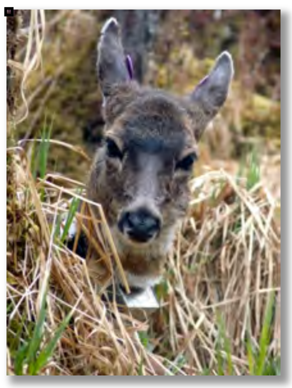
Alaska Cooperative Fish and Wildlife Research Unit

Annual Research Report—2012

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Unit Roster

Federal Scientists

- Brad Griffith: Leader
- Jeff Falke: Assistant Leader-Fisheries (effective June 4, 2012)
- Dave McGuire: Assistant Leader-Ecology
- Abby Powell: Assistant Leader-Wildlife
- Mark Wipfli: Assistant Leader-Fisheries

University Staff

- Holly Neumeyer: Travel Coordinator
- Kathy Pearse: Administrative Assistant
- Maria Russell: Fiscal Officer

Unit Students

Current

- Megan Boldenow, PhD Biological Sciences (Powell)
- Roy Churchwell, PhD Biological Sciences (Powell)
- Heather Craig, MS Wildlife Conservation (Powell)
- Dan Govoni, PhD Biological Sciences (Wipfli)
- Christopher Harwood, MS Wildllfe Conservation (Powell)
- Kurt Heim, MS Fisheries (Wipfli)
- Philip Joy, PhD Fisheries (Wipfli)
- Erin Julianus, MS Biology (McGuire and Hollingsworth)
- Sarah Laske, PhD Fisheries (Wipfli and Rosenberger)
- Jason McFarland, MS Biological Sciences (Wipfli)
- Jason Neuswanger, PhD Biological Sciences (Wipfli and Rosenberger)
- Kelly Overduijn, MS Wildlife Conservation (Powell)
- Vijay Patil, PhD Biological Sciences (Griffith and Euskirchen)
- Natura Richardson, MS Biology (Wipfli)
- Matt Sexson, PhD Biological Sciences (Powell and Peterson)
- Lila Tauzer, MS Wildlife Biology and Conservation (Powell and Prakash)
- Teri Wild, MS Wildlife Biology (Powell)

Graduated in CY 2012

- Nicole McConnell, MS Biology (McGuire)
- Megan Perry, MS Biology (Wipfli)

Post-Doctoral Researchers

- Héléne Genet (McGuire)
- Kirsty Gurney (Wipfli)
- Zhaosheng Fan (McGuire)
- Samuel Nicol (Griffith and Hunter)
- Jennifer Roach (Griffith)
- Erik Schoen (Wipfli)

University Cooperators

- Milo Adkison, School of Fisheries and Ocean Sciences (SFOS)-UAF
- Perry Barboza, Department of Biology and Wildlife(DBW) and Institute of Arctic Biology (IAB)-UAF
- F. Stuart Chapin, III, DBW and IAB
- Courtney Carothers, SFOS
- Eugénie Euskirchen, IAB
- Teresa Hollingsworth, Boreal Ecology Cooperative Research Unit (BECRU)-UAF
- Kris Hundertmark, DBW and IAB
- Christine Hunter, DBW and IAB
- Katrin Iken, SFOS
- Knut Kielland, IAB
- Mark Lindberg, DBW and IAB
- Andres Lopez, SFOS
- Sergey Marchenko, Geophysical Institute (GI)-UAF
- Kevin McCracken, DBW and IAB
- Anupma Prakash, GI and College of Natural Sciences and Mathematics
- James Reynolds, Emeritus UAF
- Vladimir Romanovsky, GI
- Amanda Rosenberger, University of Missouri
- Roger Ruess, DBW and IAB
- T. Scott Rupp, Scenarios Network for Alaska and Arctic Planning (SNAP)-UAF
- Trent Sutton, SFOS
- Dave Verbyla, SALRM
- Donald Walker, IAB

