement was estimated by tracking fish as they migrated past the sonar using acoustic tags to determine what proportion of the run is not available to the sonar count. Between 2014 and 2016 mark-recapture estimates were made. These estimates are compared and discussed.

Kuskokwim River Chinook salmon stock assessment program – making the most out of every opportunity.

Smith, Nicholas ADF&G
Liller, Zachary ADF&G

Value-added is becoming a normal term used by those of us responsible for assessment of the Kuskokwim River Chinook salmon runs. How can we do more with what we have? Did we get the biggest bang for our buck? The Chinook Salmon Research Initiative (CSRI) provides a fantastic example of how adaptive planning can benefit salmon assessment by stretching funds dedicated for a single purpose to address multiple data needs. CSRI funded a three-year mark–recapture study to estimate total run size of adult Chinook salmon returning to the Kuskokwim River in 2014–2016. This project was initiated for the single purpose of evaluating an existing statistical model used by ADF&G to estimate drainage-wide run and escapement of Kuskokwim River Chinook salmon. The study was conducted, estimates of abundance were made, and model evaluations are ongoing as planned. However, the impacts of the CSRI may turn out to be much farther reaching than originally expected. Sure, we will tell you how many Chinook salmon returned to the Kuskokwim over the past three years, but the focus of our presentation will be on the value-added products that have started to reshape our understanding of the Kuskokwim River Chinook salmon runs, future assessment, and best management practices.

Indirect evidence for evolutionary change in age at maturity of western Alaska Chinook salmon. *

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Adkison, Milo D. University of Alaska Fairbanks
McPhee, Megan V. University of Alaska Fairbanks

In salmonids, larger fish tend to have higher reproductive success, but the relationship between size and fitness differs between the sexes. Accordingly, males and females are expected to express distinct responses of age at maturity to environmental variability and selection. In this study, we compared sex-specific growth patterns and maturation reaction norms in two populations of Chinook salmon Oncorhynchus tshawytscha in western Alaskan. We also present a new measure to assess changes in maturation reaction norms accounting for growth history that we believe has the potential to be widely applied, the “probability of maturation with average growth” (PMAG). Similar results were found in both populations suggesting representation of the western Alaskan region. Males and females demonstrated distinct maturation reaction norms, with females maturing almost a year later on average. However, we found that second year marine growth best described age at maturity of both sexes. Males tended to grow more than females in length during this period, possibly due to females storing more energy in preparation for the high cost of female gonad development. Additionally, males were more likely than females to delay maturation in periods of low growth. Finally, we found that over the respective study periods 18 and 32 year study periods in each population, growth thresholds for maturation declined in both sexes demonstrated by an increase in PMAG. This suggests that declines in the average age of western Alaskan Chinook salmon may in part have been caused by adaptation to environmental or fisheries-induced selection, or some combination of the two.

Assessment of the spawning distribution of Chinook salmon in the Gulkana River and evaluation of the efficacy of a counting tower project used to estimate escapement.

Schwanke, Corey Alaska Department of Fish and Game - Division of Sport Fish
Savereide, James. Alaska Department of Fish and Game - Division of Sport Fish

The Gulkana River is one of six major spawning tributaries for Chinook salmon Oncorhynchus tshawytscha in the Copper River drainage. The Gulkana River Chinook salmon stock is subject to a substantial commercial fishery at the mouth of the Copper River and significant subsistence and personal-use fisheries in the mainstem Copper River, and the largest Chinook salmon sport fishery in the drainage. A counting tower project located in the middle portion of the drainage provides a method to index the escapement of Chinook salmon. This project is important because it provides the only method to assess the inseason progression of escapement for any Chinook salmon stock in the Copper River drainage. During the first several years of the Gulkana counting tower, it was believed that the majority of Chinook salmon spawned above the counting tower site. Early radiotelemetry data estimated that the proportion of Chinook salmon spawning above the counting tower was 0.81, 0.86 and 0.50 in 2002, 2003 and 2004, respectively, but these estimates were based on relatively small sample sizes from a drainage-wide study. The proportion of Chinook salmon spawning above the counting tower was reevaluated in 2013, 2014, and 2015 with a multi-year Gulkana River-specific telemetry study. In this study between 105 and 174 Chinook salmon were fitted each year with radio tags at the mouth of the river and tracked to their final spawning destination. This study estimated that the proportion of Chinook salmon spawning above the counting tower was 0.51, 0.45 and 0.54 during those years, respectively. It is reasonable to believe that the counting tower is now consistently enumerating about half the Gulkana River escapement, serving as a consistent index of abundance.

"You're Gonna Need a Bigger Boat": Assessing Juvenile Yukon River Chinook salmon Abundance and Ecology in a Funding-Limited World.

Garcia, Sabrina ADF&G
Murphy, Jim NOAA-AFSC
Howard, Kathrine ADF&G

Long-term monitoring of juvenile Chinook salmon is needed to identify recruitment and mortality processes, to understand early marine biology and ecology, and to produce tools useful to management, such as juvenile-based run forecasts. While juvenile Chinook salmon monitoring of Yukon River stocks was initiated by NOAA Fisheries in 2002 using a pelagic trawl survey program, the continuation of this program on an annual basis has been tenuous because of funding difficulties. This Chinook Salmon Research Initiative project simultaneously continued the juvenile salmon monitoring dataset for Yukon River stocks, leveraging the many previous years of study, while assessing the feasibility of using a smaller vessel and trawl to accomplish the same survey work at approximately half the cost. The smaller vessel/trawl platform performed comparably to the larger vessel/trawl platform from 2014-2016, though with some necessary modifications and considerations. Abundance and size distribution patterns, when accounting for time at capture, were similar among survey platforms. Timing of the survey appeared to influence spatial distribution and stock composition of catches. Above average juvenile Chinook salmon abundance was observed in 2014-2016, and juvenile abundance per spawner was above average in 2014 and 2015 and near average in 2016. As juvenile abundance in this system has been demonstrated to be a leading indicator of adult productivity, it is expected that adult returns from these juvenile cohorts will be an improvement upon the historically poor production observed in recent years. This project represents a critical step enabling the long-term monitoring of juvenile Chinook salmon in western Alaska and continued pursuit of factors determining productivity and cohort strength of Yukon River Chinook salmon.

Where Did You Come From? Using Genetics to Better Understand Chinook Salmon Productivity in Alaska.

Shedd, Kyle R. Gene Conservation Laboratory, Alaska Department of Fish and Game
Dann, Tyler H. Gene Conservation Laboratory, Alaska Department of Fish and Game
Barclay, Andrew W. Gene Conservation Laboratory, Alaska Department of Fish and Game
Rogers Olive, Serena D. Gene Conservation Laboratory, Alaska Department of Fish and Game
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Two of the key knowledge gaps identified as priorities for the Chinook Salmon Research Initiative were 1) stock assessments of indicator stocks, and 2) research on juvenile Chinook salmon in the nearshore environment. Inherent to both priorities was the need for stock-specific abundance information of Chinook salmon at different life history stages in the marine environment. We used genetic mixed stock analysis to attribute commercial, sport, and subsistence harvests from select fisheries and juveniles caught in the nearshore environment to local, non-local, and hatchery stocks. Stock composition results from Gulf of Alaska salmon fisheries indicated substantial spatial and temporal variability in the presence of Alaskan Chinook salmon stocks depending on the fishery and time of year. Catch rate information of juvenile Chinook salmon in nearshore waters of the eastern Bering Sea was combined with stock composition estimates to develop a Yukon River forecast based on an index of Canadian-origin juveniles. Additionally, the genetic baseline for Chinook salmon was expanded to include more populations, as well as develop novel genetic markers to better differentiate among important, but closely related stocks in Western Alaska. These genetic efforts improve understanding of stock productivity and provide a valuable tool for future research.

Communicating Chinook Salmon Research Initiative Outcomes to the Public.

Thompson, Terry S. Alaska Department of Fish and Game

Designed as a five-year statewide research effort, the Chinook Salmon Research Initiative involved researchers from the Alaska Department of Fish and Game, working alongside university and federal colleagues to understand the widespread downturn in Chinook salmon productivity. As Alaska's iconic fish, there was a tremendous amount of interest in the individual research projects, and our findings as the work progressed. As part of the overall effort, the department was committed to communicating our research to a wide range of audiences, including the state's political leaders who appropriated the funds, statewide and regional conservation organizations, and particularly to those that harvest these fish by subsistence, sport, and commercial means. Timely and consistent communications to

a wide range of stakeholders was critical to ensure support for the department, trust in our science, and continued financial support to carry this work in to the future.

Freshwater predation of juvenile Chinook Salmon in the Arctic-Yukon-Kuskokwim region of Alaska.

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Sellmer, Kristen W. University of Alaska Fairbanks
Wipfli, Mark S. US Geological Survey
López, J. Andrés University of Alaska Fairbanks
Ivanoff, Renae Norton Sound Economic Development Corporation

Predation can represent an important source of mortality for juvenile salmon during their freshwater residence, but for juvenile Chinook Salmon (Oncorhynchus tshawytscha) in the Arctic Yukon Kuskokwim (AYK) region these patterns are largely unknown. Our objective was to quantify spatial, temporal, and size-structured patterns of predation on juvenile Chinook Salmon in the AYK region. We sampled four piscine predator species (Arctic Grayling [Thymallus arcticus], Burbot [Lota lota], Dolly Varden [Salvelinus malma], and Northern Pike [Esox lucius]) across seasons and habitats in three study regions within the Yukon and Unalakleet River Basins. We collected stomach contents using gastric lavage and also collected stomachs donated by subsistence and recreational fishers. We identified prey specimens by sequencing their DNA and matching barcode gene sequences to those available in public databases. By genetically identifying individual prey specimens within stomach content samples, we were able to calculate quantitative diet proportions, rather than simply the presence or absence of prey species. Predators of all sampled species and size classes consumed fish, and many consumed juvenile Pink or Chum salmon, but few consumed juvenile Chinook Salmon. Only predators sampled from the Chena River (Burbot, Arctic Grayling, and Northern Pike) were found to be consuming juvenile Chinook Salmon. These species were only observed to consume Chinook Salmon during 2014, a year of record-high river discharge, not in 2015, a year of slightly above-average discharge. The consumption of juvenile salmon appeared to be episodic, with predation observed primarily during late May – early June, and September, periods of salmon movement among habitats. Finally, predation on Chinook Salmon was primarily documented in sloughs, rather than in the mainstem. These results provide new insight into how changing environments and harvest of piscivorous species may affect Chinook Salmon productivity within the AYK region.

Testing a new model of optimal prey capture maneuvers and their role in the time and energy budgets of drift-feeding fish.

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Drift-feeding fishes such as juvenile Chinook Salmon require habitat in which they can get more energy from their food than they expend to acquire it. Therefore, numerous studies have examined how habitat affects energy intake and the swimming costs of holding a steady position while searching for food. However, little is known about the additional costs of maneuvering to intercept prey items. Growth and habitat models typically dismiss these costs or approximate them using an inaccurate rule-of-thumb. To better understand maneuver costs, we built a model that uses the physical forces acting on a fish to predict the trajectory and energy cost of the optimal maneuver to capture any drifting item. We tested the model using stereo video footage of wild juvenile Chinook Salmon, dwarf Dolly Varden, and adult Arctic Grayling in interior Alaskan streams. We used the software VidSync to make 3-D measurements of each maneuver and calculate its pursuit duration, capture position, and time taken to return to the starting point. The new model predicted all three metrics for all three species as or more accurately than two simpler models from the literature. Given the model's basis in established physics and its success predicting observable values, we cautiously infer that its predictions of energy expenditure are also reasonably accurate. As a proportion of total swimming costs over a several-minute period, estimated maneuver costs averaged 54 % for Chinook Salmon, 53 % for Dolly Varden, and 61 % for Arctic Grayling. Total swimming costs varied widely from 4 % to over 100 % of estimated gross energy intake, and predicted maneuver costs depended strongly on water velocity, prey position, fish mass, and water temperature. This suggests maneuver costs should not be ignored when using foraging models to predict fish growth and the relationships between habitat characteristics and growth potential.

Growth Potential of Juvenile Chinook Salmon (Oncorhynchus tshawytscha) Across a Boreal Riverscape.

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Huntsman, Brock Department of Fish, Wildlife and Conservation Ecology, New Mexico State University
Schoen, Erik Institute of Arctic Biology, University of Alaska Fairbanks
Bennett, Katrina Earth and Environmental Sciences Division, Los Alamos National Laboratory

Across the Yukon River basin, a recent downturn in Chinook Salmon returns has led to hardship among user groups and an increased interest in better understanding how physical processes affect freshwater survival and population persistence within this important commercial, recreational, and subsistence fishery. Here we present the results of our recent work in the Chena River basin, interior Alaska, where we used field-based investigations and spatially-explicit flow and stream temperature models to assess juvenile Chinook Salmon growth potential (mean September mass [g]) across the riverscape. Although our hydrologic model predicted an increase in summer stream flows that have been linked to poor recruitment, high flow years were always relatively cool, and low flow years warm. As a result, based on field estimates of growth, size, diet, and prey abundance, and modeled and measured stream temperatures, we ran bioenergetics simulations for warm and cool years and contrasted temperature model precision and growth among different habitat types (small and large tributaries, mainstem, side channels). Predictions of stream temperature as a function of remotely sensed land surface temperature were precise during the open water season ($R2 > 0.87$; $RMSE < 1.1\ ^{0}C$) although the relationship was weaker in groundwater-mediated tributary habitats. Field observations from mainstem sites revealed that salmon were 60% smaller in September in cool versus warm years. Bioenergetic simulations predicted that, on average, growth potential is 30% higher in warm years, although considerable spatial variation exists and growth potential can vary up to 60% from cool upstream to warmer downstream habitats. Climate variability is clearly an important driver of freshwater habitat conditions, and has a large role in controlling freshwater growth of juvenile salmon. A better understanding of how climate is filtered by different rearing habitat types will be critical for conservation and management of Alaskan Chinook Salmon stocks under a warmer and more variable climate.

Beyond the ocean or freshwater debate: Insights from an integrated Bayesian stage-structured assessment model of Yukon River Chinook salmon survival.

Westley, Peter
Cunningham, Curry
Adkison, Milo

One of the perennial challenges in ecology is to disentangle the influence of multiple and potentially co-occurring environmental factors on population dynamics. To date, debate surrounding the causes of recent declines in Yukon River Chinook salmon abundance have centered on whether factors in freshwater or marine environments are most important determinants of survival. Moreover, previous analyses of Yukon River Chinook salmon population dynamics have focused on specific portions of the life cycle in isolation from others and not accounted for the impact of bycatch mortality at sea. To simultaneously estimate the direction and magnitude of a range of marine and freshwater factors on Yukon River Chinook salmon survival, we constructed a stage-structured assessment model capable of utilizing all available data, estimating bycatch fishing mortality rates and selectivity, and utilizing Bayesian model selection methods to test these alternative hypotheses regarding environmental control of Chinook salmon production. Results from an application of this model to the Chena and Salcha populations indicate that the timing of ice out on the Yukon River, Bering Sea wintertime temperature conditions, and abundance other salmon species that likely reflects competition, have the greatest support from available data.

Patterns of Chinook Salmon Growth in Alaska.*

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Adkison, Milo D. UAF CFOS

Chinook salmon returns, size, and size-at-age have declined in Alaska. Reasons for this decline are unknown; however, returns, size, and size-at-age are related to the fundamental process of growth. To better understand Chinook salmon declines in Alaska, we are developing a series of increasingly complex hierarchical models to explore sources of growth patterns, at levels ranging from individual fish to across Alaska. Hierarchical models are an appropriate framework for modeling growth because fixed and random effects can capture diverse sources of variation, both apparent, observable sources, as well as underlying, difficult to observe sources. So far, we have explored growth patterns that vary with individuals (differences among individuals), life stage (changes over the life

of a fish), populations (geographic patterns of growth), time (trends over time), brood year (differences among cohorts), and age at maturation. We applied this hierarchical approach to an extensive set of salmon scale growth zone measurements; scale growth measurements have been shown to be proportional to fish size at different life stages. The dominant pattern of growth of Alaskan Chinook salmon was life stage-dependent, varied with maturation age, and varied geographically (population level effects). This dominant pattern of growth had underlying correlation structures: random intercepts for time, brood year, and population with random slopes for life stage. Although multiple scale growth zone measurements for each fish were included, there was not enough additional fish-level variation to warrant adding an additional fish-level random effect. To further understand declines of Chinook salmon in Alaska, we plan to explore the variation in patterns of growth explained by (1) temperature and other environmental indices found to be main drivers of Chinook salmon populations, and (2) population productivity.

Genetic stock composition of the commercial and sport harvest of Chinook salmon in the Kodiak area, 2014-2016.

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Foster, M. Birch. ADF&G
Witteveen, Mark J. ADF&G
Habicht, Chris. ADF&G

The primary goal of this study was to estimate the stock of origin, age, size, and sex composition of Chinook salmon, Oncorhynchus tshawytscha, harvested in Kodiak marine commercial and sport fisheries during 2014–2016 as part of the larger statewide Chinook Salmon Research Initiative. A total of 10,154 Chinook salmon tissue samples were collected from 4 commercial fishery areas and marine sport fisheries in the Kodiak area. Of these, 8,829 samples were genotyped to represent 25 spatiotemporal strata. Stock compositions were estimated with genetic mixed stock analysis for all strata using a comprehensive, coastwide Chinook salmon baseline with important local stocks defined as separate reporting groups, to the extent possible. Harvests in both the commercial and marine sport fisheries were dominated by British Columbia and West Coast U.S. stocks, followed by smaller contributions from Southeast Alaska/Northeast Gulf of Alaska, Cook Inlet, and Kodiak. Stock composition estimates were consistent among strata within commercial and marine sport harvests, although there were differences between these fisheries. In the annual commercial harvest, over 50% of the fish were from British Columbia and over 30% of the fish were from the West Coast U.S. In the marine sport fishery, the relative abundance of British Columbia and West Coast U.S. fish varied, but jointly represented over 80% of annual harvest. In both the commercial and sport fisheries, the annual harvest of Kodiak-origin Chinook salmon was below 5% of the total harvest. These results provide the most comprehensive estimates of stock composition and stock-specific harvests of Chinook salmon in the Kodiak area, supplement previous studies, and should inform fishery management and regulatory decision makers.

Reexamining assumptions 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 evidence of predation on large Chinook salmon from recent satellite tagging research in the Bering Sea and Cook Inlet. Diagnostic evidence of predation was revealed from depth, temperature and light records collected by the satellite tags. Taken as a whole, these data suggest 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.

Estimates of annual salmon shark consumption. *

Manishin, Kaitlyn
Margaret Short
Kenneth J. Goldman
Curry J. Cunningham
Andrew C. Seitz

Salmon sharks (Lamna ditropis) are relatively large, endothermic sharks that inhabit the top trophic level in the Bering Sea. Though they are thought to be an apex predator, their role in the ecosystem remains poorly understood. For example, the biomass of prey fish annually consumed by salmon sharks is unknown. To better understand one aspect of predation by salmon sharks in the Bering Sea, we estimated annual food consumption for an average adult salmon shark. Per capita consumption estimates were calculated using three different methods drawing on a mixture of literature from salmon sharks and closely related species: 1) a percentage of predator body weight per day (daily ration), 2) the fitted parameters of a generalized von Bertalanffy growth curve, and 3) a bioenergetics mass balance equation. The agreement (or disagreement) of these estimates acts as a measure of uncertainty around the calculated values. Scaling per capita consumption estimates to a population level is most sensitive to the population size of salmon sharks, which is unknown. As a result, we present a range of population consumption estimates examined in comparison to biomass removed by commercial fisheries.

