Alaska Cooperative Fish and Wildlife Research Unit

Cover Photos:

Top: A beautiful fall day on the Chandalar River, Alaska, September 2016. Photo by Jeff Falke.

Bottom: Jason Leppi flies back from an aerial telemetry survey overlooking a tributary of the Colville River, Alaska. Photo by Jason Leppi.

Unit Roster

Federal Scientists

- Brad Griffith: Leader
- Jeff Falke: Assistant Leader-Fisheries
- Dave McGuire: Assistant Leader-Ecology
- Mark Wipfli: Assistant Leader-Fisheries

University Staff

- Monica Armbruster: Fiscal Professional
- Kathy Pearse: Administrative Generalist

Unit Students and Post-Doctoral Researchers

Current

- Megan Boldenow, MS Biological Sciences Candidate (Powell)
- Chelsea Clawson, MS Fisheries Candidate (Falke)
- Dan Govoni, PhD Biological Sciences Candidate (Wipfli)
- Jess Grunblatt, PhD Interdisciplinary Studies Candidate (Wipfli and Adams)
- Chase Jalbert, MS Fisheries Student (Falke)
- Philip Joy, PhD Fisheries Candidate (Wipfli)
- Sarah Laske, PhD Fisheries Candidate (Wipfli and Rosenberger)
- Jason Leppi, PhD Fisheries Candidate (Wipfli)
- Benjamin Meyer, MS Fisheries Candidate (Wipfli)
- Kristin Neuneker, MS Fisheries Candidate (Falke)
- Kelly Overduijn, MS Wildlife Biology and Conservation Candidate (Powell)
- Vijay Patil, PhD Biological Sciences Candidate (Griffith and Euskirchen)
- Matt Sexson, PhD Biological Sciences Candidate (Powell and Peterson)
- Eric Torvinen, MS Fisheries Candidate (Falke)

Post-Doctoral Researchers

- Trevor Haynes (WipfTf -15.211 2f

- Robert Bolton, International Arctic Research Consortium (IARC)-UAF
- Amy Breen, IARC
- F. Stuart Chapin, III, Emeritus Institute of Arctic Biology (IAB)-UAF
- Eugénie Euskirchen, IAB
- Hèléne Genet, IAB
- Teresa Hollingsworth, Boreal Ecology Cooperative Research Unit-UAF
- Tuula Hollmen, CFOS/Institute of Marine Science (IMS)
- Karsten Hueffer, IAB
- Kris Hundertmark, Department of Biology and Wildlife (DBW) and IAB
- Katrin Iken, CFOS
- Knut Kielland, IAB

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- Paul Layer, College of Natural Science

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Cooperators

- Brian Barnes–Director, Institute of Arctic Biology, University of Alaska Fairbanks
- Sam Cotten–Commissioner, Alaska Department of Fish and Game
- Greg Siekaniec–Director, Region 7, US Fish and Wildlife Service
- F. Joseph Margraf–Unit Supervisor, Cooperative Research Units, US Geological Survey (retired August 2016)
- Chris Smith–Western Field Representative, Wildlife Management Institute
- Kevin Whalen–Unit Supervisor, Cooperative Research Units, US Geological Survey (effective August 2016)

This is the Annual Report for the Alaska Cooperative Fish and Wildlife Research Unit, highlighting activities for calendar year 2016. The Unit engages in research on living natural resources for a variety of State and Federal agencies. As an unbiased research organization, the Unit provides information requested and funded by these agencies. When studies are completed, the agencies use the information to assist in their natural resource management efforts. Most of the research is conducted by graduate students, many of whom go on to work for the agencies upon graduation.