Affiliated Students

Current

- Matthew Albert, MS Fisheries (Sutton)
- Brittany Blain, MS Fisheries (Sutton)
- Tobey Carman, MS Computer Science (Euskirchen)
- Kevin Foley, MS Fisheries (Rosenberger)
- Sophie Gilbert, PhD Biological Sciences (Hundertmark)
- Elchin Jafarov, PhD Geophysics (Romanovsky)
- Tyler Lewis, PhD Biological Sciences (Lindberg)
- Jamie McKellar, MS Fisheries (Iken and Sutton)
- Stephanie Meggers, MS Fisheries (Seitz and Prakash)
- Dana Nossov, PhD Biological Sciences (Kielland)
- Daniel Rizzolo, PhD Biological Sciences (Lindberg)
- Heather Scannell, MS Fisheries (Sutton and Margraf)
- Matthew Smith, MS Wildlife Biology and Conservation (McCracken)
- Nicholas Smith, MS Fisheries (Sutton)
- Jason Stolarski, PhD Fisheries (Sutton and Prakash)
- Lindsey VanSomeren, MS Wildlife Biology and Conservation (Barboza)
- Mark Winterstein, MS Biology (Walker and Hollingsworth)

Graduated in CY 2012

- Katie Moerlein, MS Fisheries (Carothers)

Affiliated Post-Doctoral Researchers

- Amy Breen (Rupp)
- Mark Miller (Lindberg)
- Reginald Muskett (Romanovsky)
- Ken Tape (Ruess)

Cooperators

- Brian Barnes–Director, Institute of Arctic Biology, University of Alaska Fairbanks
- Cora Campbell–Commissioner, Alaska Department of Fish and Game
- Geoff Haskett–Director, Region 7, US Fish and Wildlife Service
- F. Joseph Margraf–Unit Supervisor, Cooperative Research Units, US Geological Survey
- Chris Smith–Western Field Representative, Wildlife Management Institute

This is the Annual Report for the Alaska Cooperative Fish and Wildlife Research Unit, highlighting activities for calendar year 2012. 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.

In June 2012, Dr. Jeffrey (Jeff) Falke arrived in Alaska and started his position as the new Assistant Unit Leader-Fisheries. Jeff comes to the CRU program from Oregon State University where he was a Postdoctoral Research Associate in the Department of Fisheries and Wildlife. Jeff's research and expertise have focused on freshwater fish issues throughout the Midwest and Pacific Northwest. He has recently conducted research on models to predict the distribution and abundance of steelhead redds in eastern Oregon, an assessment of the vulnerability of threatened salmonids and their habitats to wildfire, and integrated habitat suitability-occupancy models. Jeff is originally from Missouri and has a BS from the University of Missouri, MS from Kansas State University, and PhD from Colorado State University. Contact info: jeffrey.falke@alaska.edu, 907-474-6044.

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 U.S. 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 U.S. 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 relating effects of social and economic needs to production and harvest of natural populations.

In addition to the expected Unit functions of graduate student training/ instruction and technical assistance, research efforts will be directed at problems of productivity, socioeconomic impacts, and perturbation on fish and wildlife populations, their habitats and ecosystems. Fisheries research will emphasize water quality, habitat characteristics, and life history requirements of northern fish populations. Wildlife research will focus on the ecology of northern birds and mammals and their habitats. Unit research will also be directed at integrated studies of fish and wildlife at the ecosystem level.

Unit Cost-Benefit Statements

In-Kind Support

In-kind support, usually operational support of field activities, is critical to the success of the Alaska Cooperative Fish and Wildlife Research Unit. Although the monetary value of this support is not known, a listing of the assistance is provided for each project in this report.