Resource Security

Documenting Nuiqsut's Traditional Knowledge on Fish Creek for Fish CAFÉ (Response of an Arctic Freshwater Ecosystem to Climate and Land-use Change in the Fish Creek Watershed, Beaufort Coastal Plain of Alaska).

Fritz, Stacey
Chris Arp
Matthew Whitman
Matthew Weber

The Fish Creek Watershed of Alaska's Beaufort Coastal Plain is the focus of scientists' efforts to understand how anthropogenic stressors impact natural resource changes, and a community's determination to continue a subsistence lifestyle. Superimposed on the background influence of climate change, oil development is rapidly expanding in the lower Fish Creek region, a critical traditional hunting and fishing area for the Kuukpikmiut of the Colville Delta area. Research and monitoring efforts over several years have established a process baseline for fish habitat in beaded streams and connected lakes in the Fish Creek watershed. The presentation will also cover management decisions and mitigation measures the BLM has established for the area, including traditional knowledge and concerns the Kuukpikmiut have shared over the past two decades. Content analysis results of testimony at public meetings on oil exploration and development illustrate the degree of various subsistence and social impacts, as well as some mitigation possibilities. Most recently, Fish CAFÉ organized a Fish Creek traditional knowledge workshop in Nuiqsut in November, 2016, where Kuukpikmiut observations of changes in the ecology of the watershed and concerns regarding development and climate change scenarios were solicited. Themes that have emerged from these efforts directly address critical questions surrounding water, fish, and resource security for the community.

Alaska Peninsula Salmon Sharing Networks. *

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This project focuses on the six Alaska Peninsula communities of Chignik Lake, Chignik Lagoon, Chignik Bay, Perryville, Egegik, and Port Heiden. The goal is to provide information on how the social network "functions in the allocation and management of subsistence resources…and how such a model might be applied and utilized in Federal subsistence management." The research will expand upon prior research by identifying and analyzing the

social networks underlying the exchange of salmon not only within a community but within the region. The study communities exhibit an extensive range of sharing patterns which could help researchers and managers understand how salmon from this region are shared throughout Alaska and elsewhere. The project investigates these social networks of shared subsistence salmon resources and how they could be understood within the federal subsistence management system. All residents of the Bristol Bay Management Area qualify for participation in Federal subsistence fisheries. A selection of communities representative of different areas were chosen based upon researchers' prior experiences with sharing networks. In addition, these communities represent different and sometimes overlapping ties to Federal lands and resources within the area. The communities' Federal land ties include: Chignik Lake, Chignik Lagoon, Chignik Bay, and Perryville ties to the Alaska Peninsula National Wildlife Refuge; Egegik ties to the Becharof National Wildlife Refuge; Port Heiden ties to the Aniakchak National Monument and Preserve. Study objectives include: 1. Estimating the harvest and use of salmon by residents of the study communities. 2. Describing the harvest of salmon in terms of species, gear, location, timing of harvests, and distribution patterns. 3. Illustrating the sharing networks both within each community, across the broader region, and throughout Alaska using harvest surveys and key respondent interviews. This presentation will provide a brief discussion of our experiences during the initial stages of fieldwork.

Assessing the resilience and adaptive capacity of the community of Yakutat, Alaska through the lens of subsistence.

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Ream, Joshua T. USFWS
Kukkonen, Malla UAA
Cellarius, Barbara NPS

The goals of this project are to investigate questions of resilience, sustainability, and adaptability of Yakutat through the lens of subsistence. Yakutat is an ideal study community for this type of project due to its unique geographic location, history, and present circumstances. The community has undergone considerable demographic, economic, social, and environmental change over the past decades; understanding how and to what extent these changes have impacted overall community health and subsistence practices is important in providing indicators of sustainability and resilience of a small, remote coastal community. Working with the local governments and residents as researchers, we employed a combination of qualitative and quantitative research methods which allowed us to document the contemporary characteristics of the Yakutat social-ecological system, and collect local observations about its ability to adapt to ecological and social change through time as viewed through changes in subsistence activities, levels and composition of harvest, and the spatial extent of areas and time and money needed to harvest wild resources. Preliminary results suggest that overall subsistence harvest levels have declined since 2000 due to factors such as changes in the local economy, access to resources, and competition. However, 95% of households attempted to harvest resources in 2015. The spatial extent of the harvest is the smallest that has been recorded over 4 comprehensive surveys dating back to 1984. Analysis of resilience and adaptation is in its early stages, but some key factors likely contributing to these characteristics in the community are economic, geographic, and regulatory. The baseline quantitative resource harvest data and the supportive qualitative data collected through this project will help address critical information gaps about changing patterns of resource harvest and trade and will provide information to the community to support resource management strategies and address potential future vulnerabilities, increasing capacity for long-term sustainability.

How People of the Yukon River Value Salmon.

Moncrieff, Catherine F., Yukon River Drainage Fisheries Association

People along the Yukon River rely on salmon for food, culture, and income. It is well known that salmon has a high value to the subsistence users along the Yukon River but the details of this value are not well described, nor are management decisions in times of shortage currently guided by knowledge of these values. A greater understanding of the values of salmon is needed. Through this project, case studies are being developed for three Yukon River communities and Yukon River fishing families have the opportunity to share how they value salmon, why they value salmon, and the ways in which it is most important to them. This talk will review objectives, methods, community backgrounds and results to date.

Salmon 2050: Participatory Scenario Planning on Alaska's Kenai Peninsula .

Meagan Krupa,

Trammell, Jamie
Meagan Krupa
Jim Powell
Courtney Breest
Kitty Farnham

In Alaska, many of our vulnerable communities exist on social, economic, and ecological margins. Participatory scenario planning allows local communities to envision future uncertainties and strengthen their decision making processes. The scenario process is a cooperative effort that enables a diverse group of participants to step out of their usual management routines and identify pathways to achieve shared models of the future. Over the last three years, a team of interdisciplinary University of Alaska researchers engaged communities on the Kenai Peninsula in a dynamic, scenarios-based research process that explores the changing environment, the societal consequences of these changes, and the variables that affect communities' capacity to adapt to them. The research team asked the question: "How might local communities respond to changes in salmon abundance in the Kenai River?" The researchers used their expertise in GIS, economics, agent based modeling, social science, ecology, community facilitation, outreach, and planning to combine local knowledge with scientific data through the scenario process. The process began with an initial identification and ranking of stakeholders, followed by semi-structured interviews with key stakeholders. The interview data was then entered into a social network analysis and used to determine which stakeholders should attend the scenarios workshops. A series of scenario workshops identified and evaluated plausible alternative futures for the SES to 1) assess the implications of these alternative futures on the natural and socio-economic resources of the region and 2) inform a wide range of local, state, and federal management plans through the development of a decision support tool. This data produced five plausible future scenarios, which were presented in the form of videos and cartoons. The scenarios provide local communities and decision makers with a starting point to talk about vulnerabilities, understand how planning decisions can lead to specific outcomes, and plan for future uncertainties.

Landscape heterogeneity stabilizes southeast Alaska freshwater food webs and fish productivity.

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Fellman, Jason B., University of Alaska Southeast
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Edwards, Rick T., Pacific Northwest Research Station
Chaloner, Dominic T., University of Notre Dame

Spatial and temporal heterogeneity is critical for maintaining the resilience of freshwater ecosystems. Southeast Alaskan rivers drain from glaciers, snowfields, peatlands and extensive forests, creating a mosaic of glacier, clearwater and brownwater streams that have unique hydrologic, temperature and nutrient regimes. The hydrology in this region, however, is being transformed by climate change through the reduction in snowpack and loss of glaciers, which could dramatically reduce the spatiotemporal complexity of river networks. Among the unforeseen consequences of this homogenization could be changes in the composition and dynamics of aquatic food webs that support fish. Here we ask three important questions: (1) how do food web dynamics differ among glacial, clearwater and brownwater streams; (2) what are the implications of these differences for stream salmonids; and (3) how might future homogenization of watersheds via loss of glacial and clearwater hydrologic patterns influence the capacity of rivers to sustain fish production. We parameterized a dynamic food web model with physiochemical data from twelve streams on the Juneau road system. Model simulations showed that glacial, clearwater and brownwater streams have different food web dynamics. Specifically, we found asynchronies in the peaks and troughs of resource availability across the three stream, which created a more stable and reliable resource base for mobile fishes that can track peaks in resource abundance. Consequently, the presence of all three stream types supported higher fish populations than any one type alone. These findings suggest that climate change induced homogenization of watersheds may result in the loss of unique food webs, which in turn, could undermine the capacity of freshwaters to sustain healthy fish populations. Given the importance of fishery resources to the southeast Alaskan economy and culture, these modeled findings underscore the need for empirical studies that further explore the effects of climate change on freshwater food webs.

Hypoxia: mechanisms, frequency, and implications for coastal Alaskan stream ecosystems. *

McConnell, Casey
Seargent, Chris

Bellmore, Ryan
Moore, Jonathan W.

The amount of dissolved oxygen (DO) in flowing waters is primarily under thermal control, with lower solubility at high temperatures and higher solubility at lower temperatures. Within the geographic distribution of salmon several mechanisms can work in concert to derail the temperature-DO relationship including respiration, decomposition, and reaeration rates which are controlled in part by the unique discharge and habitat characteristics of each stream. Periodic hypoxic events are not limited to areas experiencing extreme heat, and have been documented in several Alaskan watersheds. From 2010 to 2015 Indian Creek near Sitka, Alaska, was monitored for DO and temperature at one in-river station. Sawmill Creek near Juneau, Alaska, was monitored for temperature, salmon abundance, and flow, as well as DO at three stations across the upstream-downstream gradient during the 2015 spawning season. Multiple hypoxic events were detected with minimum observed DO concentrations dropping to 1.7mg/L (16% saturation) and 2.9mg/L (26% saturation) in Indian and Sawmill Creeks, respectively. During this presentation the inter- and intra-annual conditions of these watersheds will be summarized to illuminate the frequency of hypoxic events and the conditions that cause them, specifically warm temperatures and low instream flow. Additionally, implications of forecasted region specific climate patterns will be stressed and the relatedness of observed hypoxic events to prespawn mortality of salmon will be highlighted.

Prioritizing Hydrological Data Collection in the Matanuska - Susitna Basin.

Dekker, Franklin J. U.S. Fish and Wildlife Service
William, Rice U.S. Fish and Wildlife Service

The Matanuska – Susitna (Mat-Su) Basin Salmon Habitat Partnership and the U.S. Fish and Wildlife Service Coastal Program have partnered with the U.S. Geological Survey (USGS) to conduct stream gaging in the Mat-Su Basin since 2008 in support of reservations of water and scientific studies. Stream gaging is a costly investment for a minimum of five years of data collection (>$175,000) to meet Alaska Department of Natural Resources water reservation standards. Data collection on an initial list of priority waterbodies was completed in 2016, necessitating a prioritization of new waterbodies and a strategy that considers several site attributes. To address the prioritization question, we asked, what are the most important waterbodies based on salmon habitat and vulnerability to development? A set of 39 waterbodies in the Mat-Su Basin lacking hydrological data were included in the prioritization effort. Using Geographic Information System (GIS) analysis of salmon habitat quality and vulnerability at the HUC 10 and 12 scales, the 39 potential waterbodies were ranked based on a combined score. Prioritized waterbodies were grouped into four tiers and the top tier of waterbodies was further refined by a suite of site attributes to strategically select the best gaging sites. Site attributes included: accessibility, cost, and the likelihood for gaged sites to correlate with adjacent un-gaged waterbodies. This prioritization provides a refined list of waterbodies for the Mat-Su Basin Salmon Habitat Partnership and U.S. Fish and Wildlife Service to address for years into the future. Most importantly, this prioritization identifies a list of waterbodies where opportunities exist for future collaboration with other hydrological data users in the areas of science, transportation, flood forecasting and recreation.

Updating Title 16: Ensuring Strengthened Protections for Alaska's Fish Habitat and Fisheries Resources.

Snyder, Samuel

At the formal request of citizens, in January 2017 Alaska's Board of Fisheries submitted a letter to the State Legislature asking for an update to Title 16: Alaska's Fish Habitat Permit Law. As it currently stands, Title 16 directs the commissioner of the Department of Fish and Game (ADF&G) to approve a fish habitat permit for a "proposed construction, work, or use … unless the commissioner finds the plans and specifications insufficient for the proper protection of fish and game." AS 16.05.871(d). The problem is, however, that the law is outdated and unclear. Nothing in Title 16 defines what constitutes, "proper protection of fish." Given the scale of development activities, such as the Pebble Mine, being proposed in Alaska today, we need a statute that will adequately and transparently protect Alaska's fish habitat and fisheries so that clarity and certainty can be provided for both developers and Alaska's communities and seafood industry. This presentation reviews the existing law and it's impact on Alaska's fisheries in light of large proposed development projects. Then, I will review critical, yet simple updates, which can be made to strengthen its fish habitat permitting. These changes, include creating enforceable scientific habitat protection standards, updating the Anadromous Waters Catalog, creating accountability through increased public process, and providing certainty in the permitting and mitigation processes. Finally, this

presentation will provide an update on the status of the updates following the letter from the Board of Fisheries to the Alaska State Legislature.

Variability in Sockeye Salmon Abundance in Sapsuk Lake, Alaska Peninsula over the last 3,000 years.

Misarti, Nicole University of Alaska Fairbanks
Finney, Bruce P. Idaho State University
Shapley, Mark. Idaho State University

The sustainability of Alaska's fisheries, including the sockeye salmon fishery, is of utmost importance not only to the health of Alaska's marine ecosystems but also to the vitality of Alaska's coastal communities. Our project collected and analyzed sediment cores from Sapsuk Lake, a sockeye spawning lake with traditionally large sockeye returns, in order to determine fluctuations in numbers of Alaska Peninsula sockeye returning from the Bering Sea over the last few thousand years. This was of particular concern to stakeholders in the area as historically the Sapsuk system had large runs but fish numbers had declined in recent years to the point of impacting subsistence and commercial uses. In 2014 these numbers had suddenly rebounded. We analyzed sediment cores collected in 2014 from Sapsuk Lake to determine relative numbers of sockeye returning to this spawning lake over the last few thousand years using $\delta 15N$. Historic data span periods too short to capture the large climatic changes the Bering Sea is now experiencing, therefore long term data sets such as this one help determine the effects of large –scale change on area sockeye populations. The $\delta 15N$ data reveal abrupt changes, with major changes occurring over multidecadal scales. The highest $\delta 15N$ were observed over the last 1000 years. We found that short-term change in sockeye abundance at Sapsuk Lake did not fluctuate in concert with other near-by sockeye-spawning lakes. However, multi-decade to centennial fluctuations in numbers of sockeye returning to Sapsuk Lake, correlate with large-scale climate change and with broader scale patterns of returning sockeye to other lakes in the southern Bering Sea and the North Pacific. This type of project can add to the current knowledge of stakeholders and policymakers, informing future management decisions and improving the chances of sustaining economic and sociocultural stability within Alaskan coastal communities.

Does life history diversity influence population productivity at small spatial scales? An examination with Olga Lakes Sockeye Salmon. *

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Westley, Peter A. H. Department of Fisheries, College of Fisheries and Ocean Sciences, University of Alaska Fairbanks

Sockeye Salmon (Oncorhynchus nerka) comprise the economic, social, and cultural fabric of many Alaskan communities. It has become increasingly clear that a diversity of spawning age classes acts as a diversified portfolio to enhance fishery resilience in variable environments. The extent to which life history diversity influences long-term productivity or abundance of populations at small-scales is relatively unknown. In this talk we report on an analysis of 40 cohorts of two distinct stocks of Sockeye Salmon from the Olga Lakes on Kodiak Island, Alaska. Recently observed declines in productivity and age composition variation of Olga Lakes salmon has raised concerns of the ability for individual populations to maintain population growth (recruits/spawner) with an homogenized age structure. Emerging results suggest that diversity in age composition (measured by variation in freshwater and saltwater residence) is associated with increases in abundance and productivity. Patterns of productivity are also dependant on the temporal scale of observation. Diversity in age composition appears to positively correlated with productivity when pooled across several generations (>5) but less so on an annual basis. Our emerging findings highlight the importance of a diverse portfolio of ages within stocks, yet also reveal that not all components of the portfolio may be correlated with diversity.

Assessing effects of Asian pink and chum salmon on western Alaska chum salmon. *

Minicucci, Tessa J., University of Alaska Fairbanks, College of Fisheries and Ocean Sciences
McPhee, Megan V., University of Alaska Fairbanks, College of Fisheries and Ocean Sciences
Yasumiishi, Ellen M., National Oceanic and Atmospheric Administration, Alaska Fisheries Science Center
Agler, Beverly A., Alaska Department of Fish and Game, Mark, Tag, and Age Laboratory, Division of Commercial Fisheries
Wilson, Lorna I., Alaska Department of Fish and Game, Mark, Tag, and Age Laboratory, Division of Commercial Fisheries

Increased hatchery production as well as favorable ocean conditions for survival have resulted in an historically high abundance of Pacific salmon (Oncorhynchus spp.) in the North Pacific Ocean. Although many salmon populations in the North Pacific increased in abundance following the 1976-77 regime shift, western Alaska chum salmon (O. keta) experienced sharp declines beginning in the 1990s. Reductions in growth and body size and increases in age at maturity have also been observed throughout the chum salmon's range. While the mechanisms underlying these changes in body size are not well understood, density-dependent effects, specifically competition with abundant Asian pink (O. gorbuscha) and chum salmon in the Bering Sea, is a primary hypothesis. This study investigates the relationship between western Alaska chum salmon growth and Asian pink and chum salmon abundance using retrospective scale analysis. The relationship between scale radius and fish length allows us to examine growth during ocean residence. Overlaps in salmon diet and ocean distribution may be related to growth of western Alaska chum salmon due to inter- and intra-specific competition. Distribution and diet data is synthesized to determine the potential for negative interactions between western Alaska chum salmon and Asian pink and chum in the Bering Sea. Chum salmon scale samples were gathered from western Alaska escapement and harvest projects operated by the Alaska Department of Fish and Game and bycatch samples obtained through the Bering Sea Aleutian Island pollock fishery. Because growth has a strong influence on age at maturation in salmon, reductions in chum salmon growth during specific periods of marine residence may therefore explain observed increases in age at maturity for western Alaska chum salmon.