The Alaska Unit was established in 1950, providing over half a century of research dedicated to helping conserve and enhance the living natural resources of the State and the Arctic Region. The Unit is part of a larger and even older program, the US Department of the Interior's Cooperative Research Unit Program. Established in 1935, Cooperative Research Units were created to fill the vacuum of wildlife management information and the shortage of trained wildlife biologists. In 1960, the Unit Program was formally sanctioned by Congress with the enactment of the Cooperative Units Act. Each unit is a partnership among the Ecosystems Discipline of the US Geological Survey, a State fish and game agency, a host university, and the Wildlife Management Institute. Staffed by Federal personnel, Cooperative Research Units conduct research on renewable natural resource questions; participate in the education of graduate students destined to become natural resource managers and scientists; provide technical assistance and consultation to parties who have legitimate interests in natural resource issues; and provide continuing education for natural resource professionals. Presently, there are 40 Cooperative Research Units in 38 states, conducting research on virtually every type of North American ecological community. The Program is staffed by more than 100 PhD scientists who advise as many as 675 graduate student researchers per year.

Statement of Direction

The research program of the Unit will be aimed at understanding the ecology of Alaska's fish and wildlife; evaluating impacts of land use and development on these resources; and

Genet, H., M. Lara, W.R. Bolton, and A.D. McGuire. 2016. Modeling vulnerability to thermokarst disturbance and its consequences on regional land cover dynamics in boreal Alaska. American Geophysical Union Fall Meeting, San Francisco, CA, 12-16 December 2016. (Contributed Poster)

Genet, H., Y. He, A.D. McGuire, Q. Zhuang, Z. Zhu, N. Pastick, B. Wylie, and K. Johnson. 2016. Quantifying the impact of permafrost dynamics on soil carbon accumulation in response to climate change and wildfire intensification in Alaska. Eleventh International Conference on Permafrost, Potsdam, Germany, 20-24 June 2016. (Contributed Poster)

Govoni, D.P., Kristjánsson, J.S. Ólafsson, and M.S. Wipfli. 2016. Surface and subsurface macroinvertebrate community differences across a thermal gradient in Icelandic streams at two spatial scales. Nordic Societ OIKOS Conference, Turku, Finland, 2-4 February 2016. (Contributed Poster)

Griffith, B., J. Roach, and A.N. Powell. 2016. Identifying climate change and cross-seasonal research priorities for waterfowl. In Symposium: Climate Change and Migratory Birds: Connecting Management Challenges to Research Programs. The Wildlife Society Annual Meeting, Raleigh, NC, 15-19 October 2016. (Invited Oral)

Grosse, G., A.B.K. Sannel, B. Abbott, C. Arp, P. Camill, J. O'Donnell, L. Farquharson, F. Günther, D. Hayes, B.M. Jones, M.T. Jorgenson, S. Kokelj, P. Kuhry, H. Lee, J. Lenz, A. Lewkowicz, L. Liu, A.D. McGuire, et al. 2016. A synthesis of thermokarst and thermo-erosion rates in northern permafrost regions. American Geophysical Union Fall Meeting, San Francisco, CA, 12-16 December 2016. (Invited Oral)

Hayes, D.J., J.B. Fisher, E.J. Stofferahn, C.R. Schwalm, D.N. Huntzinger, and A.D. McGuire. 2016. A model-data integration framework for NASA-ABoVE: The role of remote sensing in process-based model representation of Arctic ecosystem dynamics. Fourteenth International Circumpolar Remote Sensing Symposium, Homer, AK, 12-16 September 2016. (Contributed Oral)

Hayes, D.J., P. Kuhry, S. Goswami, G. Grosse, A.D. McGuire, and E.A.G. Schuur. 2016. The Permafrost Regionalization Map (PeRM): How well do observations, models and experiments represent the circumarctic-scale spatial variability in permafrost carbon vulnerability? Eleventh International Conference on Permafrost, Potsdam, Germany, 20-24 June 2016. (Contributed Poster)