Benefits

Students Graduated: 3
Presentations: 38
Scientific and Technical Publications: 23

Courses Taught

- Brad Griffith: Professional Opportunities in Natural Resources (Spring 2012; 1 credit hr)
- Brad Griffith: Foraging Ecology (Fall Semester 2012; 2 credit hr)
- Dave McGuire: Research Design in the Biological Sciences (Spring 2012; 3 credit hr)
- Dave McGuire: Interdisciplinary Modeling of High Latitude Global Change (Fall 2012; 4 credit hr)
- Mark Wipfli: Coastal Ecosystems (Spring 2012; 2 credit hr)
- Mark Wipfli: Climate Change Seminar (Fall 2012; 1 credit hr)

Honors and Awards

- Twenty-Year Length-of-Service Awards from the U.S. Government were presented to **Dave McGuire, Mark Wipfli, and Abby Powell**

- **Dave McGuire:**
  * AAAS Fellow awarded by the American Association for the Advancement of Science
  * 2012 Performance Award awarded by the Cooperative Research Unit Program
- **Abby Powell:** American Ornithologists' Union Fellow awarded by the American Ornithologists' Union
- **Heather Craig,** MS Wildlife Conservation candidate advised by Abby Powell, received a
  * CNSM Student Travel Grant Award from the UAF College of Natural Science and Mathematics to attend the North American Ornithological Conference in Vancouver, BC, August 2012
  * travel award from the Alaska Bird Conference Organizing Committee to attend the Alaska Bird Conference in Anchorage, AK, October 2012
- **Christopher Harwood,** MS Wildlife Conservation candidate advised by Abby Powell, received the 2012 Angus Gavin Memorial Migratory Bird Research Grant awarded by the University of Alaska Foundation. He received the $15,000 award for his project, "Breeding Ecology of Whimbrels in Interior Alaska," which focuses on understanding factors effecting breeding populations of whimbrels (a species of curlew) in subarctic habitats.
  * He also received a UAF Institute of Arctic Biology (IAB) Director's Travel Award to attend the Alaska Bird Conference, Anchorage, AK, October 2012
- **Kurt Heim,** MS Fisheries candidate advised by Mark Wipfli, received an IAB Director's Travel Grant Award to attend the American Fisheries Society Alaska Chapter Annual Meeting in Kodiak, October 2012
- **Philip Joy,** PhD Fisheries candidate advised by Mark Wipfli, received an IAB Director's Travel Grant Award to attend the American Fisheries Society Alaska Chapter Annual Meeting in Kodiak, October 2012

- **Jason McFarland,** MS Biological Sciences candidate advised by Mark Wipfli, received an IAB Director's Travel Grant Award to attend the American Fisheries Society Alaska Chapter Annual Meeting in Kodiak, October 2012
- **Jason Neuswanger,** PhD Biological Sciences candidate advised by Mark Wipfli, won the best student paper award for an oral presentation at the annual national meeting of the American Fisheries Society in Minneapolis, MN. The title of his talk was "3-D Territoriality and Shadow Competition within Schools of Juvenile Chinook Salmon." Co-authors are Mark Wipfli, Amanda Rosenberger, and the late Nicholas Hughes.
- **Vijay Patil:** PhD Biological Sciences candidate advised by Brad Griffith, recipient of the
  - * 2012 Student Research Grant from the College of Science and Mathematics, UAF
  - * the Biology and Wildlife Graduate Student Association Travel Award to attend the American Geophysical Union (AGU) meeting in San Francisco, December 2012
  - * an IAB Director's Travel Award to attend the AGU meeting, December 2012
- **Lila Tauzer,** MS Wildlife Biology and Conservation candidate advised by Abby Powell, received
  - * a CNSM Student Travel Grant Award from the UAF College of Natural Science and Mathematics to attend the North American Ornithological Conference in Vancouver, BC, August 2012
  - * an IAB Director's Travel Award to attend the Alaska Bird Conference, Anchorage, AK, October 2012
- **Teri Wild,** MS Wildlife Biology candidate advised by Abby Powell, received a travel award from the Alaska Bird Conference Organizing Committee to attend the Alaska Bird Conference in Anchorage, AK, October 2012

Outreach and Info Transfer

Griffith, B. February 2012. Presented an overview of biodiversity studies in the Yukon River Basin to Alaska Friends of Refuges through a webinar, focusing on the Yukon Flats National Wildlife Refuge (Public Meeting/Talk).