An investigation of genetic population structure of Tanner crab (Chionoecetes bairdi) in Alaska. *

Johnson, Genevieve M. University of Alaska Fairbanks College of Fisheries and Ocean Sciences
Hardy, Sarah M. University of Alaska Fairbanks College of Fisheries and Ocean Sciences
López, J. Andrés University of Alaska Fairbanks College of Fisheries and Ocean Sciences

Tanner crab (Chionoecetes bairdi) are important to commercial, personal use, and subsistence fisheries in Alaska. The Bering Sea commercial fishery was once the most substantial crab fishery in the state in terms of landed weight, but it has faced mixed success over the past few decades. Information on the population structure of a species can be help guide natural resource management policies, insuring longevity of the resource. Evidence from genetics has proven useful in refining understanding of population structure, but its application was historically limited by the genomic resources available for a particular species. Novel and continuously refined sequencing technology now offers the potential to circumvent this barrier and provide access to genomic-scale datasets of genetic variation even for species for which existing genetic information is absent or limited. We applied these techniques to assess the population structure of C. bairdi throughout Alaska. A set of 100 samples, composed of 25 individuals from four different commercially and/or subsistence harvested stocks (Southeast Alaska, Prince William Sound, Bering Sea west of 166° W, Bering Sea east of 166° W) were genotyped using a double-digest restriction site associated DNA sequencing (ddRAD-seq) approach. The genotyped loci can be used to compare genetic variation within and between each of these regions. We will describe our progress on assembling the largest dataset on genetic variation in this species to date. Over 5000 single nucleotide polymorphisms (SNPs) have been identified in a subset of samples. Preliminary results from principal components analysis suggest that less genetic variation exists among Gulf of Alaska samples than those collected from the Eastern Bering Sea. Our analyses of genetic variation and population structure will improve our ability to assess the potential effects of human practices and climate change on the future of this Alaskan resource.

Shared Knowledge

Conflict Based Conversation - Win the Crowd!

Hjelmgren, Jim

Giving a Voice to the Yukon River.

Stickman, Danielle E. Yukon River Drainage Fisheries Association

The Yukon River Drainage Fisheries Association (YRDFA) is a 501 (c) (3) non-profit association of subsistence and commercial fishers with a mission of protecting and promoting all healthy fisheries and cultures along the Yukon River drainage. Since its creation in 1990, YRDFA has worked hard to conserve salmon runs by giving a

voice to the people who have used and managed the resource for thousands of years. The YRDFA Board, consisting of 16 directors and 14 alternates from the full length of the Alaska Yukon River has done this by encouraging respect, fairness, and sharing as well as promoting awareness, understanding, and cooperation through all aspects of the work they do. YRDFA incorporates Traditional Ecological Knowledge in decision making processes, holds a critical annual Preseason fishery planning meeting, weekly in-season teleconferences through the months of June to August, collaborates with ADF&G and the USFWS on seasonal fishing surveys, and works on various collaborative projects with tribes, agencies, and other nonprofits. YRDFA participates and reports to all three federal subsistence regional advisory councils along the Yukon River and various relevant meetings. We prepare public education and information materials such as pamphlets, posters, social media posts, as well as letters to distribute to Yukon River communities. Although we have had budgetary cutbacks, we continue to create meaningful and informational meetings and presentations like the annual YRDFA Pre-season meeting, YRDFA board meeting, weekly in-season teleconferences, and this year we are creating a one day young-fishermen's workshop in conjunction with the YRDFA Pre-season meeting. This one day workshop will give young fisherman tools and resources to understand regulatory processes, salmon biology, the status of the runs, and other related topics. Danielle Stickman started working at YRDFA in September 2016, as their Communications and Outreach Director, and will give a brief overview of YRDFA's outreach work in the past, present, and plans for the future.

Community-Based Research and Monitoring Initiatives for Depressed Kuskokwim River Chinook Salmon.

Bechtol, William R., Kuskokwim Inter-Tribal Fisheries Commission
Spaeder, Joseph J., Bering Sea Fishermen's Association
Gillis, Karen, Bering Sea Fishermen's Association
Albertson, LaMont, Kuskokwim Inter-Tribal Fisheries Commission

After several years of low Chinook Salmon (Oncorhynchus tshawytscha) returns, including the lowest return ever estimated to the Kuskokwim River since 1976, the U.S. Congress approved disaster funding to provide relief for salmon harvesters in the Kuskokwim, Yukon, and Cook Inlet regions. Funds for the Kuskokwim River are allocated through the Arctic-Yukon-Kuskokwim — Sustainable Salmon Initiative with a focus of mitigating losses from the Chinook Salmon collapse. In contrast to commercial fishery losses which can be mitigated financially, subsistence harvests in the Kuskokwim River are difficult to mitigate because we can't replace lost harvests at low stock levels, and simply replacing food reserves ignores the social and cultural linkages associated with subsistence harvests of Chinook Salmon. The focuses of this new array of projects are twofold. First is the development of a novel community-based monitoring (CBM) program to collect data on CPUE, species ratios, and subsistence harvests of Chinook Salmon. This CBM program is to be implemented inseason, an aspect that has historically been a low agency priority but which has become increasingly important when attempting to provide for some subsistence harvests at low levels of Chinook Salmon returns. A second focus is to promote and benefit from community involvement and capacity building in stock assessment data collection, including operation of a salmon test fishery, multiple weirs, and age, sex, and length (ASL) sampling. We discuss the projects being funded for Chinook Salmon of the Kuskokwim River, how these projects build stakeholder capacity and community involvement, and how these projects link to other ongoing or anticipated projects for the Kuskokwim River.

A comparative analysis of the Bristol Bay, Southeast, and Kenai River Fisheries: tracking stakeholder participation through the governance mechanisms of proposals, agenda change requests, and emergency petitions, over the last 15 years.

Krupa, Meagan
Molly McCarthy

The Alaska Board of Fisheries (Board) oversees a governance process that is both applauded and criticized, but no one has ever assembled data to examine this process. One of the challenges preventing this work includes locating the large volume of data that accurately characterizes stakeholder engagement in the public process. While this challenge was significant, we found Board proposals online and in the state archives that allowed us to quantify stakeholder interactions with the governance process. Using integrated data digitization and coding methods, this research investigates differences in stakeholder participation in the form of Board proposals within the regions of Bristol Bay, Southeast, and Cook Inlet from 2000-2015. We conducted a regional analysis of stakeholder proposals to highlight the differences affecting the implementation of the management system across the state. The roles of advisory committees, non-government organizations, the Alaska Department of Fish and Game, and Tribes differed in each region. We will work with the National Center for Ecological Analysis and Synthesis (NCEAS) to expand

this research in the summer of 2017 to include statewide proposals, agenda change requests, and emergency petitions from 1960 to the present.

SASAP - State of Alaska's Salmon and People Synthesis.

Dutton, Ian M. Nautilus Impact Investing
Davis, Frank. National Center for Ecological Analysis and Synthesis; University of California, Santa Barbara
Westley, Peter. Westley College of Fisheries and Ocean Sciences, University of Alaska Fairbanks
Cornejo-Donoso, Jorge. National Center for Ecological Analysis and Synthesis; University of California, Santa Barbara
Schake, Katherine. Nautilus Impact Investing

Alaskan salmon management has a firm science foundation and there are well-established research and monitoring programs to inform fisheries allocation, management and policy. However, it can be difficult for stakeholders of Alaska's salmon system to readily access up-to-date, accurate and integrated information. Existing information is often fragmented and lacks a significant body of indigenous knowledge. In addition, due to insufficient interdisciplinary approaches there are a range of salmon science, policy and management questions that have not yet been addressed. These knowledge gaps can leave salmon stakeholders inadequately informed about the status of salmon populations and habitats as well as options to address the increasing pressures on salmon systems. Information asymmetries can undermine the stakeholders' ability to equitably and knowledgeably participate in the management processes. A new multi-institution initiative, the State of Alaska's Salmon and People (SASAP), seeks to provide an up-to-date interdisciplinary perspective on Alaska's salmon systems and the people who rely on them. The SASAP project is working to connect knowledge across disciplines and agencies, between cultures and users, and across regions to create new institutional capacity that allows the generation of interdisciplinary salmon knowledge and establish a foundation for integrated knowledge that can be built on over time. SASAP is being undertaken by eight diverse working groups from mid 2016 through early 2018. The groups span a range of disciplines, including social and biological sciences, and actively engages indigenous knowledge holders as an equal partner in synthesis research. This presentation describes the SASAP process and intended outcomes. Further details of working group membership and interim progress are available at https://alaskasalmonandpeople.org/.

Contributed Papers

Don't Trash Those Data: The FAST Approach to Halibut Research.

Webster, Sarah R. Fisheries, Aquatic Science & Technology (FAST) Lab at Alaska Pacific University
Wolf, Nathan. FAST Lab at APU
Harris, Brad. FAST Lab at APU

In 2011, the Fisheries, Aquatic Science and Technology (FAST) Laboratory at Alaska Pacific University partnered with the Alaska Department of Fish and Game Sport Fish Port Sampling Program and the US Geological Society Marrowstone Marine Field Station to examine a potential connection between the parasite Ichthyophonus and Mushy Flesh Syndrome in Pacific halibut. Under this cooperative partnership, teams of FAST Lab students travelled to ports in Southcentral Alaska and made use of a novel sampling technique to collect Pacific halibut tissue samples from sport fishermen. Samples were collected after fish had been filleted, but before the remaining carcasses were discarded. While the team did not find a correlation between Mushy Flesh Syndrome and Ichthyophonus, the "pre-dumpster/post-mortem" sampling technique proved successful and yielded several other important results. Baseline information on prevalence of Ichthyophonus in halibut was established in all five ports and ranged from 26.2 – 44.7%. The first findings of Ichthyophonus in Pacific cod, lingcod, yellow eye rockfish, and black rockfish were documented, and baseline data on Ichthyophonus prevalence was established for these species. Perhaps the most fundamental lesson from this project was the success of the sampling technique in generating powerful, reliable data from fish that otherwise would have been trashed. Since the project, the "pre-dumpster/post-mortem" technique has been used in additional studies on Ichthyophonus, Pacific halibut size-at-age, and to build a stable isotope library.

How many fish are in this barrel? Sustainably harvesting two easily caught skate species. *

Farrugia, Thomas J., College of Fisheries and Ocean Sciences, University of Alaska Fairbanks
Kruse, Gordon H., College of Fisheries and Ocean Sciences, University of Alaska Fairbanks
Taylor, Ian G., Northwest Fisheries Science Center, NOAA Fisheries
Ormseth, Olav A., Alaska Fisheries Science Center, NOAA Fisheries
Seitz, Andrew C., College of Fisheries and Ocean Sciences, University of Alaska Fairbanks

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

Evaluating the accuracy of remote sensing using aerial, water and land platforms to quantify glacial habitats utilized by pinnipeds. *

Pegus, Courtney
Atkinson, Shannon
Quinn, Terry
Jansen, John
Pyare, Sanjay

Harbor seal (Phoca vitulina) populations have experienced significant declines over the past 50 years, which might be related to climate-driven changes to habitat. Approximately 10-15% of harbor seals in Alaska use tidewater glacial ice as substrate for pupping, but these habitats are disappearing due to warming sea temperatures. Little is known about the fine-scale characteristics of glacial habitats used by these animals, making it difficult to identify and quantify habitat changes over temporal and spatial scales. My study 1) evaluates the accuracy of using remote sensing to measure fine-scale dimensional characteristics of glacial ice platforms and 2) quantifies and measures the dimensional characteristics of ice platforms accessed by harbor seals during pupping. Height measurements of ice platforms were obtained from remotely sensed images captured on three different platforms water, air, and land, and statistically compared with the true heights of the selected ice platforms. My preliminary results indicate that regardless of the platform, measurements extracted from remote sensing images were as accurate as surveys conducted in the field. There were no statistical differences between the true heights of ice platforms and heights extracted from images captured on land and water platforms. Height measurements calculated from the air platform using an unmanned aerial vehicle (UAV) were significantly over-estimated by a constant amount, but correctable. Remote sensing techniques tested in this study will be used to evaluate dimensional features of ice platforms occupied by harbor seals in at least three tidewater glaciers in southeast Alaska during the summer 2017. Data from this effort will be used to better understand how marine mammals, such as harbor seals, utilize these changing ecosystems. Predicting how marine mammal populations respond to habitat changes will be essential for developing conservation management strategies in the 21st century.

Eklutna River Lower Dam Removal-history, Challenges and Opportunities. *

Miller, Joseph P. HDR

In 1929, Alaska's first hydroelectric dam project was completed by Alaska Light and Power on the Eklutna River. Providing electricity to the young city of Anchorage, the project was remarkable in its construction and effects on the salmon population in the river. The 70-foot tall concrete arch dam operated until 1952, when it was abandoned after a new hydroelectric project was completed upstream on Eklutna Lake. Located in a 300-foot deep canyon, dam construction presented unique challenges; removal presents equal construction challenges with bright opportunities for salmon populations. Two primary challenges confront removing the dam: access and sediment management. The dam is only accessible on foot by descending a steep gully with rope assistance. To safely reach the dam, the contactor installed an 700 ft aluminum stairway down the gully and placed a 750,000 lb crane at the canyon edge to lower equipment. The second challenge is sediment management. After abandonment, the dam's reservoir filled with 250,000 cubic yards of sediment. With lake flows cut off from the river by the operating hydroelectric project, mobilization of the sediment will be slow while removing the sediment out of the canyon is not feasible. A sediment transport model was developed to evaluate the consequences of dam removal and a post project monitoring program will be important in measuring project success and restoration of salmon upstream of the dam. The removal is being led by HDR, Inc. on behalf of The Conservation Fund, using private funding. Construction staging is complete and dam demolition is scheduled to begin in early 2017. The dam removal signifies the first step in the long process to restoration of the Eklutna River and its historic salmon populations.

The riverdist package for R: a toolset for river network distance.

Tyers, Matthew B. Alaska Dept. of Fish & Game

For spatial analyses within a river network, even summary measures of distance can prove challenging to obtain. Shortest-path distance and linear referencing often require proprietary software or a workflow involving multiple programs. Here the riverdist package for the open-source software R is presented, which allows a user to import a polyline shapefile as a connected network, make changes or edits to the imported network as needed, and perform network distance and linear referencing tasks using spatial point data, all within the R environment and needing no additional software. The riverdist package is intended to streamline spatial summaries in fisheries research, and contains some automated analyses designed for telemetry projects in rivers.

Density dependence and spawning segregation lead to the evolutionary stability of partial migration in female steelhead and rainbow trout. *

Ohms, Haley A. Oregon State University
Lytle, Dave A. Oregon State University
Mohapatra, Anushaya Oregon State University
De Leenheer, Patrick. Oregon State University

Partial migration within a population, the phenomenon in which migrant and non-migrant phenotypes coexist, is widespread among salmonids. One hypothesis for the evolutionary stability of partial migration is that reproductive success depends on the frequency of each phenotype and is highest for individuals with the rare phenotype because they experience less competition for a shared resource. While this 'successful when rare' hypothesis explains partial migration in males, it does not explain partially migration in females because females do not compete between phenotypes for mates. Rather, female competition is segregated by habitat for redd sites; migrant females compete only among themselves, while non-migrant females compete only among themselves. We examine how female partial migration can be an evolutionarily stable strategy, even though migrant and non-migrant females do not compete directly for spawning habitat. Using steelhead and rainbow trout as a focal species, we demonstrate how competition within phenotypes can lead to partial migration by indirect frequency dependence at spawning sites. Our results indicate that the relative abundance of spawning habitats plays a key role in the relative abundances of female steelhead and rainbow trout, and partial migration in females may best be conceptualized as an adaption that expands niche space for the entire population of O.mykiss.

Using a food-web model to examine restoration potential of river reaches.

Whitney, Emily J. University of Alaska Southeast
Bellmore, J. Ryan U.S. Forest Service
Benjamin, Joseph R. U.S. Geological Survey
Jordan, Chris NOAA
Newsom, Michael Geophilia Consulting

Millions of dollars are spent each year on river restoration projects aimed at recovering fish. Many restoration programs prescribe to a “one-size-fits-all” approach where the same restoration strategy is employed across broad landscapes. However, restoration effectiveness can be strongly controlled by local physical and biological conditions, such as temperature, discharge and nutrient regimes. Prioritizing restoration at locations with the greatest potential for improvement requires an a priori understanding of this context dependence. Here, we used a mechanistic food-web model to simulate potential restoration responses at twelve reaches in the Methow River (central Washington, USA) that have different environmental conditions (e.g., discharge, channel dimensions, vegetation cover, and temperature). We modeled food web and fish responses to three restoration alternatives that are commonly practiced in the Methow River and across the Pacific Northwest: (1) riparian vegetation restoration, (2) nutrient augmentation via salmon carcass addition, and (3) habitat restoration aimed at increasing suitable rearing habitat for juvenile fish. Model simulations suggest that reaches strongly differed in their sensitivity to restoration; fish populations responded positively to restoration at some reaches, but were relatively unresponsive at others. The least sensitive reaches were those that were intrinsically unproductive due to low water temperatures, and limited light and nutrient availability. Moreover, the highest ranked restoration strategy—i.e., those one with largest fish response—varied across the twelve sites. For example, salmon carcass augmentation produced greater fish responses in unproductive nutrient-limited reaches, whereas increasing suitable habitat was more beneficial in reaches with higher background productivity. These findings challenge the “one-size-fits-all” approach to restoration, and suggest that a more nuanced approach that accounts for site specific conditions may be necessary. Our modeling approach can be used to prioritize restoration by identifying the locations within river networks most sensitive to specific restoration actions.

The Office of Subsistence Management fisheries program.

Ayers, Scott D. USFWS, OSM

Have you ever found yourself wondering what a fisheries biologist does for the Office of Subsistence Management? If so, you’ve come to the right place. This discussion will provide a brief overview of the Federal Subsistence Management Program’s history and structure, and will then delve into the fisheries end of things including the Fisheries Resource Monitoring Program, the Partner’s Program, and how to change Federal Subsistence fishing regulations.

Enumerating Sheefish in the Upper Kuskokwim River.

Stuby, Lisa, Alaska Department of Fish and Game

Post-spawning outmigrating sheefish (Stenodus leucichthys) were enumerated at their most populous spawning location in the Upper Kuskokwim River (Big River) using Adaptive Resolution Imaging Sonar (ARIS) technology during 3-15 October 2016. An ARIS was placed near the mouth of Big River and ensonified the entire river cross-section. Sheefish typically arrive at this spawning area during late July through mid-September and spawn during late September through early October. Post-spawning outmigration typically occurs during a 2-week period during mid-October. Sheefish have been noted to spawn in the Big River at water temperatures ranging from 7.1oC and lower. As water temperatures neared 0oC, outmigration numbers increased. Most post-spawning outmigrating sheefish migrated during the night and the very early morning hours. Sheefish were still outmigrating downriver on 15 October. However, due to river ice formation the sonar had to be removed and camp dismantled. Enumeration efforts along with spawning frequency knowledge acquired from a past radiotelemetry study will be used to develop a spawning abundance index. Sheefish spawn in very few locations in the Kuskokwim drainage, and temperature, oxygen, and conductivity data loggers will be deployed at known spawning areas on the Middle Fork Kuskokwim, Big River, and an assumed spawning area on the South Fork Kuskokwim River in order to better understand sheefish spawning habitat needs. This project is funded for two more seasons by the USFWS Office of Subsistence Management.

Do the 2016 USGS Flood-Peak Regression Equations Systematically Over- or Under-Estimate Flood-Peak Discharge.

Aldrich, James W.

For more than 40 years, the USGS flood-peak regression equations have been used to design bridges, culverts and flood control measures at ungaged sites throughout Alaska. Updated approximately every 10 years, as our flood-peak database increased, the equations have provided an increasingly more accurate method of estimating flood-

peak magnitude and frequency at ungaged sites. Although the equations are easy to use, there are important concepts that the users should understand regarding the development of the equations. Additionally, in 2016 a significantly different approach was taken in the development of the equations. This presentation will discuss some of the basic concepts that users of the regression equations should understand as well as present the results from a test of the new equations to determine if they systematically over- or under-estimate flood-peak discharge.