Hayes, D.J., R. Vargas, S. Alin, R.T. Conant, L.R. Hutyra, A.R. Jacobson, W.A. Kurz, S. Liu, A.D. McGuire, B. Poulter, and C.W. Woodall. 2016. The North American carbon budget past, present and future. American Geophysical Union Fall Meeting, San Francisco, CA, 12-16 December 2016. (Contributed Oral)

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Lara, M.J., P. Martin, and A.D. McGuire. 2016. Mapping polygonal tundra geomorphology across the Arctic Coastal Plain of Alaska. Eleventh International Conference on Permafrost, Potsdam, Germany, 20-24 June 2016. (Contributed Poster)

Laske, S.M., A.E. Rosenberger, M.S. Wipfli, and C.E. Zimmerman. 2016. Hydrology and fish

model. Western Alaska Interdisciplinary Science Conference, Dillingham, AK, 9-12 March 2016. (Contributed Oral)

Projected Future Carbon Storage and Greenhouse-gas Fluxes in Ecosystems of Alaska. U.S. Geological Survey Professional Paper 1826, 196 pp., http://dx.doi.org/10.3133/pp1826.

Grosse, G., S. Goetz, A.D. McGuire, V.E. Romanovsky, and E.A.G. Schuur. 2016. Changing permafrost in a warming world and feedbacks to the Earth System. Submitted to Environmental Research Letters 11, paper 040201, 10 pp., doi:10.1088/1748-9326/11/4/040201.

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permafrost region between 1960 and 2009. Global Biogeochemical Cycles, 30:1015-1037, doi:10.1002/2016GB005405.

McGuire, A.D., H. Genet, Y. He, S. Stackpoole, D.V. D'Amore, T.S. Rupp, B.K. Wylie, X. Zhou, and Z. Zhu. 2016. Alaska Carbon Balance. Chapter 9 (pp. 189-196) in Z. Zhu and A.D. McGuire, eds. Baseline and Projected Future Carbon Storage and Greenhouse-gas Fluxes in Ecosystems of Alaska. U.S. Geological Survey Professional Paper 1826, 196 pp., http://dx.doi.org/10.3133/pp1826.

McGuire, A.D., T.S. Rupp, T. Kurkowski, and S. Stackpoole. 2016. Introduction. Chapter 1 (pp. 5-16) in Z. Zhu and A.D. McGuire, eds. Baseline and Projected Future Carbon Storage and Greenhouse-gas Fluxes in Ecosystems of Alaska. U.S. Geological Survey Professional Paper 1826, 196 ppA of Freshwater Fishes. Cambridge University Press. Chapter DOI: https://doi.org/10.1017/CBO9781139627085.010

Zhou, X., S.A. Schroder, A.D. McGuire, and Z. Zhu. 2016. Forest inventory-based analysis and projections of forest carbon stocks and changes in Alaska coastal forests. Chapter 4 (pp. 77-94) in

for juvenile occupancy using environmental DNA (eDNA) and distribution within tributaries using snorkel surveys. Water samples were collected from 75 tributary sites in 2014 and 2015. The presence of Chinook Salmon DNA in water samples was assessed using a quantitative polymerase chain reaction (qPCR) assay targeting that species. Snorkel surveys were conducted and physical habitat was measured for a subset of tributaries examined with the eDNA approach. Juvenile salmon were counted within 50 m reaches starting at the tributary confluence and continuing upstream until no juvenile salmon were observed. The IP model predicted over 900 stream km in the basiurvasu(a)-p(a)-p(a)-3(a)-rt3(s)high (0.75)(a)-3(s)quali (IP reariur habitat. Occu(a)-p(a)-ancy estimation based on eDNA (s)samples indicated that3(s)80.2% (± 4.3 SE) of previously unsampled sites classified as high IP and 56.4% of previously unsampled habitat selection o