Neuswanger, J. November 2012. Salmon: Animal behavior in 3D. UAF Research Showcase Series, sponsored by URSA (Undegraduate Research and Scholarly Activity).

Invited Seminars

Griffith, B. and J. Roach. April 2012. Lake area change in Alaskan National Wildlife Refuges: Magnitude, mechanisms, and implications. Presented to the USFWS, R7, Climate Science Series Webinar.

Griffith, B. February 2012. Lake change in Alaskan National Wildlife Refuges: Magnitude, mechanisms, and biological implications. Presented to the Alaska IEM Thermokarst and Wetland Dynamics Meeting.

Neuswanger, J. R., M.S. Wipfli, and M. Evenson. May 2012. Environmental variables influence Chinook salmon stock-recruitment analyses. AYK-SSI Workshop.

Wipfli, M. July 2012. Marine and terrestrial resource subsidies influence freshwater food web productivity in Alaska. Association for the Sciences of Limnology and Oceanography International Meeting, Lake Biwa, Japan. (Invited Seminar).

Papers Presented

Churchwell, R. and A.N. Powell. October 2012. Impacts of feeding shorebirds on the invertebrate community of an arctic mudflat. 15th Annual Alaska Bird Conference, Anchorage, AK. (Contributed Oral)

Craig, H., A. Powell, S. Kendall, and T. Wild. August 2012. Annual survival of Smith's Longspurs in Alaska. 5th North American Ornithological Conference, Vancouver, B.C. (Contributed Poster)

Craig, H., A.N. Powell, S. Kendall, and T. Wild. October 2012. Effects of sex and age on survival of Smith's Longspurs in northern Alaska. 15th Annual Alaska Bird Conference, Anchorage, AK. (Contributed Oral)

Euskirchen, E.S., T.B. Carman, and A.D. McGuire. December 2012. Modeling leaf phenology variation by groupings within and across ecosystems in northern Alaska. American Geophysical Union 45th Annual Fall Meeting, San Francisco, CA. (Contributed Poster)

Falke, J.A. and D.J. Isaak. October 2012. Overview and applications of stream water temperature predictive models for fish conservation and management. Alaska Chapter of the American Fisheries Society 39th Annual Meeting, Kodiak, AK. (Invited Oral)

Falke, J., K. McNyset, B. Flitcroft, G. Reeves, C. Jordan, and J. Dunham. August 2012. Application of a riverscape water temperature model for conservation and management of threatened salmonids in the Pacific Northwest. American Fisheries Society Annual Meeting, St. Paul, MN. (Invited Oral)

Genet, H., K.M. Barrett, J.F. Johnstone, A.D. McGuire, F. Yuan, E.S., Euskirchen, E.S. Kasischke, S.T. Rupp, and M.R. Turetsky. December 2012. Modeling the effects of fire severity on soil organic horizons and forest composition in interior Alaska. American Geophysical Union 45th Annual Fall Meeting, San Francisco, CA. (Contributed Poster)

Gurney, K., R. G. Clark, S. Slattery, and L. Ross. August 2012. Seasonal patterns of offspring diets and survival in lesser scaup in relation to temporal fluctuations in aquatic food resources in northern boreal ecosystems. 5th Annual North American Ornithological Conference, Vancouver, BC. (Contributed Oral)

Harwood, C. and A.N. Powell. October 2012. Breeding ecology of Whimbrels in interior Alaska. 15th Annual Alaska Bird Conference, Anchorage, AK. (Contributed Oral)