Discovering Coho Salmon Spawning Habitats in the Resurrection River, Kenai Fjords National Park.

Young, Daniel B.

The sport fishery for coho salmon in Resurrection Bay, Alaska, is one of the largest in the state, and while hatchery releases of coho support this fishery, in some years wild coho salmon can make up 60% of the sport catch. Presumably, wild coho salmon that evade anglers in Resurrection Bay are returning to spawn in the Resurrection River and its tributaries. Apart from escapement data from the weir at the Bear Lake Hatchery and from eight index streams in the lower watershed, relatively little information exists on the migratory patterns and spawning distribution of coho salmon in the upper watershed. In 2014, NPS staff, in collaboration with the Chugach National Forest and Alaska Department of Fish and Game, implemented a study to capture, radio tag, and track coho salmon to their spawning locations in the upper Resurrection River. In total, 90 coho salmon were captured, radio tagged, and released into the river. Of these 63 (70%) were tracked upstream using fixed tracking stations, foot surveys, and aerial surveys. The project successfully identified two primary spawning areas within the drainage with most migrating to an area upstream of the glacial inputs.

Migration of Sockeye Salmon at the Northern Edge of Their Distribution.

Carey, Michael P.
Christian E. Zimmerman
Kevin D. Keith
Merlyn Schelske
David Douglas

Anadromous fish such as Pacific salmon are particularly susceptible to the climate changes that are underway in the Arctic due to the physiological challenges of their spawning migrations. Predicting how migratory timing will change under Arctic warming scenarios requires an understanding of how environmental factors drive salmon migrations. Multiple mechanisms exist by which environmental conditions may influence migrating salmon, including cues from the ocean and natal river. We explored relationships between inter-annual variability and annual migration timing (2003–2014) of Sockeye Salmon (Oncorhynchus nerka) in a subarctic watershed with environmental conditions at broad-, intermediate-, and local-spatial scales. Low numbers of salmon have returned to this high-latitude (65N) watershed in recent years and run size has been a dominant influence on the migration duration and inter-annual variability of the date of the midpoint of the run. The duration of the migration upriver has varied by as much as 25 days across years and shorter run durations were associated with smaller run sizes. The duration of the migration was also extended with warmer sea surface temperatures in the staging area. The inter-annual variability of reaching the date of 50% of the total run was earlier with a larger run size and delayed in years river temperatures warmed earlier in the season. Due to the influence of temperature on migration time, we explored the influence of river temperature on the energy costs of migration and hypothesize that higher river temperatures have increased the energetic demands on sockeye salmon in this watershed. Documenting factors related to migration of Sockeye Salmon near the northern limit of their range provides insights into the determinants of salmon migrations and suggests processes that could be important determinants of future changes in Arctic and Subarctic ecosystems.

Ecosystem Management

2017 Non Fishing Impacts Report.

Limpinsel, Douglas
Eagleton, Matthew
Hanson, Jeanne

The Magnuson-Stevens Fishery Conservation and Management Act is the primary law governing marine fisheries management in United States federal waters. In 1996, Congress added new provisions assisting fishery management councils in describing and identifying Essential Fish Habitat (EFH) in fishery management plans (FMPs); including the identification of adverse impacts to EFH and authority to recommend mitigation measures to ensure the conservation of EFH. EFH regulations also mandate a complete review of EFH provisions in FMPs at least once every 5 years to update information on potential impacts from commercial fishing and impacts from other non-fishing activities. The recent review has three focal areas; 1) update EFH descriptions, incorporating General Additive Models (GAM) or MaxEnt, 2) a subsequent evaluation of fishing impacts on EFH, and 3) updating information and adding new sections to the non-fishing impacts report. Previous iterations of the Non Fishing Impacts report describe sources of impacts to EFH and offer recommendations to mitigate impacts. The 2017 report builds upon those existing components, however, introduces an ecosystem approach to the most important EFH attribute to sustainable fisheries, water. Water connects all ecosystem and hydro-geomorphic processes from wetland headwaters through riverine, estuarine and marine systems. These ecosystem processes extend over Arctic, subarctic, and temperate climate zones; four recognized Large Marine Ecosystems; seventeen nearshore and coastal zones; and eight terrestrial eco-regions. A new chapter on climate change summarizes two recently well documented examples illustrating the influence of warming sea surface temperatures on marine fisheries in the Bering Sea and Gulf of Alaska. Based upon recent emission scenario projections, the 2017 review also cites current literature addressing potential cumulative impacts to marine ecosystem productivity; changes in marine fisheries distribution, abundance and species composition; altered predator-prey interactions; and potential impacts to associated coastal communities and food security.

Seascape-scale modelling of benthic habitat disturbance from commercial fishing activities.

Harris, Brad. Fisheries, Aquatic Science & Technology (FAST) Lab at Alaska Pacific University (APU)*Smeltz, T. Scott. U.S. Geological Survey, New York Cooperative Fish and Wildlife Research Unit, Cornell University, FAST Lab at APU
Olson, John. NOAA, National Marine Fisheries Service
Sethi, Suresh A. U.S. Geological Survey, New York Cooperative Fish and Wildlife Research Unit, Cornell University, FAST Lab at APU

The United States is among the world's largest producers of wild-caught fish. Most of this fish is caught using gear that contacts the seafloor, causing varying levels of habitat disturbance. Federally managed fisheries are required by law to minimize disturbance to fish habitats. To assist managers with this directive, we developed a modelling tool to estimate impacts to benthic habitats associated with fishing activities. The "Fishing Effects" model tracks disturbance dynamically through a discrete-time impact and recovery model and can be used at seascape spatial scales. It is currently implemented for Alaska-based fisheries in the North Pacific using a comprehensive spatially explicit database of fishing activity since 2003 as well as the best available sediment-based habitat maps, and literature-derived recovery and susceptibility parameters. The model predicts a maximum domain-wide disturbance of 2.6% from 2003-2008, but shows a steady decrease to 1.7% following rationalization and implementation of gear modifications. Disturbance to species-specific habitats, however, varies considerably from this background rate. The Fishing Effects model has recently been approved for use by the North Pacific Fisheries Management Council, but is applicable in any fisheries with sufficient data inputs.

Fishing effects in 3D – it's not all about bottom contact anymore.*

Nimick, Aileen M. Fisheries, Aquatic Science & Technology (FAST) Lab at Alaska Pacific University
Harris, Bradley P. FAST Lab at APU
Rose, Craig S. FAST Lab at APU, FishNext Research
Smeltz, T. Scott FAST Lab at APU, Cornell University
Sethi, Suresh A. FAST Lab at APU, Cornell University

The Magnuson-Stevens Fisheries Conservation and Management Act mandates that fisheries management councils minimize adverse fishing effects to essential fish habitat. The National Research Council has identified three fishing effect mitigation tools – harvest reduction, habitat closures, and gear modifications. The New England and the North Pacific councils have created mathematical models that estimate fishing impacts to the seabed to support the determination of whether the impacts are considered adverse, the other fisheries councils use qualitative approaches. Ideally fishing effects models should be able to assess the relative efficacy of these three management tools. The

New England and the North Pacific models can examine impacts associated with changes in harvest levels and the use of area closures; because they assess habitat impacts in a two-dimensional (width X distance) framework they are limited in their ability to incorporate information about gear modifications. We are creating a generic three-dimensional component-specific model for estimating habitat disturbance, adapted from the North Pacific Council's Fishing Effects Model. We are modifying the model framework to include component-specific fishing gear information in three dimensions, and the habitat feature susceptibility groups to account for feature height. Using simulated fishing data, we explore how our perception of fishing effects changes when considered a three-dimensional process. This talk will present results from these simulations.

Ecosystem-based fishery management: Lessons from down under.

Kruse, Gordon H. University of Alaska Fairbanks, College of Fisheries and Ocean Sciences, Juneau, AK

Ecosystem-based fisheries management (EBFM) is a systematic approach to fisheries management in a geographically specified area that contributes to the resilience and sustainability of the ecosystem, recognizes the physical, biological, economic, and social interactions among the affected fishery-related components of the ecosystem, including humans, and seeks to optimize benefits among a diverse set of societal goals. Implementation of EBFM requires development of appropriate governance and regulatory frameworks, statement of goals and operational objectives, a set of tools for implementation, ongoing monitoring and review, and high levels of stakeholder engagement throughout the whole process. Australia has been a world leader in the implementation of EBFM. In this presentation, I review a suite of tools for EBFM implementation developed in Australia. These include a regional-level, risk-based framework that has been used to cost effectively implement EBFM in Western Australia, a broader Commonwealth effort that developed and implemented an ecological risk assessment for the effects of fishing (ERAEF), and development of an ecosystem model (Atlantis) that considers all parts of marine ecosystems, with a structure built around the management strategy evaluation (MSE) approach. The MSE is used to examine trade-offs in performance over a range of management objectives that support decision-making. The ERAEF has been adapted for use by the Marine Stewardship Council to set global standards for sustainable fishing, and Atlantis has now been applied in over 30 ecosystems around the world. The utility of these tools to fisheries in Alaska will be discussed.

ShoreZone Imaging and Mapping in Alaska - over 92,000 Kilometers of Imagery and Mapping Data.

Hartmann Moore, Cindy
Steve Lewis
Mandy Lindeberg
Carl Schoch
Sarah Cook

ShoreZone is a coastal marine habitat mapping system, in which spatially referenced aerial imagery is collected specifically for classification. The resulting dataset includes imagery with mapped geomorphic and biological attributes in a searchable geospatial dataset. The imagery provides a useful baseline and visual reference. The mapped features include: shoreline morphology, substrates, and biotic resources such as eelgrass, canopy kelps, salt marshes and other habitat descriptors. There are many applications for this data including: oil spill contingency planning, habitat research, and coastal resource management. The Alaska ShoreZone imaging and mapping project is on-going with ~ over 92% of the coast imaged and mapped or with mapping in progress. Areas remaining to be imaged include the Western Aleutian Islands, the Bering Sea Islands, and Forrester Islands. The Alaska ShoreZone program is built on a foundation of multiple funding and contributing partners, including federal agencies, state agencies, nonprofit organizations, and private industry. The multi-organization program provides a framework to build on and supports a contiguous, integrated coastal resource database that extends from Oregon to the Beaufort Sea. The program goal is to have all of the Alaskan shoreline imaged and mapped using the ShoreZone protocol and to continue to make all the data web accessible. The Alaska imagery can be viewed online at http://alaskafisheries.noaa.gov/shorezone/ and at www.shorezone.org.

Informing and implementing landscape-scale freshwater and marine ecosystem management through Alaska's Landscape Conservation Cooperatives.

Murphy, Karen Western Alaska Landscape Conservation Cooperative
Pocewicz, Amy Northwest Boreal Landscape Conservation Cooperative
Loya, Wendy Arctic Landscape Conservation Cooperative

Mahaffy, Mary North Pacific Landscape Conservation Cooperative

Landscape Conservation Cooperatives (LCCs) are by their nature designed to support ecosystem management. LCCs bring together federal, state and local governments, Tribes and First Nations, non-governmental organizations, universities and interested public and private organizations, with the vision of landscapes capable of sustaining natural and cultural resources for current and future generations. Five LCCs intersect Alaska; we will highlight efforts of the Arctic, Northwest Boreal, North Pacific, and Western Alaska LCCs to measure and adapt to landscape changes affecting fisheries and other aquatic resources. Efforts are underway to coordinate monitoring of freshwater ecosystems, including the development of networks to collect stream temperature data, and broad-based discussions to increase monitoring of other important abiotic characteristics across agencies and organizations. LCCs and partners are also facilitating data management of large, historic datasets for hydrology, climate and soils to enable better understanding of past changes and inform current initiatives. Finally, we will highlight LCC-supported research projects that include improving understanding of fish habitat connectivity and response to climate change, identifying resilient landscapes that are hydrologically connected, and enhancing our current understanding of resilient ecosystems.

Assessing the accuracy of Landsat derived stream temperatures for use in juvenile salmonid habitat assessments on the Anchor River, Alaska. *

Hagan, John A. Fisheries, Aquatic Science and Technology Laboratory
Harris, Bradley P. Fisheries, Aquatic Science and Technology Laboratory
Smeltz, T.S. Cornell University
Sethi, Suresh A. Cornell University

This study assesses the ability of Landsat 8 thermal infrared imagery (TIR) to derive stream temperature in a small salmonid rearing stream, and identifies the influence of habitat variables. From May 1st to September 30th 2015, in-situ temperature data were collected concurrently with the remotely sensed TIR images at ten field sites throughout the Anchor River watershed in south-central Alaska. At each field site, thorough stream delineations were preformed to assess the influence of riparian vegetation, stream morphology, discharge and air temperature on TIR-derived stream temperatures. The accuracy of TIR data were assessed by Landsat Thermal Offset (LTO), which is found by calculating the difference between TIR-derived temperature and the in-situ temperature (TIR – In-situ =LTO). To examine the relationship between habitat variables and LTO, a Generalized Additive Model was employed. AICc multi-model selection indicated two top models within all variables. The model with the lowest AICc scores and root mean squares errors included both Rosgen Stream Classification, a stream morphology classification system and Gage Difference, which depicts trends in stream discharge in the week preceding TIR data collection. The top model suggest the accuracy of TIR-derived stream temperature data is driven by morphological and hydraulic processes throughout the study period and these processes effect on vertical mixing at each field site.

The aquatic eDNAtlas: All species, all streams through crowd-sourcing and one interagency database.

Isaak, Dan
Young, Mike
McKelvey, Kevin
Schwartz, Mike
Franklin, Tommy

Aquatic environmental DNA (eDNA) sampling is rapidly transforming our ability to describe and monitor biological communities. Adoption of this sampling technology is occurring broadly across many natural resource organizations and now results in samples being collected at thousands of sites each year. To reduce redundancy and maximize data sharing among organizations, the Aquatic eDNAtlas project will develop an interagency database, sampling template maps, and a website to ensure standardization of data collections while providing access to samples collected in association with the National Genomics Center for Wildlife and Fisheries Conservation (http://www.fs.fed.us/research/genomics-center/). Data will be provided in flexible digital formats that enable efficient use for many purposes that include species status assessments, trend monitoring, distribution modeling, detection and tracking of nonnative species invasions, and assessments of habitat restoration efforts. The eDNAtlas project will encompass all species throughout perennial rivers and streams in 12 western states. The website and database will be launched in the latter half of 2017 and will be updated semi-annually with newly processed samples from those willing to share their data. The NGC database currently houses eDNA samples from ~8,000 stream sites,

and >4,000 new sites are sampled each year so a wealth of data will soon become available to the aquatic community.

Speed Talks

If you can't catch em' grow em'.

Markis, Joel A. University of Alaska Southeast

There are many different users, managers and even gear types in Fisheries. Effectively managing Alaskas fisheries resources requires collaboration on all fronts. One often overlooked contributor to fisheries in Alaska is the notable enhancement that is afforded the salmon fisheries by private nonprofit hatchery contributions. We briefly examine the status of salmon enhancement in Alaska and make a call for more inclusion education and collaboration of this often overlooked sector.

Do scales protect fish from electroshock?

Reynolds, Jim. University of Alaska Fairbanks

Some biologists hold the opinion that scales protect fish from electroshock by increasing resistance to penetration of the electrical field during electrofishing. However, comparison of lightly-scaled species and heavily-scaled species is invalid because any differences in response are confounded by other species characteristics. At a fish farm along the Snake River, Idaho, in September 2016, I conducted a preliminary test on four Koi Cyprinus carpio, two with common-variant scale pattern (complete coverage) and two with mirror-variant pattern (partial coverage). Fish were exposed, one at a time, to a uniform field of 60-Hz pulsed DC in a test tank to determine electrical field intensity at immobilization threshold. One pair of Koi (42-43 cm) was immobilized at 0.55 V/cm (mirror) and 0.69 V/cm (common). The other pair (48-49 cm) was immobilized at 0.39 V/cm (mirror) and 0.51 V/cm (common). Because common variants were immobilized at higher thresholds than mirror variants, preliminary results indicated that scales seem to provide some electroshock protection. A rigorous experiment is planned for 2017.

Exploring the dynamics of fish DNA in streams: Can environmental DNA be used to estimate the abundance of spawning salmon?*

Tillotson, Michael D
Duda, Jeff
Kelly, Ryan
Hoy, Marshal
Quinn, Tom

Estimates of abundance at various stages of the salmon life cycle provide valuable data on survival, movement and population productivity that directly inform fisheries management. Weirs, counting towers, mark-recapture studies, float/walking/aerial surveys and hydroacoustics are among the methods currently used to enumerate salmon. These and other counting methods are typically expensive and/or labor intensive; severely limiting the spatial and temporal extent of monitoring for management agencies with finite budgets. Recent advances in the collection and analysis of environmental DNA (eDNA) may offer a relatively low cost alternative to traditional salmon counting. eDNA methods for fish detection are now well established and have been applied in many cases of rare or endangered species detection. Several studies have also shown a quantitative relationship between fish abundance and the concentration of DNA replicates in water samples. Nevertheless, many uncertainties remain regarding the source and fate of fish DNA in streams, and these uncertainties limit the current application of eDNA to enumeration efforts. In order to investigate the dynamics of salmon DNA is streams, during the summer of 2016 we paired eDNA sampling with daily visual enumeration of adult sockeye salmon in Hansen Creek, a small stream (~2km long) in the Bristol Bay region of Alaska. In addition we collected environmental parameters that may influence DNA decay including dissolved oxygen, temperature, water level and photoactive radiation. The fine temporal and spatial scale of these data paired with high accuracy of our visual counting methods make this the most comprehensive study of fish enumeration via eDNA to date. Although complete genetic analyses are forthcoming, here we describe the study design and present preliminary results.

Seeing the Big Picture: A Better Way to Visualize Stock-Specific Harvest Data?

Shedd, Kyle R. Gene Conservation Laboratory, Alaska Department of Fish and Game

Stock composition and stock-specific harvest data are often visualized as barplots, with each bar representing the harvest proportion or number attributed to a given stock group. While barplots are simple to produce and easily interpretable by lay audiences, this method often results in numerous figures in an attempt to visualize variation in stock composition and harvest across spatial and temporal strata. Perhaps a better visualization tool is the bubble plot. Bubble plots have two main axes (stocks and areas) in a grid pattern with circles at each intersection depicting the size of the stock-specific harvest for a given spatial strata. Bubble plots can depict results of many spatial strata at once for a given temporal period and better characterize differences in harvest magnitude between areas and periods. Barplots can be added to the margins of the grid to allow for simple comparison of total harvest in each area and total harvest of each stock. I'm looking for feedback on whether this is a more useful visualization tool than barplots.

The More Variety, the Better Society!

Loewen, Mary Beth Alaska Dept of Fish and Game*

In fisheries science, we often celebrate the biodiversity of species. That celebration, however, exists in tension with the low diversity of gender and race or ethnicity in our workforce and membership. Our progress in becoming more diverse is evident to long-term members. Still, our national membership is now 25% female, only half way to being truly representative. Racial and ethnic numbers for the Parent AFS membership are currently unavailable, a sign that not enough importance is paid to having a truly diverse membership. A diverse workforce in science can bring about competitive advantages, innovation, and new knowledge, skills, and experiences for understanding complex problems involving the science and management of natural resources. AFS can play an important role in facilitating collaboration among potential students, universities, and employers to open wider those valves that are restricting outflow from the pipeline. I welcome the challenge of "moving the needle" on diversity in the fisheries profession, and will present some statistics for our Chapter and parent organizations, as well as some take-action-now options for our members to encourage and develop diversity.