escapements relate to juvenile growth, size, and abundance may ultimately improve management. The objectives of this study were to identify how salmon escapements relate to MDN assimilation and juvenile salmon performance in a naturally rearing salmon population in the Unalakleet River, western Alaska. A simulation study of spawner-recruit data was used to examine if MDN from Pink Salmon were influencing productivity of Coho Salmon in Norton Sound. MDN assimilation was assessed with stable isotopes and compared to salmon escapements. Gut fullness was assessed through stomach contents, growth was assessed through RNA:DNA ratios and condition assessed via length:weight relationships. The relationship between performance metrics and MDN content was analyzed. Simulation results demonstrated that observed relationships between Pink and Coho salmon are most likely from MDN. Fluctuations of MDN were related to spawner density and escapement levels, with MDN retention greatest in areas with substantial off-channel habitat. Juvenile salmon gut fullness, size, growth and condition were correlated with MDN levels. Results from this study help quantify the relationship between salmon escapements, MDN content and Chinook and Coho Salmon stock productivity and provide a basis for improving management in a multi-species framework.

A Remote Sensing and Occupancy Estimation Approach to Quantify Spawning Habitat Use by Fall Chum Salmon (*Oncorhynchus keta*) along the Chandalar River, Alaska

Student Investigator: Chelsea Clawson, MS Fisheries Candidate
Advisor: Jeff Falke
Funding Agency: USFWS (RWO 216)

Groundwater upwellings provide stable temperatures for overwinter salmon egg development, and this process may be particularly important in cold, braided, gravel-bed Arctic rivers. Understanding how salmon utilize thermal heterogeneity as spawning habitat is critical for effective management and conservation, but data collection in these systems is difficult due to their remote and inaccessible setting. Mapping groundwater upwellings as warmwater thermal refugia on the Chandalar River and the occurrence of spawning fall chum salmon will help guide future management decisions to mitigate against future population declines. Study objectives are to (1) d habitat occupancy as related to temperature and channel type. We delineated 330 unique river segments and found mean temperature for each segment. Small abundance aggregations were detected 36.7% of the time, and large abundance aggregations were detected 71.7% of the time. The occupancy analysis indicated that temperature was an important factor in spawning site selection. Sites occupied at high abundance remained occupied from year to year about 33% of the time, but sites occupied at low abundance were much more dynamic and rarely remained occupied for all three seasons. Results of this work will contribute toward a long-term monitoring plan for important spawning habitat on the Chandalar River and provide information and techniques for methods of monitoring salmon and habitat in remote Arctic systems.

Distribution, Migration Rates, and Energetics of Spawning Chinook Salmon (*Oncorhynchus tshawytscha*) in the Stikine and Taku Rivers

Student Investigator: Kristin Neuneker, MS Fisheries Candidate
Advisor: Jeff Falke
Funding Agency: ADFG
In-Kind Support: ADFG

The Stikine and Taku Rivers and their tributaries in southeastern Alaska and western British Columbia are important producers of wild Chinook Salmon that are targeted in U.S. and Canadian fisheries. This project seeks to gain a better understanding of movement patterns (e.g., spawning distribution, dropout and movement rates) and energetics for individual Chinook Salmon during their spawning migration. It is important to collect this baseline information owing to potential threats from climate change and mining activities in these watersheds. Study objectives are to (1) quantify movement patterns of Chinook Salmon during their spawning migration on the Stikine and Taku Rivers; (2) parameterize a bioelectric impedance analysis (BIA) model for Chinook Salmon; and (3) relate movement patterns to Chinook Salmon energetics. Adult Chinook Salmon will be captured using drift gillnets; measured for sex, body size, and condition (using bioelectrical impedance analysis); and outfitted with a radio telemetry tag. Individuals will be tracked via stationary datalogging towers and aerial surveys. A sample of adult Chinook Salmon will be collected and returned to the lab for proximate composition analysis. A predictive model will be generated based on proximate composition metrics and field-collected BIA measurements. Data collection for the project is complete. We captured, tagged, collected sex and size information, and determined spawning locations for 673 Chinook Salmon from the Stikine and Taku Rivers in 2015 and 2016. Migration rates and timing will be determined for these fish and compared to biological and hydrologic descriptors to evaluate differences in these responses among years and rivers. Bioelectrical impedance analysis measurements were taken using needle and piston electrode devices from 83 Chinook Salmon from the Nushagak and Chena Rivers and the Whitman Hatchery during summer 2016. Proximate composition analysis has been completed and will be used to create a predictive model to non-lethally estimate body condition in this species. Results from this project will be used to