Hayes, D.J., D.W. Kicklighter, A.D. McGuire, M. Chen, Q. Zhuang, J.M. Melillo, and S.D. Wullschleger. December 2012. The impact of permafrost thaw on land-atmosphere greenhouse gas exchange in recent decades over the northern high latitudes. American Geophysical Union 45th Annual Fall Meeting, San Francisco, CA. (Contributed Oral)

Heim, K., M. Wipfli, M. Whitman, N. Sather, and M. Loewen. October 2012. Seasonal movement patterns of Arctic grayling (*Thymallus arcticus*) in a small beaded stream on the Arctic Coastal Plain, Alaska. American Fisheries Society Alaska Chapter 39th Annual Meeting, Kodiak, AK. (Contributed Oral)

Jafarov, E.E., H. Genet, V.E. Romanovsky, A.D. McGuire, and S.S. Marchenko. December 2012. The effects of forest fire on the frozen soil thermal state. American Geophysical Union 45th Annual Fall Meeting, San Francisco, CA. (Contributed Poster)

Johnson, K.D., J.W. Harden, A.D. McGuire, F. Yuan, and M. Clark. December 2012. Permafrost degradation and organic layer thickening over a climate gradient in a discontinuous permafrost region. American Geophysical Union 45th Annual Fall Meeting, San Francisco, CA. (Contributed Poster)

Johnston, C.E., S.A. Ewing, R.K. Varner, J.W. Harden, M.R. Turetsky, and A.D. McGuire. December 2012. Methane emission through diffusion and ebullition in thaw wetlands in interior Alaska. American Geophysical Union 45th Annual Fall Meeting, San Francisco, CA. (Contributed Oral)

Joy, P., M.S. Wipfli, C. Stricker and W. Jones. 2012. Marine-nutrient assimilation in rearing coho and Chinook salmon in the Unalakleet River. American Fisheries Society Alaska Chapter 39th Annual Meeting, Kodiak, AK (Contributed Oral).

Koch, J.C., R.L. Smith, K.E. Gurney, M. Wipfli, S.A. Ewing, M.T. Jorgenson, R.G. Striegl, and J. Schmutz. December 2012. Evolving drainage networks and nutrient fluxes in continuous permafrost zones of interior and arctic Alaska. American Geophysical Union 45th Annual Fall Meeting, San Francisco, CA (Contributed Oral)

Koch, J.C., M. Wipfli, and K. Gurney. March 2012. Water, heat, and nutrient fluxes on the Arctic Coastal Plain, Alaska. Alaska Section Annual Meeting, American Water Resources Association, Juneau, AK. (Contributed Oral)

Laske, S.M, M.S. Wipfli, A.E. Rosenberger, and C.E. Zimmerman. October 2012. Fish and invertebrate assemblages in ponds and lakes on the Arctic Coastal Plain, Alaska. American Fisheries Society Alaska Chapter 39th Annual Meeting, Kodiak, AK. (Contributed Oral)

McFarland, J., M. Wipfli, and M. Whitman. October 2012. Feeding ecology of Arctic grayling (*Thymallus arcticus*) in a small beaded stream on the Arctic Coastal Plain, Alaska. American Fisheries Society-Alaska Chapter 39th Annual Meeting, Kodiak, AK. (Contributed Oral)

McGuire, A.D. June 2012. Importance of research on climate change in the Arctic-Boreal Region. NASA Arctic Boreal Vulnerability Experiment (ABoVE) Workshop, Boulder, CO. Invited. (Invited Oral)

McGuire, A.D., S.T. Rupp, A. Bennett, W.R. Bolton, A. Breen, E.S. Euskirchen, T. Kurkowski, S.S. Marchenko, V.E. Romanovsky, M.P. Waldrop, and F. Yuan. December 2012. The Alaska Integrated Ecosystem Model: An interdisciplinary tool to assess the responses of natural resources in Alaska to climate change. American Geophysical Union 45th Annual Fall Meeting, San Francisco, CA. (Contributed Poster)