Fisheries sustainability through collaboration.

Jovanovich, Madeline M., University of Alaska Fairbanks

Lessons from history show that the lack of stakeholder engagement disconnects relationships between people, management organizations, and natural resources. Fisheries sustainability is threatened by a breakdown of these relationships, and a tight connection between resource users and management leads to better outcomes for both the resource and stakeholders based on synthesized management applications. This talk provides an argument for intimate collaborations based on a recent example from Bristol Bay that can be applied to future partnerships and projects that seek sustainable fisheries.

Documenting habitat for anadromous species: Exploring affordable methods for protecting Alaska's salmon streams.*

Sarah O'Neal
Dan Young
Carl Ostberg
Jeff Duda
Marshal Hoy

For anadromous fish to be protected by Alaska's fish conservation statutes and regulations, they must be explicitly documented and nominated to the Alaska Department of Fish & Game's (ADF&G's) Anadromous Waters Catalog (AWC). However, ADF&G estimates that less than half of the state's streams have been surveyed. Because most streams are remote, AWC surveys are often time consuming and expensive. Consequently, we evaluated alternative methods of documenting fish distribution in remote Bristol Bay watersheds. Presence/absence surveys were conducted in and near mining claims in the Chulitna, Newhalen, and Koktuli River basins in Bristol Bay using electrofishing and two methods of environmental DNA (eDNA) collection (barcoding for all teleost taxa, and quantitative polymerase chain reaction targeted for salmonids). Agreement between all three methods occurred

in 31-71% of sites (n=24), depending on the species. Agreement was most common when species were absent using all methods. The two eDNA methods agreed in 58-79% of sites, depending on the species, and suggested that eDNA may be capable of detecting more species than traditional electrofishing methods. We will present preliminary results describing potential application of eDNA methodology for documenting fish distribution and expanding overall geographic coverage of the AWC.

Changing flowpaths, groundwater, and permafrost: long-term chemical flux increases within the Yukon and Tanana Rivers.

Toohey, Ryan

Ocean Acidification Research Center: 3 Ps for OA samples.*

Monacci, Natalie
Mathis, Jeremy T.
Kelley, Amanda L.

Are you interested in adding ocean acidification (OA) monitoring to your current research program? Do you have an OA sensor that needs to be calibrated? The Ocean Acidification Research Center (OARC) is housed in the College of Fisheries and Ocean Sciences at the University of Alaska Fairbanks. The OARC opened in 2008 and now operates as a non-profit recharge center. This structure allows us to accept seawater samples from other researchers to analyze at cost. The OARC currently operates four OA analyzers, VINDTA and AIRICA, for the determination of Dissolved Inorganic Carbon and Total Alkalinity. OARC also maintains a SEAL Autoanalyzer for nutrient analyses (NO3, NO2, PO4, SiO2). The policies, pricing, and protocols for seawater sample collection, submission, and analysis will be discussed.

Beaver Dam Management: Mitigating Obstructions to Salmon Migration in the Yukon Territory.

Trerice, Jesse Executive Director Yukon Salmon Sub-Committee
Al von Finstger, DFO
Don Toews, Environment Yukon (retired)
Harvey Jessup, Environment Yukon (retired)

There has been constant and consistent messaging from some Yukon communities and Yukon First Nations that observations of negative impacts of beaver dams on Chinook spawning and rearing streams have been taking place for several decades. In the 1990's the Yukon River Panel's R&E fund supported a number of beaver dam management projects in the Territory, however, the concern of the impacts that obstructive dams have on the Kings has not abated and if anything is being voiced increasingly during stock restoration workshops and during the Salmon Sub-Committee's recent community engagement process. This is happening during a time when Chinook stocks are in decline and depressed due to a variety of factors such as decades of heavy fishing, over fishing and size selective harvesting, changes in ocean productivity, climate change, loss and degradation of freshwater fish habitat and water and environmental quality. People are looking for solutions to increase abundance and productivity to past levels, and while there is no 'one size fits all' approach, assessing the need for and supporting beaver dam management programs is a stock restoration activity that under the right circumstances can produce near-term results. Examples have been documented by biologists in the Yukon where Adult Chinook salmon have recolonized spawning streams within one or two years after obstructing dams were breached. While the YSSC focus is on salmon, we have evidence that breaching impeding dams has also been shown to benefit freshwater fish such as lake Trout and Broad Whitefish. We also recognize that an ideal beaver dam management program combines activities such as assisting salmon past dams, breaching dams and controlling beaver populations to maintain access to and from spawning grounds. That is, it is strategic, long-term and focuses on productive Chinook spawning and rearing streams.

Instream Flow Reservations in the Nushagak Watershed.

Larquier, Ann Marie, Alaska Department of Fish and Game

Water of sufficient quality and quantity is needed to maintain ecological functions and values in rivers and lakes. ADF&G's Aquatic Resources Unit seeks to protect fish and wildlife habitat through the process of acquiring reservations of water (instream flow water rights). ADF&G, in partnership with Southwest Alaska Salmon Habitat Partnership and USGS, has initiated a streamgaging network in the Nushagak watershed to support instream flow

reservations. An overview of the anticipated reservations and the hydrologic data collection efforts to support these reservations will be presented.

Dispersal Ecology of Larval Lake Sturgeon (Acipenser fulvescens) in a connecting channel of the Great Lakes. *

Krieger, Joseph R. University of Michigan
Diana, James S. University of Michigan

Species-environment interactions have formed the foundation of both historic and modern ecology. Unfortunately, our understanding of the connectivity between a species and its surrounding environment is often incomplete, hindering the abilities of resource managers to accurately predict the impacts or implications of future environmental change, or to assess hindrances to restoration and rehabilitation efforts. Such difficulties are exacerbated by species exhibiting multiple life history stages and stage specific habitat requirements, such as seen in fishes. In these cases, traditional ecological population models often prove insufficient when attempting to understand the habitat needs of given species. With the use of a well studied threatened species, iconic to Michigan and the Great Lakes Basin, this research begins to address this gap in understanding of species-habitat connectivity and habitat 'preference' criteria. From an ecological sense, preferred habitat may simply imply an area where the species is located frequently or in some density. However, this definition often breaks down as individuals may be utilizing sub-optimal or less than preferred patches because high quality, preferred habitat is limiting or no longer present in a system. The distinction between a species optimal, preferred condition and its current, observed preference is critically important for restoration efforts aimed at preserving ecological, cultural, recreational, and/or commercially valuable species. Here, we evaluated the quantity, quality, and spatial distribution of riverine nursery habitat for larval, YOY, and juvenile lake sturgeon (Acipenser fulvescens) in the St. Clair and Detroit rivers, MI, using habitat suitability modeling and fish collections. Variation in habitat patch composition and lake sturgeon occurrence patterns suggest a level of plasticity in young lake sturgeon ecology not previously accounted for in management efforts. This study demonstrates an effective sampling methodology for fishes found in large, hard to sample rivers, with implications and applications for on-going work in Alaskan fisheries management.

AWRA Special Session – Interagency Hydrology Committee for Alaska

ADEC Environmental Monitoring in Southeast Alaska, 2017-2020.

Bethe, Amber N., Alaska Department of Environmental Conservation
Lomax, Terri J., Alaska Department of Environmental Conservation

One of the responsibilities of the Alaska Department of Environmental Conservation (ADEC) is to characterize the waters of Alaska. In part, this is accomplished is through the Alaska Monitoring and Assessment Program (AKMAP), which is responsible for implementing statistical surveys to assess water quality on a regional basis. Survey goals are to estimate current status and trends, establish associations between indicators of natural and anthropogenic stresses, and determine indicators of the condition of aquatic ecological resources. A combination of random and targeted sites are surveyed to ensure data is collected across a range of environmental conditions. AKMAP will begin conducting environmental monitoring in Southeast Alaska in 2017. Surveys will be conducted in conjunction with EPA's National Aquatic Resource Surveys and will include lake, river, stream and coastal surveys focusing on one waterbody type per year. Each survey will sample parameters to provide a baseline environmental health assessment of water quality, sediment, aquatic and riparian habitat, and biological conditions. This talk will cover the basics of AKMAP and planned survey work in Southeast Alaska.

Mapping Alaska's Water: an update on hydrography work in Alaska.

Krieger, Kacy

Alaska is an enormous state with a lot of water. However, much of the mapping of this water is based on 1950's-era USGS Historical Topographic Maps and is mapped at a broad 1:63,360-scale. Numerous partners are engaged in an effort to remap Alaska's waters to meet national high-resolution 1:24,000-scale standards. This work is overseen by the Alaska Hydrography Technical Working Group which employs a stewardship model, the Alaska Hydrography Database or AK Hydro, to coordinate and update hydrography in Alaska. AK Hydro has two goals. First, update the

National Hydrography Dataset, or NHD, to national standards. And second, meet the needs of Alaskan agencies. AK Hydro streamlines hydrography updates by centralizing NHD maintenance within a single group for all of Alaska. In doing so, the various agencies mapping surface water no longer need to run complex NHD tools. Instead, editors provide updated hydrography data that meet statewide and national standards to AK Hydro who then submit updates back into the NHD. The effort has been successfully employed to update hydrography across the state and has led to nearly 20% of the NHD in Alaska now meeting national 1:24,000 scale standards. This updated hydrography data is available to anyone and has many uses. This presentation will explore the workflow for updating surface water mapping in Alaska, how to access the data, and the many different applications for high-resolution 1:24,000-scale hydrography in Alaska.

National Springs (Water) Inventory and Alaska's Status.

Stevens, Larry

Dr. Larry Stevens has been studying freshwater ecosystems for the past four decades. Recently, he has focused his attention on improving understanding and sustainable management of springs. In 2012, he started the Springs Stewardship Institute (SSI) as a global initiative of the 501c3 Museum of Northern Arizona in Flagstaff. With a team of information managers, geographers, biologists, and students, this effort has led to research, inventory, ecological assessment, and agency advisement throughout western North America, and in Italy and Austria. He and the SSI team study springs ecology and the role of these critically important ecosystems in the landscapes and basins in which they exist. Springs create much of the baseflow of rivers around the world, provide critical habitat to many rare and refugial species, and function as ecologically and culturally significant points in the landscape. SSI's research and conservation efforts have resulted in publication of books, scientific journal articles, and popular articles on springs ecosystems around the world, and is having significant, long-lasting impacts on the field of springs ecosystem ecology and management. Springs are widely used by humans, and Larry and the SSI team are bringing these often-overlooked ecosystems into focus as points in the landscape worthy of attention to scientists, governmental agencies, indigenous cultures, the conservation community, and the public. The webinar will cover a wide range of topics on springs ecosystems. Dr. Stevens will discuss what makes a spring a spring and the many different forms springs can take, from awe-inspiring geysers to inconspicuous hillslope springs. He will also explain the basics of the inventory and assessment process at springs as well as the current state of knowledge on Alaska's springs.

Posters

The primary authors are listed first.

Marine movement, behavior, and survivorship of Chinook salmon in Cook Inlet, Alaska.

Seitz, Andrew C., University of Alaska Fairbanks College of Fisheries and Ocean Sciences
Courtney, Michael B., University of Alaska Fairbanks College of Fisheries and Ocean Sciences
\vans, Mark D., University of Alaska Fairbanks College of Fisheries and Ocean Sciences

While Chinook salmon are widely distributed in the North Pacific Ocean and of great economical and subsistence importance, little is known about their marine ecology. To address this knowledge gap, we used pop-up satellite archival tags (PSATs) to provide insights into the marine movements, behavior, thermal environment and survivorship of Chinook salmon in Cook Inlet, Alaska. To date, 20 PSATs have been deployed on Chinook salmon 69–95 cm FL (75.2 ± 5.9 cm, mean±SD) in March 2016 near Homer, AK. While at liberty 10–84 days, most end locations and individual fish tracks determined by a Hidden Markov Model suggest that Chinook salmon remained in Cook Inlet (n = 14) or made quick excursions to and from the Gulf of Alaska (n =2). In contrast, some tagged Chinook salmon quickly left Cook Inlet and reported from Shelikof Strait (n =1), Prince William Sound (n = 2), and near Icy Strait (n =1) ~250–1000 km away from their release locations. While occupying Cook Inlet, Chinook salmon occupied depths of mostly 0–50 m and a thermal environment of 5–6°C. While occupying waters in Shelikof Strait and the Gulf of Alaska, tagged Chinook salmon occupied depths of 0–330 m and ambient water temperatures of 3–9°C. Additionally, preliminary results suggest predation on tagged Chinook salmon by ectothermic predators (n =3) 10–20 days after release. In the future, we plan to deploy 20 additional PSATs on Chinook salmon near Homer, AK. These further investigations on the marine movements, behavior, survivorship and thermal environment will be valuable for improving our understanding of the marine ecology of Chinook salmon, and may inform future management considerations by fisheries and natural resource managers.

Processed based water balance modeling on the Arctic Coastal Plain to assess the linkages between hydrology and aquatic habitat.

Gaedeke, Anne
Ronald Daanen
Christopher Arp
Anne LiljedahlLei Cai

The impact of a change in climate on the seasonal and long term linkages between hydrology and aquatic habitats is only poorly understood in low-gradient Arctic terrestrial environments. Here we apply the physically based spatially distributed Water Balance Simulation Model (WaSiM) to the Fish Creek watershed (4900 km2) and its subwatershed Crea Creek (30 km2) located within the National Petroleum Reserve-Alaska (NPR-A). Fish Creek is a pristine watershed which has so far primarily been used for subsistence activities. The uncertainty regarding the impact of climate change on the hydrology poses a considerable challenge to regional stakeholders regarding the management and protection of aquatic habitats. WaSiM simulates all aspects of the water cycle as well as permafrost and seasonal soil freeze and thaw. Our simulations using WaSiM are carried out using a spatial model resolution of 30m and 10m for the Fish and Crea Creek watershed, respectively. We use existing observational data (meteorology, runoff, end of winter snow accumulation, soil temperatures) to inform WaSiM. Climate change impacts on surface water runoff are assessed in the form of three scenarios: warmer, snowier winters, wetter summers and prolonged summer droughts. Downscaled meteorological output from the Weather Research & Forecasting Model (WRF) form the basis for the climate scenarios. After successful parameterization and initialization, WaSiM reliably reproduces seasonal freezing and thawing of the ground, snow melt peak runoff and drying and decreased surface water connectivity during late summer. Model performance is highly dependent on resolving fine scale topographic features (channels, interconnected polygonal troughs) as well precipitation input data. The scenario analysis indicates that climate change has a considerable impact on the hydrology in low-gradient Arctic landscapes. Our results may assist regional stakeholders in managing surface water, aquatic habitat and fisheries resources more effectively considering the uncertainties of a changing climate.

Alaska Water Quality Standards for Temperature.

McGee, Chandra J. Alaska Department of Environmental Conservation
Tabor, Brock N. Alaska Department of Environmental Conservation

Determining the difference between natural and anthropogenic influenced changes in water temperatures can be challenging for state regulatory agencies. A temperature monitoring network would dramatically improve the existing decision making process. Such a network should: represent a variety of geomorphologic and riparian conditions, including wetlands; collect air temperature, wind direction and precipitation data; collect stream discharge; be available in a number of different formats for modeling purposes; have enough sampling locations to be statistically significant; and, have enough resources to be functioning for a minimum of five years.

Communicating Integrated Scientific Data Utilizing the Participatory Scenario Process.

Courtney Breest
E. Jamie Trammell
Meagan Krupa
Jim Powell 4 and others

The Southcentral Test Case of Alaska EPSCoR initiated the Salmon 2050 Project by asking the question "How might local communities respond to changes in salmon abundance in the Kenai River?" The participatory scenario process integrated multidisciplinary data with local stakeholder knowledge to develop five plausible futures, or scenarios, for the Kenai River watershed. The success of this project relied upon multiple forms of communication between EPSCoR researchers and the local communities before, during, and after the participatory scenario workshops. Another key element that contributed to success of this project was the high level of engagement from the stakeholder participants. Stakeholders who attended the workshops were selected based on a social network analysis that identified connections between stakeholders in the Kenai River Fishery. Following the workshops, the team established a steering committee with key stakeholders to maintain communication and participation in refining the scenario narratives. The project team also found it useful to engage a graphic facilitator throughout the project to maintain a consistent profile in terms of communications to stakeholders as well as publicly available multimedia products. The sustainability of the Salmon 2050 scenarios and the utilization of the developed products will be the project's final measures of success. Expected outcomes include an outreach partnership to connect the scenarios to the Kenai River watershed communities and collaboration with local decision makers to incorporate the scenarios into their future management plans and decisions.

BIG BIOLOGY meets microclimatology: Defining thermal niches of aquatic species for conservation planning using large interagency databases.

Isaak, Dan
Wenger, Seth
Young, Mike

Temperature strongly affects the ecology of aquatic species and is an environmental characteristic subject to change from global warming and habitat alteration. Information about the realized thermal niches of species and where temperatures are most constraining is needed for conservation planning this century. We developed a large species occurrence database (>23,000 electrofishing surveys) from USFS, IDFG, MTGFP, WYGF, and ID-DEQ and linked the information to NorWeST stream microclimate scenarios for a 149,000-km network in Idaho and Montana to describe thermal niches of 14 fish and amphibian species. Thermal response curves showed that species occurrence peaked across a wide range of temperatures (7–19°C) and that all species had distinct warm- or cold-edge distribution boundaries. Bull trout, cutthroat trout, brook trout, and tailed frogs had especially cold thermal niches and showed warm-edge boundaries; whereas rainbow and brown trout had warmer niches with cold-edge boundaries that indicated some streams were unsuitably cold. Remaining species (longnose dace, speckled dace, redside shiner, longnose sucker, mountain whitefish, Chinook salmon, slimy sculpin, and Columbia spotted frog) also had warm niches showing cold temperature constraints. Thermally-mediated boundaries are where populations may be most sensitive to thermal changes and habitat protection or restoration efforts could be targeted at these areas to protect local populations.

The crowd-sourced NorWeST temperature database and massive microclimate scenarios for streams and rivers of the American West.

Isaak, Dan
Wenger, Seth
Peterson, Erin

Ver Hoef
JayNagel, Dave

Climate change is warming streams across the West and threatens investments made to conserve valuable cold-water fishes. Efficient threat response requires prioritization of limited conservation resources and investments guided by accurate information about climate at scales relevant to species distributions within landscapes. We aggregated and organized most of the stream temperature data collected by >100 natural resource agencies throughout the West during 1993–2015 to create the NorWeST database that hosts >200,000,000 temperature recordings from >20,000 unique stream sites. A subset of those data were extracted from the database and used with a geostatistical spatial-stream-network (SSN) model (r2 ~ 0.90; RMSPE ~ 1.1°C) to predict mean August temperatures and map predictions at 1-km resolution for 36 historical and future scenarios in all streams. This poster shows a historical scenario for 1993–2011 of perennial streams mapped to 400,000 km the NHDPlus 1:100,000-scale stream layer. Temperature data summaries and scenarios are available in user-friendly formats through the NorWeST website (http://www.fs.fed.us/rm/boise/AWAE/projects/NorWeST.shtml) to facilitate inter-agency coordination of monitoring, climate vulnerability assessments, and research on stream thermal ecology. NorWeST information has been rapidly adopted by the management community because of its accuracy, convenient use, and development from data collected by the people working in local landscapes.