Genetic Diversity and Population Relationships of Resident Kokanee and Anadromous Sockeye Salmon in Copper Lake (Wrangell-St. Elias National Park)

Student Investigator: Genevieve Johnson, MS Fisheries Candidate
Co-Advisors: Jeff Falke and Andrés López (CFOS)
Funding Agency: NPS (RWO 208)

Copper Lake in the Wrangell-St. Elias National Park (WSTP) is thought to be home to a population of Kokanee Salmon, a non-migratory (i.e., resident) form of Sockeye Salmon. Field surveys have produced small Sockeye Salmon specimens in reproductive condition. Whether these fish belong to a self-perpetuating population of resident salmon or 461 0 Td [(Je-1.22 Td

efforts to monitor LWD based on remote sensing and link the distribution and abundance of wood along the river to wildfire and land management practices.

Completed Wildlife Studies

Breeding Ecology of Whimbrels (*Numenius phaeopus*) in Interior Alaska

Student Investigator: Christopher M. Harwood, MS Wildlife Biology
Advisor: Abby Powell
Funding Agencies: USFWS; UA Foundation; Arctic Audubon Society
In-Kind Support: AKCFWRU

Note: Christopher Harwood graduated from the University of Alaska Fairbanks in December 2016. His thesis abstract follows:

Abstract: Whimbrels *Numenius phaeopus* breed in tundra-like habitats, both beyond treeline and within the boreal forest of interior Alaska. Despite their widespread distribution and designation as a species of conservation concern, their ecology has been particularly understudied in Alaska. During 2008–2012, I initiated the first dedicated study of Whimbrel breeding ecology in Alaska, and the first such study of any boreal-breeding shorebird in the state. Within a habitat mosaic of forest, woodlands, muskeg, scrub, and ponds within the floodplain of the Kanuti River in north-central Alaska, Whimbrels bred in the three largest (of nine) patches of discontinuous tussock tundra. These Whimbrels exhibited a compressed annual breeding schedule with the first birds arriving about 6 May and nests hatching about 17 June. Evidence for clustered and synchronous nesting, which may aid in predator defense, was equivocal. Most (69%) Whimbrels nested in mixed shrub-sedge tussock bog. I modeled nest-site selection at multiple spatial scales for 39 nests; however, the only variables i

Feeding Ecology

were conducted during late summer 2014. Survey plots were discrete habitats that could be Th by the most common bacteria isolated (a *Neissera* species) is vertical or horizontal. Samples from the 2014 hatching season (n=470) were assessed in 2014 and 2015. This year, tissue samples from 20 nesting females were assayed for *Neisseria arctica* bacteria using PCR. Additionally, laboratory-based infection studies using fertilized chicken eggs were conducted to attempt to determine route of infection and infectious dose of *N. arctica*. Finally, antibiotic resistance patterns and genetic characterization of another commonly isolated bacteria (*Streptococcus uberis*) were explored. Results show that some tissues contain *N. arctica* DNA (ovary, uterus, jejunum, and cloaca). We attempted to infect washed and unwashed chicken eggs with *N. arctica* via the trans-shell (horizontal) route, and were largely unsuccessful. This data is still being analyzed. The *Streptococcus* work is still being conducted, but we have documented some antibiotic resistance in our isolates. Many species of bacteria, most notably a *Neisseria* species, are commonly found in addled goose eggs and are likely contributing to embryo mortality in wild populations.