Environmental DNA (eDNA) sampling for aquatic species.

Tommy Franklin
Kevin McKelvey
Mike Young
Dan Isaak
Mike Schwartz

Environmental DNA (eDNA) is collected from environmental samples such as water, soil, or air. Organisms that exist in these environments sluff DNA which can be collected and analyzed. In this poster, we show how filtering water from streams is used to detect the presence of bull trout (Salvelinus confluentus) in the Rocky Mountains. Single molecules of eDNA can be reliably detected, making the method extremely sensitive. Further, collecting a sample requires only a single individual and about 10 minutes so sample collection is inexpensive. The ease of sampling coupled with extreme sensitivity provides a revolutionary technology enabling detection and range mapping for many species. eDNA markers already exist for many aquatic organisms, or can be developed inexpensively for those currently lacking them to enable species-specific monitoring.

Quantifying drivers of mercury in resident lake fish from Southwest Alaska I&M Network parks.

Bartz, Krista, NPS Southwest Alaska I&M Network
Krabbenhoft, David P. USGS Wisconsin Water Science Center
Lepak, Ryan F. USGS Wisconsin Water Science Center
Ogorek, Jacob M. USGS Wisconsin Water Science Center
Young, Daniel B. NPS Lake Clark National Park and Preserve

The Southwest Alaska Network (SWAN) is part of the NPS Inventory and Monitoring Program, which was created in 1998 to better understand the status and trends of select “vital signs.” One of the vital signs monitored within SWAN is resident lake fish (i.e., nonmigratory freshwater species). Monitoring indicates that some of these species have acquired elevated concentrations of mercury, the majority of which is methylmercury, a potent neurotoxin. Compared with resident lake fish sampled in 21 parks from 10 park networks in the western United States, mercury concentrations in fish from SWAN are among the highest, although considerable variation exists among lakes. Why do fish from SWAN – which inhabit some of the most pristine and remote waters in North America – have such elevated mercury levels? And what accounts for differences in fish mercury levels among lakes? Our ability to answer these questions and to provide relevant information for park managers and the public is limited. Therefore, SWAN is partnering with the USGS Mercury Research Laboratory in a three-year study examining the factors controlling fish mercury levels among SWAN lakes. The study focuses on a long-lived piscivorous species (lake trout) in two park units (Katmai and Lake Clark National Parks and Preserves). The first two years of the study involve collecting water, plankton, and fish samples from 13 lakes with a range of glacier, wetland, and salmon influences, and then analyzing the samples for mercury, methylmercury, and other analytes including stable isotopes of mercury, carbon, and nitrogen. The final year of the study involves developing quantitative models to relate

mercury in lake trout with potential drivers. Preliminary results suggest that lake trout from Katmai have a unique source of mercury, compared with lake trout from Lake Clark

Introducing the Alaska Ocean Acidification Network: connecting researchers and stakeholders to expand the understanding of ocean acidification in Alaska.

Dugan, Darcy G. Alaska Ocean Observing System
Monacci, Natalie. University of Alaska - Ocean Acidification Research Center

With Alaskans heavily reliant on the ocean for their lives and livelihoods, both direct and indirect effects of ocean acidification could have serious implications on species being harvested, and the food web that sustains our fisheries. Researchers are trying to better understand the chemical and ecological systems at play so we can anticipate and respond to future changes due to ocean acidification. Currently, the direct risks to Alaska's fisheries and shellfish industry are not well understood. An Alaska-focused study on public understanding and awareness of OA risk revealed that Alaskans are three times more aware of ocean acidification than Americans in general. However, despite the heavy reliance on fishing in Alaska's economy, Alaskans do not consider ocean acidification as an immediate risk and have a limited understanding of how Alaska will be impacted by ocean acidification. In response, the Alaska Ocean Observing System (AOOS) initiated an ocean acidification (OA) network for the state of Alaska. The Alaska OA Network is one of six in the nation, with a primary mission to engage impacted communities in order to expand the understanding of OA processes and associated consequences in Alaska. The Alaska OA Network provides and receives relevant information from the fishing and aquaculture industries, policy makers, coastal communities as well as the general public, and works closely with both OA science experts and Alaska entities interested in participating in OA research and monitoring. Stakeholder communities are members and provide input to the knowledge gaps and information needs for their regions. The Network anticipates advising on priorities for monitoring, research & modeling and will share best practices for monitoring quality assurance. The Network will also work to identify funding available to support OA efforts. Through AOOS, the network promotes data sharing and acts as a resource hub for OA information in Alaska.

Forecasting Alaska River Ice Breakup.

Edward Moran
Scott Lindsey

Spring breakup along large interior rivers in Alaska is a time of nervous anticipation for riverside villages. During breakup, ice jams forming along rivers such as the Yukon and Kuskokwim can result in severe and sudden flooding causing potential loss of life and extensive destruction to property. The limited observation network (there are only three automated USGS stream gauges along the 1,215 mile length of Yukon River in Alaska) and the inherently transient nature of ice-jam formations present a tremendous challenge in predicting the timing and severity of flooding. The National Weather Service (NWS) Alaska Pacific River Forecast Center (APRFC) is working to develop quantitative tools to provide adequate lead time for potentially devastating flooding of Alaskan Villages. In the past, qualitative assessments by APRFC in coordination with the NWS Alaska Region Climate Program Manager using the primary spring breakup drivers (snowpack, river ice thickness and short and medium-range forecasts of spring weather) have successfully identified years when flood severity was elevated or decreased and have indicated the likelihood of a thermal or dynamic breakup. Process/physical deterministic breakup models generally are the desired breakup forecasting approach, but such models require data that for most locations in Alaska are either not available or very limited. Thus, quantitative forecasting of river ice breakup timing and severity has rarely been attempted for Alaskan rivers. Therefore, a 'Temperature Index' method was developed for locations throughout Alaska to provide a forecast tool for breakup timing. Combining the Index method with a linear model of breakup progression downstream of the headwaters, APRFC identified record early-breakup dates at multiple locations along the Yukon and Kuskokwim Rivers during the 2016 spring breakup season.

Cumulative effects of size-selective fishing on size-at-age of Pacific halibut in the northeast Pacific Ocean.

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Martell, Steven J.D. International Pacific Halibut Commission
Kruse, Gordon H. University of Alaska Fairbanks

The biomass of Pacific halibut (Hippoglossus stenolepis) in the northeast Pacific Ocean has been declining since the late 1990s, and reductions in size-at-age since the 1980s explain more than half of the observed decline in halibut

biomass. For example, on average an age-20 female halibut weighed 61 kg in the 1980s but weighed <21 kg in 2014. We hypothesize that declines in size-at-age are, in part, the result of size-selective fishing. An age- and size-structured equilibrium model was developed to examine the long-term relationship between fishing mortality and size-at-age. Historical estimates of fishing mortality for Pacific halibut ranged between 0.18 and 0.60, with a mean of 0.40 over 2000-2014; fishing mortality was significantly higher in the eastern Gulf of Alaska than in the central or western Gulf of Alaska. Results suggest that fishing can explain 30-100% of the observed declines in size-at-age since the 1980s, depending on sex, age, and region. Given that length-at-age for any given cohort is highly variable, Pacific halibut are vulnerable to the cumulative effects of size-selective fishing. The most effective management action to potentially reverse trends in size-at-age would be to reduce harvest rates to diminish the intensity of size selection. Additional research is needed to better understand the potential for other mechanisms to the observed variability in size-at-age of Pacific halibut.

Freshwater growth of wintering juvenile stream-type Chinook Salmon.

Boersma, James U.S. Fish and Wildlife Service

Winter conditions can interact with gradations of body size, metabolism, and energy reserves resulting in a shift in the algometric growth patterns of Chinook Salmon Oncorhynchus tshawytscha. To investigate these relationships, we fit nine sub-models of an elapsed time mark-recapture Schnute-type growth model to winter growth data. The averaged models fit the growth data reasonably well, explaining 78% of the total variation in recapture lengths. The best fit models were charterized by an asymtotic relationship between time at-large and growth, presumably due to a winter related reduction in digestive capacity offset by the cost of growth. Over the range of initial lengths the average increase in growth during the study period was estimated to range from 20% for a 55mm fish to 6% for a 85mm fish, illustrating the effect of body size on the expected growth of juvinile Chinook Salmon during winter. The increase in asymetry of size-dependent growth during the winter period may contribute to the equalization of fish size at smoltification and thus increased survival during subsequent life-history stages

Stretching fisheries across vast distances and technological landscapes to meet Alaska's needs.

Markis, Joel A. University of Alaska Southeast

Alaska is a vast state with abundant fisheries resources. It requires numerous organizations and most notably, trained professionals to manage these resources. In a time when the graying of the fleet is a commonly used anecdote, fishery managers and professionals are not getting any shorter in the tooth. A need to develop new techniques for recruitment and education of future generations of fisheries professionals exists. The University of Alaska is striving to meet that need by streamlining program offerings, delivering flexible education options and reaching out across Alaska and beyond. We present some of the unique ways we are trying to recruit students into fisheries careers and educational programs and seek support and input on how to better home grow the exceptional fisheries professionals Alaska needs and deserves.

Observations on First Reports of Saprolegniosis in Aanaakłiq, Broad Whitefish (Coregonus nasus), from the Colville River near Nuiqsut, Alaska.

Sformo, Todd L. North Slope Borough-Department of Wildlife Management
Adams, Billy. North Slope Borough-Department of Wildlife Management
Seigle, John C. ABR, Inc.- Environmental Research and Services
Stimmerlmayr, Raphaela. Sformo, Todd L. North Slope Borough-Department of Wildlife Management
Ferguson, J.A. Alaska Department of Fish and Game

We report the first confirmed cases (2013–2016) of saprolegniosis caused by a water mold from the genus Saprolegnia in Aanaakłiq (Broad Whitefish; Coregonus nasus), from the Colville River near Nuiqsut, Alaska. The observations of this infection were first noted by Native subsistence fishermen from Nuiqsut. Their extensive local traditional knowledge underscores the incipient nature of this infection, despite the fact that the mold which causes saprolegniosis is widely acknowledged to be present worldwide, even in Alaska. Additionally, we report the more recent (2016) emergence of this disease in a second species of whitefish, Pikuktuuq (Humpback Whitefish; Coregonus pidschain) in the Colville River. Because fish are an integral part of the nutritional and cultural subsistence activities in Nuiqsut, individual subsistence fishers, in a collaborative effort with local governmental entities representing Nuiqsut, requested an examination of affected fish and information on possible drivers of this disease. The collaborative work described herein ranges from subsistence fishermen's observations, transfer of fish

and mold specimens from various scientists working with fishermen in the region to agency personnel, and multi-agency efforts toward collecting histopathology data and molecular identification of the mold. It should be noted that this collaborative work is not a specifically grant-funded, methodically pre-planned effort, but an approach that began with Native observations that incorporated with western scientific methods. While several Saprolegnia species are known to be endemic worldwide in freshwater systems, including Alaska, recent observations of the infection near Nuiqsut are a concern to locals who have not previously observed mold-infected fish. A preliminary program to determine the extent and possible driver(s) of saprolegniosis in Nuiqsut whitefish is briefly described in this presentation.

SASAP - State of Alaska's Salmon and People.

Dutton, Ian M. Nautilus Impact Investing
Davis, Frank. National Center for Ecological Analysis and Synthesis, University of California Santa Barbara
Westley, Peter. College of Fisheries and Ocean Sciences, University of Alaska Fairbanks
Cornejo-Donoso, Jorge. National Center for Ecological Analysis and Synthesis, University of California Santa Barbara
Schake, Katherine. Nautilus Impact Investing

Alaskan salmon management has a firm science foundation and there are well-established research and monitoring programs to inform fisheries allocation, management and policy. However, it can be difficult for stakeholders of Alaska's salmon system to readily access up-to-date, accurate and integrated information. Existing information is often fragmented and lacks a significant body of indigenous knowledge. In addition, due to insufficient interdisciplinary approaches there are a range of salmon science, policy and management questions that have not yet been addressed. These knowledge gaps can leave salmon stakeholders inadequately informed about the status of salmon populations and habitats as well as options to address the increasing pressures on salmon systems. Information asymmetries can undermine the stakeholders' ability to equitably and knowledgeably participate in the management processes. A new multi-institution initiative, the State of Alaska's Salmon and People (SASAP), seeks to provide an up-to-date interdisciplinary perspective on Alaska's salmon systems and the people who rely on them. The SASAP project is working to connect knowledge across disciplines and agencies, between cultures and users, and across regions to create new institutional capacity that allows the generation of interdisciplinary salmon knowledge and establish a foundation for integrated knowledge that can be built on over time. SASAP is being undertaken by eight diverse working groups from mid 2016 through early 2018. The groups span a range of disciplines, including social and biological sciences, and actively engages indigenous knowledge holders as an equal partner in synthesis research. This presentation describes the SASAP process and intended outcomes. Further details of working group membership and interim progress are available at https://alaskasalmonandpeople.org/.

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

Doroff, Angela Kachemak Bay National Estuarine Research Reserve
Trammell, E. Jamie Alaska Center for Conservation Science, University of Alaska
Abrahamson, Svyerine Kachemak Bay National Estuarine Research Reserve
Geist, Marcus A. Alaska Center for Conservation Science, University of Alaska

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

native clam rehabilitation techniques. Collectively, these actions foster stewardship, harvest sustainability, and best management practices of native clams through stakeholder engagement and public education.

Office work can wait- summer funemployment with ADF&G.

Loewen, Mary Beth, Alaska Dept of Fish and Game

Most of us went, or are going, into fisheries work because we love the outdoors, love fish, like to work with our hands, and get paid to play in beautiful areas. See with the Westward Region of the Alaska Department of Fish and Game has to offer for seasonal employment in beautiful locations throughout the Alaska Peninsula. You will gain valuable, applicable skills, get to work in some of the state's most spectacular scenery, and with room and board provided and no place to spend your paychecks, add some financial cushion to your winter work!

Potential Impacts of Industrial Winter Lake Water Extraction on Summer Fish Habitat and Lake-Stream Connectivity in the Arctic.

Whitman, Matthew S. Arctic Office, Bureau of Land Management
Arp, Christopher D. Water & Environmental Research Center, University of Alaska Fairbanks
Jones, Benjamin J. Alaska Science Center, U.S. Geological Survey

The petroleum industry conducts work in the Arctic during winter, using water from lakes to build ice roads and pads to support exploration drilling or development construction. The volume utilized is regulated based on maximum depth, ice thickness, and fish species present. Liquid water is removed from under-ice in lakes that do not freeze to the bottom and ice aggregate is scraped from areas that are <4 feet (1.2 meters) deep that normally freeze to the bottom. Under-ice water quality investigations suggest no detectable impacts from liquid water withdrawal, providing evidence that current guidelines are effective in avoiding degradation to overwintering fish habitat. However, concerns remain regarding the potential impact of lake water removal on downstream flows and habitat connectivity during the following summer. To date, post-winter evaluations of lake “recharge” have focused on whether or not a lake has outflow during spring snowmelt and if sufficient snowmelt water exists to replace removed lake water, which does not address potential impacts to summer flows. Reduced lake water supply could limit fish access to lakes, alter downstream habitat conditions, and diminish the transport of important fish prey items. Recent hydrology studies indicate that lake-stream connectivity can vary greatly on a seasonal and annual basis. Lake water removal could potentially tip this balance, particularly in dry summers that cannot be predicted. Paired fish research highlights the implications of reduced habitat connectivity in lake-stream systems. Development of impact thresholds and standardized criteria to mitigate potential impacts of reduced lake outflow in summer is complicated by differences in drainage area, lake morphology, outlet channel structure, and annual precipitation. Ongoing monitoring of lake-stream systems, a recent lake cover classification, and advances in hydrological modeling may improve the ability to effectively evaluate and manage for potential downstream impacts from winter lake water use in the future.

A comparative analysis of the Bristol Bay, Southeast, and Kenai River Fisheries: tracking stakeholder participation through the governance mechanisms of proposals, agenda change requests, and emergency petitions, over the last 15 years.

Meagan Krupa
Molly McCarthy

The Alaska Board of Fisheries (Board) oversees a governance process that is both applauded and criticized, but no one has ever assembled data to examine this process. One of the challenges preventing this work includes locating the large volume of data that accurately characterizes stakeholder engagement in the public process. While this challenge was significant, we found Board proposals online and in the state archives that allowed us to quantify stakeholder interactions with the governance process. Using integrated data digitization and coding methods, this research investigates differences in stakeholder participation in the form of Board proposals, emergency petitions, and agenda change requests within the regions of Bristol Bay, Southeast, and Cook Inlet from 2000-2015. We conducted a regional analysis of stakeholder participation to highlight the differences affecting the implementation of the management system across the state. The roles of advisory committees, non-government organizations, the Alaska Department of Fish and Game, and Tribes differed in each region. We will work with the National Center for Ecological Analysis and Synthesis (NCEAS) to expand this research in the summer of 2017 to include statewide proposals, agenda change requests, and emergency petitions from 1960 to the present.

History of Aerial Imagery in the Fairbanks, Alaska, Area and Applications For Water Resources and Fish Habitat Evaluations.

Lilly, Michael R., GW Scientific
Ruffino, Cari, GW Scientific
Henszey, Robert J., US Fish & Wildlife Service
Sparks, Stephen, Quantum Spatial
Wilson, Phillip, R., GW Scientific

The collection of aerial images in Fairbanks predates World War 2. Some early images, such as the 1938 set, were collected by an aviator hanging a camera out a plane window. As technology changed, the quality of the images changes to where we have both aerial images and satellite images available in recent years and have started the early incorporation of low-level drone images to help form a bridge between on-ground observations and those collected at higher altitudes. The archiving, care and enhancement of these images is important to fisheries and water resource evaluations. Uses of historical aerial and satellite observations can help evaluate and understand surface-water features, vegetative conditions and changes, winter ice and snow cover and how these features relate to fish habitat, which is often changing over time. In Alaska, the application of historical aerial images is particularly important to supplement already sparse on-ground data sets and get a better understanding of natural or development driven changes. The presented examples illustrate the applications of aerial and satellite information in the Fairbanks area and highlight the importance of maintaining and improving these resources in the future.

Student Posters

Meteorological field measurements transitioning from lowlands to mountains, Jarvis Creek, Interior Alaska.

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Liljedahl, Anna K. Water and Environmental Research Center; University of Alaska Fairbanks
Gatesman, Tiffany A. Water and Environmental Research Center; University of Alaska Fairbanks
Gaedeke, Anne Water and Environmental Research Center; University of Alaska Fairbanks

Meteorological field measurements are paramount in order to understand and predict future changes for Alaska's water sources. However, most meteorological measurements are only available along road networks in Alaska, and therefore, representative of primarily lower elevations. The meteorological data presented here was measured in Interior Alaska from the glaciated Jarvis Creek watershed (634 km2), which ranges in elevation from 383-1746 m.a.s.l. Lowlands are mainly covered in conifer and deciduous forests of various burn ages, while higher elevations include alpine tundra with low shrubs, bedrock, perennial snowfields and glaciers. The meteorological stations were distributed across the watershed to represent lowland and mountain weather (2013-2016). Measurements included rainfall, snowfall and end-of-winter snow accumulation, humidity, wind speed, solar radiation, soil moisture and water, soil and air temperatures. Rainfall and air temperatures are the two most commonly used meteorological data for water resources studies. In 2015, cumulative rainfall ranged from 211 to 500 mm between stations, with more rain at higher elevations. In 2016, total rainfall ranged from 227 to 436 mm with increased rainfall at mid-elevation stations compared to the previous year. Air temperatures tend be colder in lowlands than mountains during winter, but warmer in the lowlands during summer compared to higher elevations. Collectively, these types of measurements are imperative to understand the hydrology of a glaciated Interior Alaska watershed. The information is also valuable in a variety of other fundamental and applied sciences such as describing permafrost extent, evaluating channel stability for bridge construction, and identifying habitat for fish and wildlife.

Trophic feeding ecology of mercury in Kotzebue Sound fish: emphasis on monomethylmercury.

Mayo, Emalia Department of Biology and Wildlife, University of Alaska Fairbanks
Cyr, Andrew P. College of Fisheries and Ocean Sciences, University of Alaska Fairbanks Whiting, Alex Environmental Program, Native Village of Kotzebue
Lopez, J.Andres, College of Fisheries and Ocean Sciences and University of Alaska Museum of the North, University of Alaska Fairbanks
O'Hara, Todd M. Department of Veterinary Medicine, University of Alaska Fairbanks

Monomethyl mercury (MeHg+), a potent neurotoxin and endocrine disruptor, accumulates in some fish tissues. MeHg+ is more bioavailable from the diet than inorganic Hg forms because of its high assimilation efficiency, thus

the majority of Hg in many tissues is MeHg+. People who consume large quantities of fish, such as fish-based subsistence cultures including many native Alaskan communities, can potentially be at risk of consuming large quantities of MeHg+, depending on the %MeHg+ of the fish species that make up their diet and the commonly measured THg (includes all forms of Hg). We hypothesize that %MeHg+ ([MeHg+/total Hg) * 100]) is independent of feeding ecology, as indicated by δ15N, or fish size, a proxy for age. We analyzed fish donated by subsistence fishermen, (Kotzebue Sound, Alaska) to assess the potential for MeHg+ load. We analyzed muscle samples from 100 fish representing five species for total Hg concentrations [THg], [MeHg+], and stable isotopes of nitrogen (δ15N), and carbon (δ13C). We determined that [THg] and [MeHg+] increased with δ15N in three of the species. For the species studied, we determined that regardless of feeding ecology, or fish size, %MeHg+ remained relatively constant in muscle, at >85%. We suggest this is due to a diet predominately composed of MeHg+, high assimilation efficiency of MeHg+, and lack of demethylation processes independent of the age or feeding ecology of the fish. This information highlights the importance of understanding Hg accumulation dynamics in fish to better evaluate and set health consumption guidelines with attention to forms of Hg (e.g., %MeHg+).

The influence of feeding ecology and migration barriers on mercury accumulation Dolly Varden char (Salvelinus malma).

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Sergeant, Christopher J. National Park Service, Southeast Alaska Inventory and Monitoring Program
Lopez, J.A. College of Fisheries and Ocean Sciences and University of Alaska Museum of the North, University of Alaska Fairbanks
Bower, M. National Park Service, Southeast Alaska Inventory and Monitoring Program
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Assimilation of mercury (Hg) into food webs is directly influenced by ecological factors such as local habitat characteristics, species' migration patterns, and feeding behavior. Total Hg concentrations ([THg]) in biota from subarctic latitudes are driven both by broad spatial processes such as long range atmospheric transport and more local influences such as biotransport and geology. Due to the broad range of spatial and temporal scales associated with these drivers even relatively "pristine" protected lands such as national parks are undergoing Hg accumulation. We measured [THg] and stable isotopes of carbon (δ13C) and nitrogen (δ15N) in 104 Dolly Varden char (Salvelinus malma) collected in the summer of 2012 from the Indian River in Sitka National Historical Park and the Taiya River watershed in Klondike Gold Rush National Historical Park. We sampled fish below and above natural migration barriers to upstream salmon movement. There were no differences in Dolly Varden mean [THg] between sites after standardizing for log10 fork length. Unadjusted [THg] in Dolly Varden varied relative to fish size and δ15N enrichment values. While previous studies generally demonstrate that [THg] increases with higher δ15N values, we found that Dolly Varden below migration barriers had the highest δ15N values among all sampled individuals, but the lowest [THg]. One possible explanation is that those individuals were also foraging on salmon eggs, known to have high δ15N values and low [THg]. Dolly Varden residing below anadromous barriers had δ13C values consistent with marine carbon influence. Our findings show that Hg accumulation in these populations is influenced by several factors such as river type (local geology), location within a river (with respect to anadromous barriers), as well as access to different types of forage.

Phylogeography and species boundaries of the cryptic species, Harmothoe imbricata (Polychaeta, Polynoidae).

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Hardy, Sarah University of Alaska Fairbanks, College of Fisheries and Ocean Sciences
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Cryptic diversity in seemingly widespread species leads to the underestimation of true species diversity and makes tracking of species distributions impossible. Cryptic diversity is known to be prevalent in polychaete worms, commonly referred to as bristle worms, and recent molecular work using mitochondrial DNA (mtDNA) suggests that the scale worm Harmothoe imbricata represents a species complex comprised of six distinct lineages. One provisional species was shown to have amphiboreal-arctic distribution. The overarching goal of this study is to shed light on the diversity and recent evolutionary history of the species complex H. imbricata. I examine genetic variability in both COI and ITS genes to determine if there is congruence in how variation is structured among populations of H. imbricata. As expected, nuclear DNA sequences show lower levels of divergence than those reported for COI. Preliminary analysis shows distinct genetic variation between populations from the Pacific Ocean

compared to all other populations. Examination of the genetic variation within this species complex will provide insights on how glaciations have affected population structure and understanding of species diversity is vital for tracking changes in species distributions associated with climate change.

Stress Hormone Levels as a Physiological Metric to Improve Understanding of the Catch-and-Discard Process in Commercial Fishing.

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Wolf, Nathan. FAST Lab at APU
Webster, Sarah R. FAST Lab at APU
Harris, Bradley P. FAST Lab at APU

The endocrine responses of fishes captured by commercial fishing gear can provide insight into their ultimate survival. During the capture process a suite of physical and sensory interactions between the gear, the environment, and the fish can produce increased levels of circulating stress hormones (e.g. epinephrine, cortisol). Mortality from asphyxiation is expected when fish are retained on the vessel. Non-retained fish are often discarded alive, but have experienced the same stimuli and physical interactions as retained individuals and can experience delayed mortality. Currently, the probability of a fish surviving after handling (i.e. the discard mortality rate) is determined by visual assessments. This approach lacks a quantifiable physiological metric that would allow for the creation of predictive modelling. Our research aims to understand the stress physiology and it's relationship with mortality in Pacific halibut, focusing on three objectives: (1) developing best practices for an inexpensive and non-invasive mucus sampling method, (2) measuring the magnitude and rate of cortisol absorption and elimination in mucus as compared to blood in a controlled environment, and (3) using this gained knowledge in a field setting. We expect that mucus cortisol levels measured immediately after capture will provide insight into the complex interactions fish experience in the catch-and-discard process.

Contributing to the life history of data-poor octopus stocks: applying stable isotope analysis to Alaskan populations of the giant Pacific octopus, Enteroctopus dofleini.

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Wolf, Nathan. FAST Lab at APU
Harris, Bradley P. FAST Lab at APU
Scheel, David. Behaviour and Benthic Ecology (BBE) Lab at APU
Hocking, Richard. Alaska Sea Life Center (ASLC)

The giant Pacific octopus, Enteroctopus dofleini (Wülker 1910), is widely caught as bycatch in Alaskan fisheries. However, successful management of E. dofleini has been hindered by a paucity of data on the species' life history. For example, our knowledge of the species diet composition is largely limited to populations inhabiting the inter- and sub-tidal regions of Alaska and Western British Columbia. Midden studies done in these regions have provided information on some of the species' hard-bodied prey, yet little is known about dietary composition beyond these coastal regions, nor what contribution soft-bodied prey might make. Recently though, advances in stable isotope analysis (SIA) have provided an efficient approach to studying the diet composition and trophic position of cephalopods. We propose to integrate these molecular methods to assist in describing the diet of E. dofleini populations incidentally caught in Alaskan fisheries. This will include a two-part isotopic study incorporating both lab and field components. A controlled diet-switch experiment will be performed in the Alaska Pacific University Aquarium Lab. Repeated tissue sampling during this experiment will allow us to determine the incorporation rates and the discrimination values of stable carbon (13C) and nitrogen (15 N) in the species' tissue. With these, we will be better equipped to implement an isotope field study of E. dofleini caught incidentally in Alaskan fisheries to assist in describing key dietary components of the species life history.

Spatiotemporal assessment of Pacific halibut (Hippoglossus stenolepis) growth performance in IPHC Area 3A

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Webster, Sarah R. FAST Lab at APU
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Pacific halibut growth has decreased coast-wide since the late 1970s and early 1980s. This decrease in individual size-at-age has resulted in declines of observed stock biomass, relative to historical biomass averages. In all

International Pacific Halibut Commission (IPHC) management areas, harvest levels and apportionments are determined using IPHC setline surveys which produce information on the observed distribution of fish >32 inches (minimum commercial retention size limit) and catch rates. The lower observed biomass of halibut, and the associated lower female spawning biomass, has resulted in decreases in the harvest levels of target and non-target halibut fisheries. The driving mechanisms behind decreasing size-at-age are not yet fully understood, and many of the relationships between them have yet to be explored. Further, while declines in mean size-at-age are well established, work remains to be done on the spatiotemporal aspects of these declines. This project's objectives are; 1) to describe the spatiotemporal distribution of halibut size-at-age in IPHC Area 3A, and to model the spatial structure of halibut growth performance (length-at-age) using geo-statistics; 2) determine the presence/absence of consistent spatiotemporal anomalies in growth performance above or below the Area 3A intra-cohort, year-over-year mean size-at-age values.

Quantifying Seafloor Contact in Commercial Fishing Gear.

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Harris, Bradley P. FAST Lab at APU
Rose, Craig S. FAST Lab at APU, FishNext Research

A vast majority of commercial fishery species harvested globally either live on or near the seabed (also referred to as the benthos or benthic environment) or employ life history strategies which are linked to benthic processes. The act of pursuing and catching benthic and demersal ('near the bottom') species requires operating fishing gear on or very near the seabed, resulting in direct gear-seabed contact. It is essential to further quantify bottom contact, given that contact made by commercial fishing gear with the benthos is considered one of the most significant human impacts on the oceanic environment. There are a few devices that measure bottom contact; these devices, however, usually address only one point of contact, such as the center of the footrope, when other components of the fishing gear may be making contact as well. An NPRB-funded study by Rose et al. (2016) used multiple bottom contact sensors (accelerometers) hung from the footrope of a trawl net to quantify bottom contact; however, this study was not conducted under real fishing conditions (i.e. the codend was open). The authors of this study provided statistical analyses of the gear configurations as they relate to habitat susceptibility, but examination in terms of components, material and clearance was beyond the scope of the work. Here I propose an algorithm to examine these covariates as estimators of habitat susceptibility by reassessing the data from the field, constructing quantitative models based on these covariates, re-running the applicable models, and examining the spatial distribution seabed clearance for each material and component combination. This data, along with an assessment of the current state of science and technology in bottom contact sensors, will help determine the best method of bottom contact measurement to be used in future lab-based and field-based portions of this study.

Patterns of growth, age, and habitat use of nearshore fishes from Barrow, Alaska.

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Norcross, Brenda. University of Alaska Fairbanks

In recent years, climate change has decreased ice cover in the Alaskan Arctic, which in turn has led to increased ship traffic and oil and gas exploration in the region. This increase highlights the need for basic life history understanding of the fish species that utilize this region. Length-weight relationships are used to determine growth patterns of a fish species and can be used to detect regional differences in growth for a single fish species. Using length-weight relationships in conjunction with length-at-age information from different regions, we were able to identify prime growth habitat for Arctic fishes. In 2013 and 2014, nearshore fish surveys were conducted near Barrow, Alaska in the Chukchi Sea, Beaufort Sea and Elson Lagoon using beach seines as part of the Arctic Coastal Ecosystem Study (ACES). Length (mm) and weight (g) measurements were taken for all fishes collected and otoliths were removed. Eight species were analyzed for length-weight relationships and a total of 309 fishes had ages estimated. Within species differences in growth type were observed in the Beaufort Sea, Chukchi Sea, and Elson Lagoon for three species (Arctic Cod, Saffron Cod, Belligerent Sculpin). Five species (Least Cisco, Capelin, Yellowfin Sole, Longhead Dab, Arctic Flounder) displayed the same growth type in all sampled regions. Differences in age distributions reveals species-specific juvenile and adult habitat use patterns.

Landscape genetic diversity of native and invasive Northern pike in Alaska.

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This project will be the first to investigate the genetic and environmental landscape among introduced populations of Northern Pike (Esox lucius) in southcentral Alaska. First, we will examine genetic diversity among native and introduced populations of Northern Pike through the use of next generation sequencing. Genotyping-by-sequencing methods will allow for the creation of a multilocus genotype dataset expected to provide sufficient resolution for differentiation between native and introduced populations. Project goals are to test hypotheses regarding origins of invasive populations and inferred size of founding populations. Second, we will develop a Northern Pike distribution model for the Matanuska-Susitna Basin (MatSu, southcentral Alaska) using NetMap, an integrated set of watershed terrain parameters and analysis tools. Attributes representing climatic, hydrologic and topographic features will be generated across the MatSu Basin and used to characterize and rank habitat suitability for Northern Pike. Presence-absence data will be compiled from the Alaska Department of Fish and Game's freshwater fish inventory database, sport fish harvest survey data, and maps of known and probable pike waters. These data will be used to parameterize and evaluate the accuracy of the habitat suitability model. Additionally, we will quantify habitat connectivity throughout the MatSu Basin to predict areas were Northern Pike are likely to invade. Finally, we will assess the potential impact of this invasion on salmon populations by comparing our Northern Pike habitat suitability model and among-habitat connectivity estimates to the known distribution of juvenile salmonid rearing habitats in the MatSu. This study is expected to increase our understanding of Northern Pike genetics across their native and invasive ranges, as well as our understanding of the abundance and dispersal abilities of this invader.

A comparative assessment of resource use by Pacific Halibut and Arrowtooth Flounder throughout the Gulf of Alaska.

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Beaudreau, Anne H. University of Alaska Fairbanks
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Pacific Halibut (Hippoglossus stenolepis) have supported culturally and economically important fisheries throughout the Gulf of Alaska for over a century. However, recent decreases in spawning stock biomass and size-at-age have generated concerns among those who depend upon and manage the resource. Among the prevailing hypotheses for reduced size-at-age is intensified competition with Arrowtooth Flounder (Atheresthes stomias), a voracious predator that has exhibited nearly five-fold increases in biomass over the past 60 years. With considerable population sizes, Arrowtooth Flounder are thought to competitively exclude Pacific Halibut from preferred habitats and/or prey, resulting in decreased growth rates for halibut. Evaluating this hypothesis requires evidence of resource limitation and opposing population trajectories as well as measures of spatiotemporal and dietary overlap. As a first step toward addressing the potential for competition between Pacific Halibut and Arrowtooth Flounder, we assessed how their distributions and diets have changed as a function of time, space, and environmental and demographic variables. Using food habits and bottom trawl survey data collected by the Alaska Fisheries Science Center (1990 to 2013), we quantified spatial and size distributions as well as diet compositions (i.e., frequency of occurrence and proportion of prey by weight) for Pacific Halibut and Arrowtooth Flounder at local, survey stratum, management area, and regional spatial scales. We then used generalized additive models to explore how these metrics varied in relation to location, year, depth, bottom temperature, and population biomass. This study represents an initial exploration of the hypothesis that interspecific competition with Arrowtooth Flounder is responsible for decreased size-at-age of Pacific Halibut and helps identify broad-scale environmental and ecological conditions that may limit population-level productivity of Pacific Halibut.

Using PPGIS to spatialize future management responses to a changing environment.

Christine Brummer
E. Jamie Tramell Meagan Krupa
Courtney Breest Others

A stakeholder scenario planning project was initiated in 2015 with the purpose of identifying possible future scenarios for the Kenai River Watershed. These scenarios are developed to encourage future-thinking by local agencies in current management decisions. This project is part of the NSF EPSCoR-funded Alaska Adapting to Changing Environment project, where the Southcentral Test Case has focused on the socioecological system of the Kenai River Watershed. In May 2016, the Salmon 2050: Scenario Implications workshop was held in Soldotna, Alaska. This workshop brought together local resource managers to discuss possible outcomes of different management and biophysical scenarios. Paper maps were provided to resource managers to document the implications of the scenarios and where management responses may be enforced. Those maps are presented here, along with the scenario narratives, providing insight into the adaptive capacity of management agencies in the Kenai River watershed. In some cases, agencies were able to point to specific management options and decisions with geographic specificity, while others were only able to identify general management actions. Final scenario narratives incorporate these findings to represent alternative views of how salmon management may evolve on the Kenai over the next 35 years.

DNA barcoding and next generation sequencing of arthropod prey in shorebird feces.

Danielle Gerik
Richard B. Lanctot
Kirsty E. Gurney Mark Spangler
J. Andrés López

Climate change in the Arctic is affecting the timing of arthropod prey available for nesting shorebirds and their young. It is unclear whether shifts in arthropod availability may impact shorebird chick growth as a result of a trophic mismatch. Understanding the diet composition of shorebirds is crucial for evaluating whether a trophic mismatch exists and to assess its potential impact on declining shorebird populations in the Arctic. In this study, DNA barcoding paired with next-generation sequencing was used to identify arthropod remains in the feces of shorebirds breeding in Utqiaġvik, Alaska. Environmental DNA analysis of avian diets is a minimally invasive technique with the potential to provide finer scale and greater taxonomic coverage of diet components than traditional gut content diet analyses. To enhance identification of prey in shorebird feces, we developed a reference DNA barcode library to supplement existing public databases coverage of arthropods inhabiting the Arctic Coastal Plain. We are evaluating potential biases in the recovery of prey DNA in avian feces by carrying out a diet study on captive shorebird chicks. We aim to determine how factors such as prey type (hard versus soft body), taxa, prey size, and time post consumption of prey affect the molecular detection of prey in feces. We present preliminary results related to the reference library, chick diet study, and efforts to sequence shorebird feces. The primary goals of this research are to test the efficacy of the fecal DNA barcoding technique and to produce valuable diet information for assessing climate impacts on shorebirds in the Arctic.

Diet Characteristics and Condition of Juvenile Chinook Salmon in the Eastern Bering Sea.

Stone, Jarred J. Alaska Pacific University

Multiple user groups are invested and engaged to better understanding the declines of Chinook Salmon across the state of Alaska. The primary users of Chinook Salmon are subsistence and small scale commercial fisheries. Beginning in 1997, a sharp decline in Chinook Salmon was observed (Schmidt and Newland 2012). This prompted the Alaska Board of Fisheries to reclassify the Yukon River Chinook Salmon run as a stock yield concern at its September 2000 work session. Since this reclassification, researchers began to question the early marine life stages that are most critical to survival. Unfavorable ocean conditions could be negatively effecting the recruitment of adult Chinook. This study aims to identify diet characteristics and how these characteristics influences condition. This research looks to make the connection between diet and condition to help explain possible outcomes of poor diet selection verses optimal diet selection. Other possible research topics such as mouth gape will also be explored to determine if condition increases with larger mouth gapes.