Identifying Causes of Nest Failure for Pacific Common Eiders on the Beaufort Sea Coast

Student Investigator: Wilhelm Wiese, MS Wildlife Biology Candidate
Co-Advisors: Tuula Hollmen and Mark Lindberg
Funding Agency: USFWS (RWO 215)
In-Kind Support: Personnel and logistical support provided by Arctic NWR, USFWS

Pacific Common Eider populations decreased over 50% from the 1950s to 1990s. Although Pacific common eiders have declined throughout the

Completed Ecological Studies

Moose (Alces alces) **Browse and Habitat Availability and Use in Response to Post-Fire Succession on Kanuti National Wildlife Refuge, Alaska**

Student Investigator: Erin Julianus, MS Biology
Co-Advisors: A. David McGuire and Teresa Hollingsworth
Funding Agency: USFWS Region 7 (RWO 204)
In-Kind Support: Personnel and project support provided by USFWS

Note: Erin Julianus graduated from the University of Alaska Fairbanks in August 2016. Her thesis abstract follows:

Abstract: I examined post-fire moose habitat dynamics on Kanuti National Wildlife Refuge in interior Alaska with the objective of increasing understanding of local moose habitat characteristics. I estimated browse density, biomass, and summer browse use uUp(a)-1(r)2(T42(m)6)6(

of sockeye salmon from the Iliamna Lake system, Alaska by rearing them in common garden conditions in the laboratory. To meet these goals I reformulated a widely cited developmental model to incorporate variability in natural regimes and use it to predict hatching timing over the course of the spawning duration for 25 populations of Bristol Bay sockeye salmon. Additionally, I hind- and forecasted lake temperature based off historical and predicted air temperatures to estimate and predict hatching for a single population. I found that predicted hatching timing for wild populations varied between 58 and 260 days, and was largely variable as a result of habitat thermal heterogeneity and parental spawn time. I also predicted a three-week decrease in hatching timing over the course of the next century for a single beach spawning population, which was just beyond historic variability. Counter to expectations, for a subset of populations hatching and emergence timing variability exceeded that of spawning timing, indicating the relationship between spawning timing and incubation temperature may be weaker than expected. The results of the common garden experiment revealed indistinguishable differences between populations in hatching timing across five temperature scenarios, but strong plasticity as timing differed between 74 and 189 days in the warmest to coolest treatment. Furthermore, I detected family-specific differences in hatching timing both within a time, potentially limiting their resilience. Policymakers face challenges in managing highly productive ecosystems and fishing communities to withstand future risks and capitalize on opportunities.

Climate-Induced Changes in Ecological Dynam

Development and Application of an Integrated Ecosystem Model for Alaska

Post-doctoral Researchers: Hèléne Genet and Yanjiao Mi

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phase (year 4 and 5) will be focused on applying the improved model framework across the refuge from 2000 to 2100 and developing and applying an impact model that will help determining how the changes in landcover will alter wildlife habitat and subsistence resources in the refuge.

land ownership and explicitly tailored to stakeholder needs. Maps can be used to inform conservation plans and management actions.

Development of an Alaska-based Research Framework for Migratory Waterfowl

Post-doctoral Researcher: Jennifer Roach
Faculty: Brad Griffith and Abby Powell
Funding Agency: Alaska Climate Science Center, USGS (RWO 218)

The direction and magnitude of climate effects on the seasonal ranges of migratory species are unlikely to be consistent. Thus, the cumulative effects across annual life cycles and decades will be difficult to predict without a coordinated and focused effort to integrate research across the entire annual range. A multi-regional framework is needed to efficiently integrate management-focused research among seasonal ranges and focus limited resources on the most critical season-specific links between climate change and waterfowl population trends. Our objective is to identify and prioritize the most critical cross-seasonal information needs regarding climate effects on the factors (e.g., habitat, species interactions, distribution and phenology, among others) most likely to affect waterfowl demography. We will use a literature review; a questionnaire survey of waterfowl researchers and managers representing state, federal, and non-governmental organizations; and a panel discussion at an international conference to identify and prioritize research needs. Results from a preliminary literature review have been used to develop a questionnaire survey which was administered during fall 2016 and spring 2017. This prioritization of management-focused research needs will be used to more efficiently and effectively allocate limited resources and will enable researchers and managers from widely separated ranges to communicate in common terms.

Effects of Large-scale Climate Patterns (PDO, ENSO, AO) on Calving Ground Location, Forage Availability, and Calf Survival of the Porcupine Caribou Herd

Graduate Student: MS, to be decided
Faculty: Brad Griffith
Funding Agency: USFWS, SSP (RWO 221)
In-kind Support: Alaska Department of Fish and Game

During 1983-2001, concentrated calving areas (CCAs) of the PCH were predominantly in Alaska. Calf survival was notably low in 2000 and 2001, the only two years during 1983-2001 when the annual calving ground was completely within Canada. As a result, calving in Canada was considered sub-optimal. However, during 2002-2015, CCAs were exclusively located in Canada in 7 of 13 years and by 2013 the population size had reached ~197K from a low of 123K in 2001. In retrospect, there appears to have been a phase shift from positive (warm) to negative (cool) in the Pacific Decadal Oscillation (PDO) index in ~1999-2000 that may have affected the distribution of forage for calving caribou. The population increase suggests that calving caribou continued to choose annual calving grounds that optimized calf survival, even when calving in Canada. Our goal is to develop a mechanistic understanding of why CCAs of the PCH shifted to Canada, 2000-2015. This goal addresses whether the eastward shift in concentrated calving, 2000-

2015, continued to optimize calf survival. We expect a graduate student to begin work in summer 2017.

Application of an Integrated Ecosystem Model: A Multi-Institutional and Multi-Disciplinary Effort to Understand Potential Landscape, Habitat, and Ecosystem Change in Alaska and Northwest Canada

Post-doctoral Researcher: To be determined
Faculty: Amy Breen, Eugenie Euskirchen, Robert Bolton, Helene Genet, T. Scott Rupp, Vladimir Romanovsky, Sergey Marchenko, Dave McGuire, and Brad Griffith
Funding Agency: USGS Alaska Climate Science Center (RWO 224)

Natural resource managers and decision makers projections, and other available data to assess landscape vulnerability in LCCs. We will assess various metrics for estimating connectivity (e.g., species, topography, habitats, climate) to develop landscape vulnerability maps and a geodatabase that may be used by managers to identify the decision space and context for managing land units across a continuum of vulnerability. We are in the final stages of selecting the Post-doctoral Researcher and expect that work will begin in fall 2017.

Influence of Surface Water Connectivity on Arctic Freshwater Fish and Food Webs in a Changing Climate

Student Investigator: Sarah M. Laske, PhD Fisheries Candidate
Co-Advisors: Mark Wipfli and Amanda Rosenberger
Funding Agency: Alaska Science Center, USGS (RWO 188)

The rapid rate of climate warming in the Arctic requires knowledge of ecological baseline conditions. In freshwater systems, hydrological processes and associated species responses are predicted to change, affecting surface water distribution and connectivity, and fish species distributions. Understanding how fish distributions and freshwater food webs shift as a result of climate-induced change to hydrological processes is important not only for aquatic biota, but also for the many species of wildlife that rely upon them for food. To assess current biotic and abiotic controls on Arctic freshwater food webs we investigated the following hypotheses: (1) food web structure differs with the degree of surface water connectivity; (2) fish predation and number of consumer levels affect food web structure; and (3) the effect of fish species in structuring food webs depends on their feeding strategy and diet breadth. We sampled fish and their stomach contents and muscle tissue from 32 water bodies at two locations within the Chipp River drainage on the Arctic Coastal Plain. Water bodies varied in size and degree of surface water connectivity to surrounding water bodies. Fish food web complexity increased with the strength and permanence of surface water connectivity due to increased fish species richness and addition of one trophic level. Generalist feeding habits increased the number of trophic links in associated food webs. Information from this study will provide important baseline data, inform us about potential long-term changes in ecosystem services, and help guide fish and wildlife management as the Arctic landscape responds to climate change.