Nearshore fish sampling in the Alaskan Arctic, 2001–2016.

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Green, Duncan G. University of Alaska Fairbanks, College of Fisheries and Ocean Sciences
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Annual monitoring of nearshore fishes in the Prudhoe Bay region of the Alaskan Beaufort Sea has produced a nearly continuous dataset of relative abundance, species composition, and body size since 1981, which is now one of the longest comprehensive time series of Arctic fish communities. During the open-water study period (July–August), fish were collected by sampling daily at four fyke net locations, totaling over 1.7 million samples. Catch data from 2001–2016 were analyzed (n = 29 fish species from 13 families) and have been predominately anadromous / amphidromous whitefish species (Arctic Cisco Coregonus autumnalis, Broad Whitefish C. nasus, Least Cisco C. sardinella, Humpback Whitefish C. pidschian) as well as trophically important marine species (Arctic Cod Boreogadus saida). The local ecosystem is inherently dynamic with large variation in daily, inter-site, and interannual species composition; for example, annual catches of Arctic Cod vary by several orders of magnitude (yearly relative abundance ranged 1–91%). Annual species richness varied between 17 and 23 species though catches were primarily concentrated in just a few species (Shannon-Weiner Index 0.51–0.95). Fish community composition was largely driven by wind directionality and velocity: wind-driven dispersal was the primary factor affecting juvenile recruitment of Arctic Cisco. Growth of several whitefish species was significantly correlated with increased water temperature. Conversely, changes in environmental conditions (e.g., wind directionality) has occasionally caused recruitment failure of entire age classes of whitefish, demonstrating the susceptibility of the regional fish assemblage to climatic alterations. In addition to establishing the correlations between fish community fluctuations and their environment, this dataset provides an important baseline from which to evaluate potential ecosystem shifts resulting from climate change in the Arctic.

Microbiota and the immune system.

Ireland, Kelly
Lescak, Emily
Milligan-Myhre, Kat

Antibiotics are being increasingly recognized as aquatic contaminants throughout the United States and Europe. A major concern is that chronic exposure to antibiotics may be disrupting symbiotic relationships between hosts and microbes. The gut microbiota play an important role in the health of their host, particularly immune system development. We aim to study the immune response of threespine stickleback (Gasterosteus aculeatus) reared in conventional, germ-free, monoassociated, and antibiotic-treated settings to determine how environmental microbial diversity and antibiotic exposure affect host immune development. We will use quantitative real time PCR (q-RT-PCR) amplification of immune genes associated with both the innate and adaptive immune responses. We hypothesize that conventionally reared G. aculeatus will have greatest immune gene expression, followed by individuals associated with one bacterial isolate, antibiotic-exposed individuals, and those reared germ-free. This research is important for understanding how microbes benefit their hosts and how antibiotics in the environment may affect organisms.

Examination of structure-forming benthic features inside and outside the Red King Crab Savings Area in the Bering Sea.

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Harris, Bradley P. FAST Lab at APU

Juvenile red king crab (RKC, Paralithodes camtschaticus) use structural habitats when settling to the benthos after their pelagic life cycle stage. Settlement in areas with complex benthic features like structural invertebrates (hydroids, bryozoans, sea whips and sea pens) or coarse substrate (cobble and shell hash) is associated with increased juvenile RKC survival rates. These structure-forming features are vulnerable to impacts from bottom-tending fishing gears (e.g. trawls). In addition, adult RKC are vulnerable to mortality due to interactions with trawl gear. Due to declining RKC stocks, a 13,715 km2 marine protected area called the Red King Crab Savings Area (RKCSA) was implemented in the Bering Sea in 1996 to protect adult RKC from disturbance effects associated with trawling. The emphasis of the North Pacific Fisheries Management Council (NPFMC) action creating the RKCSA (Amendment 37) was on adult crab mortality, but reference was also made to habitat protections. RKC stocks abundance and recruitment indices are still low prompting the recent NPFMC reviews of RKC prohibited species catch which have noted the lack of information about the habitats inside versus outside the closure boundaries. This research examines the distribution of structure-forming benthic features inside and outside the RKCSA relative to sediment type and fishing disturbance using National Marine Fisheries Service trawl survey data and outputs from the Essential Fish Habitat Fishing Effects Model.

Assessment of Habitat Information to Improve the Aleutian Island Pacific Cod (Gadus macrocephalus) Stock Assessment.

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Harris, Bradley P. FAST Lab at APU

Pacific cod (Gadus macrocephalus) migrate both within and between the Eastern Bering Sea (EBS), Aleutian Islands (AI), and the Gulf of Alaska (GOA), but recent research indicates discrete stocks in the EBS and AI. Since 2013 these stocks have had separate harvest specifications. Abundance trends of AI Pacific cod appear to be decreasing. The BSAI Plan Team, the joint BSAI and GOA Plan Teams, and the NPFMC SSC have asked the stock assessment authors to develop an age-structured model of the AI Pacific cod. However, there is a temporal and spatial mis-match between the Aleutian Islands Pacific cod stock assessment survey and the commercial fishery. The survey uses standardized trawl sampling and is conducted in the summer, but the fishery is prosecuted with trawl, longline, pot, and jig gear, primarily in the winter. Between 2006 and 2015, trawl gear accounted for 75%, longline gear 20%, and pot gear 4% of the catch on average. Both the seasonal movements of cod and the seabed trawlability impact the survey-apparent AI cod stock. We propose to use the available AI Bathymetry Grid created by Mark Zimmerman (NOAA, AFSC, RACE), available sediment data, and season-specific commercial Pacific cod catches using the NOAA catch-in-areas database to estimate the habitat (depth, slope, rugosity, etc..). We will also estimate the habitat (depth, slope, rugosity, etc.) of season-specific NOAA survey catches. These will be compared to determine the temporal and spatial differences in commercial vs. survey perspectives with an eye towards the impacts of gear type and areas sampled/fished. Finally, we will consider the efficacy of a cooperative survey design the uses commercial fishing vessels in a study-fleet model. The compilation of these habitat data will also support the ongoing NPFMC Essential Fish Habitat Amendment.

Identifying Genetically Distinct Juvenile Coho Salmon Stocks in the Jim Creek Watershed, Alaska.

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The Jim Creek watershed, in southcentral Alaska is a well-known adult spawning and juvenile rearing area for Coho and Sockeye Salmon, and a popular sport fishery for these species. This watershed is located within the Knik River Public Use Area (KRPUA) and consists of a large wetland complex of shallow lakes, meandering streams, and entrenched channels. It is one of the only clear water refugia (e.g. non-glacial) areas within the Knik River basin. The Jim Creek watershed is hypothesized to provide rearing habitat for juvenile Coho Salmon who are not necessarily spawned there but have migrated to this area in search of better habitat. The primary objective of this study is to determine how many genetically distinct stocks of juvenile Coho Salmon reside in the Jim Creek watershed for summer rearing. Fieldwork was conducted during the summer of 2016. 300 fin clips were taken from juvenile Coho Salmon captured in baited minnow traps. To ascertain stock origin, DNA was extracted from fin clippings, then microsatellite loci and polymerase chain reaction were used to determine genetic differences. The lab work for this project is currently being completed and more specific results will be available during the poster presentation. This project was completed in cooperation with the Fisheries, Aquatic Science & Technology Laboratory at Alaska Pacific University, Alaska Department of Fish & Game, U.S. Fish and Wildlife Service Anchorage Conservation Office, and the U.S. Fish and Wildlife Service Conservation Genetics Laboratory. The ultimate goal of the broader research interest is to help determine differential use of critical salmon habitat.

Identifying overwintering habitat for whitefishes in Arctic coastal lagoons using remote sensing.

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Seitz, Andrew C. UAF
Haynes, Trevor B. Wildlife Conservation Society
Jones, Tahzay. National Park Service
Whiting, Alex. Native Village of Kotzebue

Over one-third of the Arctic coastline between the Bering Strait and the Canadian border is comprised of lagoon/barrier island ecosystems. These are highly productive areas that sustain local subsistence fisheries for whitefishes that are vital for Alaska Native food security. Nevertheless, very little is known about the overwintering habitat of whitefishes in lagoons. We will identify and characterize overwintering habitat for whitefishes in coastal

Arctic lagoons and their associated watersheds using Synthetic Aperture Radar (SAR) remote sensing techniques. Specifically, we will identify liquid water in freshwater drainages and potentially in brackish lagoon habitats, by testing novel analysis techniques. To understand changes in available overwintering habitat over time, we will examine several years of historical data to locate areas that consistently have available liquid water. To groundtruth remotely sensed data, we will conduct field studies in March 2017 to determine if liquid water identified in SAR imagery actually exists. When liquid water is found, we will measure the water quality parameters beneath the ice to determine if the pools are viable overwintering habitat for fish. Concurrently, we will sample for fish in identified pools using hook and line, minnow traps and underwater video to sample for fish. This information will further our understanding of the winter distribution and available habitat of whitefishes. This information may be used to help manage overwintering habitat and assess the potential impacts of climate change on overwintering habitat for important fish species that are critical components of subsistence-based diets.

Climate Driven Extent Changes in Brooks Range Perennial Snowfields in Gates of the Arctic National Park & Preserve.

Tedesche, Molly E. University of Alaska Fairbanks

Pronounced warming of the Arctic is driving significant physical and ecological changes, including losses in extent of perennial snowfields in Gates of the Arctic National Park and Preserve in the central Brooks Range. These snowfields are sensitive indicators of climate change and an important eco-hydrological resource. Like glaciers, they form through accumulation and compaction of seasonal layers of snow, however, in contrast to glaciers; these features never grow thick enough to flow under the influence of gravity. Perennial snowfields can alter hydrology, geology, permafrost distribution, and are important ecosystems for an array of wildlife, including caribou, which flock to snowfields for insect avoidance and to thermoregulate. Caribou are critical to the traditional subsistence lifestyle for Native Alaskan people in the Arctic. This research quantifies how perennial snowfields are changing, addresses impacts to caribou and subsistence, and also involves substantial education and outreach components. The outreach components include grades K-12 science education, local engagement, and citizen science, through the Global Learning and Observations to Benefit the Environment (GLOBE) Program. Modeling changes in Brooks Range perennial snowfields involves both remotely sensed and field collected data sets. The study area is remote, so satellite products are imperative to the project; including Landsat imagery, climate reanalysis data, and digital elevation models (DEMs). The goal of this interdisciplinary project is to help subsistence users, hydrologists, and other scientists and stake holders understand snowfield extent changes and implications for caribou.

Ice and Snow Coverage on Rivers and Streams: Characteristics that Indicate Upwelling and Winter Fish Habitat.

Phillip R. Wilson
Michael R. Lilly

In cold climates, warm groundwater upwelling into streams and river channels plays a crucial role in creating winter fish habitat and altering river ice coverage. The formation and degradation of ice on a river channel is a result of the system attempting to reach thermal equilibrium between cold air and warmer surface-water. Mid-winter opening of leads in river channels can be used as an indicator of internal changes in the system, primarily higher levels of thermal (warmer water) and/or kinetic energy (flowing water). Visual identification of open leads can give insight into key locations of higher thermal energy and potential for winter fish habitat. The use of aerial or satellite imagery can allow a large area to be searched for open leads relatively quickly. Additionally, thermal imaging can be a useful tool in confirming and identifying locations of warm groundwater upwelling at the surface. Our examples illustrate how various forms of imaging are used to understand winter flow conditions related to upwelling and winter fish habitat.

Effects of tetracycline on somatic development in threespine stickleback fish.

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Gut microbiota are important contributors to host health and development. Disturbances can therefore result in delayed development and severe health consequences. We hypothesized that disruption of the microbiota due to antibiotic exposure affects development of threespine stickleback fish (Gasterosteus aculeatus) in a gene by environment interaction. Stickleback are useful developmental model organisms because they share many physiological pathways and microbial members with other vertebrates, and juveniles are optically transparent, which permits non-destructive observation of organ development. We exposed F1 juvenile fish from two freshwater (FW1 and FW2) and one anadromous (AD) population to one of four treatments: We found that both the high and low tetracycline treatments for the FW1 population had significantly increased standard length and eye diameter. The FW1 population also had significantly reduced swim bladder area for the high tetracycline and 70% ethanol treatments. The FW2 population had significantly increased standard length for the high tetracycline treatment and significantly increased eye diameter for both the high and low tetracycline treatments. The AD population did not have any significant differences between treatments. Our results show that antibiotic exposure can influence multiple phenotypic traits in a gene-by-environment interaction.

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

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Hershberger, Paul K. USGS Marrowstone
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Ichthyophonus is a globally distributed, largely undescribed genus of fish parasites inhabiting fresh and saltwater aquatic systems. Documented in 140 fish species including economically important stocks (e.g. salmon and herring), it can result in reduced growth, stamina, and overall health, decreased market value, and has triggered large-scale mortality events. As changing ocean temperatures increase the potential for presence and spread of pathogens, it is important to establish baseline information for Ichthyophonus and its current and potential effects on Alaskan fisheries. Preliminary studies conducted at Alaska Pacific University in 2012 and 2013 found Ichthyophonus in 26% (n=563) of Pacific halibut (Hippoglossus stenolepis) sampled in the port of Homer, AK. The parasite infected heart tissues but not liver, kidney, or spleen, and was more prevalent in older fish. This research expands this initial work to assess Ichthyophonus prevalence in three port towns (Homer, Seward, and Whittier, AK) within three economically significant Alaskan fish species, Pacific halibut, Alaska pollock (Gadus chalcogramma), and Pacific cod (Gadus macrocephalus). The study employs a length-based sampling design, as well as bioelectric impedance analysis and Fulton's Condition Factor to assess Ichthyophonus impacts on fish condition. Also evaluated is size-at-age (growth), host immune response to infection (histolopathological methods), parasite load within the heart (qPCR), and parasite-induced changes in heart mass. 2016 field objectives were accomplished while sampling cooperatively with the ADF&G port sampling program and charter fleets. Overall Ichthyophonus prevalence in Pacific halibut was 57% (n=572), in pollock was 9% (n=11), and in P. cod was 11% (n=81). Additional analyses are currently ongoing, and a second field season is planned for 2017.

Stomach Content Analysis of Pacific Razor Clams on the Kenai Peninsula, AK.

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Blackmon, Tim Alaska Dept. of Fish and Game - Division of Sport Fish (ADF&G)
Booz, Mike, Dept. of Fish and Game - Division of Sport Fish (ADF&G)
Harris, Bradley P. FAST Lab at APU

Pacific razor clams (Siliqua patula), are marine bivalve filter feeders that live on sandy intertidal beaches from California to the Aleutian Islands. Data collected by the Alaska Department of Fish & Game, Division of Sport Fish (ADF&G) indicates that adult razor clam abundance on east side Cook Inlet beaches has been declining. Additionally, razor clam growth data on these beaches suggests significant differences between beaches with growth rates increasing from north to south down Cook Inlet. The mechanisms for the abundance decline and the spatial variations in growth are unknown but may be attributable to changes in clam diet. To date no assessment of razor clam diets have been conducted from this region. This project examined the gut contents of 220 razor clams from seven east side Cook Inlet beaches. A total of 25 different organisms, including centric and pennate diatoms, dinoflagellates, and zooplankton were identified in the samples. An analysis of the prevalence of organisms by species group and beach is ongoing.

Optical assessment of the Gulf of Alaska benthos east of Kodiak Island, AK.

Victoria M. Batter
Dr. Bradley P. Harris

The continental shelf east of Kodiak Island is a diverse and productive region of the Gulf of Alaska which includes several submarine canyons and supports commercial harvests of weathervane scallops (Patinopecten caurinus). Despite its proximity to Kodiak Island the spatial distributions of fishery species and their habitats in this region are poorly understood. This paucity of information has constrained the assessment of the weathervane scallop abundance in this region to catch per unit effort information only. During the spring of 2014, the Alaska Department of Fish & Game collected more than 10 million high-resolution underwater photographs of the benthos in and around the Chiniak Gully (North and South), Christmas Tree and Albatross scallop beds. I selected approximately 150,000 of the georeferenced images using systematic random sub-sampling and counted benthic macroinvertebrates (including weathervane scallops) and identified benthic substrates. The resulting data will be used to estimate the abundance of scallops and generate the first maps of macroinvertebrates and substrates for the surveyed areas.

Films:

Producer's name is in bold with length of film (minutes:seconds).

1. *Iliamna Lake - A Land Worth Preserving* - **Jason Ching (1:59)**
   Dr. Thomas Quinn is a professor at the University of Washington who has been studying the ecology of Iliamna Lake since 1987. Iliamna Lake in Southwest Alaska is a unique ecosystem that thrives as an intact watershed.

2. *It's All For the Fish: Shelikof Salmon Stream Restoration* - **Maia Mares (5:29)**
   It's all for the fish. We like the fish around here," says Ariel Miller, daughter of Todd Miller, who owns TM Construction. "So that's why we're doing this." She's talking about the restoration of Shelikof Creek on Kruzof Island, an iconic volcanic island in Southeast Alaska. Damaged by past large-scale timber harvests and wood removal, the stream lacked salmon spawning habitat. By helping the salmon, we're helping Southeast Alaska, which depends on fish both ecologically and economically. This short film follows Ariel, her family, and the Forest Service experts who worked together to restore salmon habitat in the Shelikof Stream.

3. *A Fish-friendly Nature-based Solution to Erosion* - **Katrina Liebich (00:30)**
   This timelapse features a 300 foot section of the Chena River's waterfront receiving a fish-friendly makeover. Watch the week-long transformation in 30 seconds flat.

4. *Sun'aq Tribe of Kodiak: Buskin Watershed Signal Crayfish Project 2016* - **Kelly Krueger (5:12)**
   Signal crayfish (Pacifastacus leniusculus), which are not indigenous to Alaska, were first recorded in the Buskin River Watershed on Kodiak Island in 2002. In 2016, the Bureau of Indian Affairs Invasive Species Program provided funding for Sun'aq Tribe of Kodiak to survey for signal crayfish within the watershed. To enhance the success of signal crayfish detection and removal from the watershed, this project utilized capture methods not previously used by others, including kick seining and electrofishing techniques. This video highlights project work from the 2016 field season, including sampling methods and collaboration with the public.

5. *The Super Salmon* - **Ryan Peterson (25:02)**
   A salmon in Alaska makes an unlikely journey on "the Mount Everest of rivers" - the Susitna - as residents consider the costs/benefits of a government-proposed mega-dam.

6. *Voices of the Chena* - **Jimmy Fox (12:28)**
   Deep in the heart of the Great Land lies the Chena River. This river is home to the second-largest run of Yukon River king salmon in Alaska yet it flows through one of the most populated cities in the state. This film celebrates the progress the community is making to conserve, restore and protect king salmon and the Chena River for themselves and future generations.

7. *Fish-friendly Solutions Where Roads Cross Streams* - **Katrina Liebich (XX:XX)**
   Ever been locked out of your house? For us, it's an inconvenience. For fish - always on the move to survive - it's everything. This short film features timelapse footage of two road-stream crossings receiving a fish-friendly makeover.