Hyporheic Community and Food Web Dynamics Across a Thermal Gradient in Small Icelandic Streams!

Student Investigator: Daniel P. Govoni, PhD Biological Sciences Candidate
Advisor: Mark Wipfli
Funding Agency: Rannsóknami" stö" Íslands (Icelandic Centre for Research – RANNIS)
In-Kind Support: Hólar University, Freshwater Fisheries Institute of Iceland, Blönduós Academic Center
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Food webs and invertebrate communities have been reasonably well studied in small 3(r5Í)3 Tc Tc 12(e)-

hyporheic interface, and (2) how how seasonal thermal variability shapes subsurface invertebrate communities. We are studying streams across a range of thermal regimes and taking samples from four stations within each stream. At each station, we collect benthic samples and hyporheic samples of invertebrates at 25 and 50 cm below the streambed. Gut contents will be used to construct topological food webs. For Objective 1, we are studying spring-fed streams that are thermally stable within stream but thermally variable among streams due to geothermal activity. For Objective 2, we are contrasting lake-fed streams that are thermally fluctuating seasonally with spring-fed streams that are thermally stable throughout the year. Invertebrate abundances at streambed surfaces were much greater than in hyporheic zones, but taxa richness was similar between the two habitats. Although richness was similar in the surface and hyporheos, faunal composition (assemblage) was dissimilar. Multivariate analyses indicated that seasonal thermal variability, temperature, and conductivity explained a third of the variability in community structure when comparing seasonally fluctuating and stable streams, while surface-subsurface differences were the only significant explanatory variable in thermally stable streams. The results of this study will provide insight into the community and trophic linkages between streams and hyporheic habitats and the influence of climate change on these linkages.

LiDAR-Based Evaluation of Terrestrial Invertebrate Subsidies for Juvenile Salmon in the Kenai River Watershed

Student Investigator: Jess Grunblatt, Interdisciplinary PhD Candidate, Department of Biology and Wildlife
Advisors: Mark S. Wipfli and Barb1(a)-3(s)

terrestrial prey subsidies for juvenile salmon will allow us to better predict effects of riparian management and climate change.

Growth and Foraging Patterns of Juvenile Chinook (Oncorhynchus tshawytscha" and Coho Salmon (Oncorhynchus kisutch"!in Three Geomorphically Distinct Sub-Basins of the Kenai River

Student Investigator: Benjamin Meyer, MS Fisheries Candidate
Advisor: Mark Wipfli
Funding Agency: NSF/EPSCoR, State of Alaska
In-Kind Support: Kenai Peninsula College, Kenai Watershed Forum, Cook Inletkeeper

Climate change affects juvenile salmon freshwater habitat effects are further mediated by dietary consumption rates. Development activities in southcentral Alaska are often concentrated near low-elevation watersheds where

Lake Trout (*Salvelinus namaycush*) Otoliths as Indicators of Past Climate Patterns and Growth in Arctic Lakes

Student Investigator: Eric Torvinen, MS Fisheries Candidate
Advisor: Jeff Falke
Funding Agency: USGS Alaska Climate Science Center
In-Kind Support: Bureau of Land Management; USGS Alaska Science Center

objective is to determine the morphological, genetic, and physiological differences among CSUB and CRAM from Arctic and subarctic Alaska. A morphological study has been used to

List of Abbreviations

ADFG	Alaska Department of Fish and Game
AKCFWRU	Alaska Cooperative Fish and Wildlife Research Unit
AKSSF	Alaska Sustainable Salmon Fund
BLM	US Bureau of Land Management
CFOS	