Neuswanger, J., N. Hughes, M. Wipfli, and A. Rosenberger. August 2012. Territoriality and shadow competition within schools of juvenile chinook salmon. American Fisheries Society Annual Meeting, Minneapolis, MN. (Contributed Oral)

Nicol, S., B. Griffith, J. Austen, and C. Hunter. February 2012. Implications of climate variability for optimal monitoring and adaptive management in wetland systems. Final project presentation to RCRP cooperators, 28 February 2012, Seattle, WA.

Overduijn. K., A.N. Powell, and C. Handel. October 2012. Brood movement and habitat use by American and Pacific Golden-Plovers. 15th Annual Alaska Bird Conference, Anchorage, AK. (Contributed Oral)

Parmentier, F.W., T.R. Christensen, L. Sorensen, S. Rysgaard, A.D. McGuire, P.A. Miller, and D.A. Walker. December 2012. The impact of lower sea ice extent on arctic greenhouse gas exchange. American Geophysical Union 45th Annual Fall Meeting, San Francisco, CA. (Contributed Oral)

Patil, V.P., D.B. Griffith, and E. Euskirchen. December 2012. Interaction between lakes and terrestrial ecosystem dynamics in the Yukon River floodplain, in interior Alaska, USA. American Geophysical Union 45th Annual Meeting, San Francisco, CA. (Contributed Poster)

Powell, A.N. and R.L. Bentzen. March 2012. Using satellite telemetry to determine survival and movements of juvenile sea ducks. Microwave Telemetry, Inc. 2012 Avian and Marine Tracking Conference, Columbia, MD. (Contributed Oral)

Roach, J.K. and B. Griffith. December 2012. Heterogeneity in high latitude lake area trends and relationship to landscape characteristics. American Geophysical Union 45th Annual Fall Meeting, San Francisco, CA. American Geophysical Union 45th Annual Fall Meeting, San Francisco, CA. (Contributed Poster)

Schädel, C., A.D. McGuire, J. G. Canadell, J. W. Harden, P. Kuhry, V. E. Romanovsky, M. R. Turetsky, and E.A.G. Schuur. June 2012. Vulnerability of permafrost carbon research coordination network. Tenth International Conference on Permafrost. Salekhard, Russia. (Contributed Poster)

Schädel, C., E.A.G. Schuur, A.D. McGuire, J. Canadell, J. Harden, P. Kuhry, V. Romanovsky, and M. Turetsky. April 2012. Vulnerability of permafrost carbon research coordination network. Annual Meeting of the European Geophysical Union, Vienna, Austria. (Contributed Poster)

Sexson, M.G., M.R. Petersen, and A.N. Powell. October 2012. Spatiotemporal distribution of Spectacled Eiders throughout the annual cycle. 15th Annual Alaska Bird Conference, Anchorage, AK. (Contributed Poster)

Sloan, V.L., C. Iversen, J. Childs, E.S. Euskirchen, A.D. McGuire, and R.J. Norby. December 2012. Linking vegetation composition to geomorphic units in a polygonal tundra landscape: A framework for improving estimates of plant functional type coverage in ecosystem models. American Geophysical Union 45th Annual Fall Meeting, San Francisco, CA. (Contributed Poster)

Tauzer, L. and A. Powell. August 2012. Ecosystem shift in an Alaskan boreal forest: Is there evidence of change in avian communities? 5th North American Ornithological Conference, Vancouver, B.C. (Contributed Poster)

Tauzer, L., A.N. Powell, and S. Sharbaugh. October 2012. Ecosystem shift in an Alaskan boreal forest: Evidence that succession drives avian population change. 15th Annual Alaska Bird Conference, Anchorage, AK. (Contributed Oral)

Waldrop, M.P., J. McFarland, E.S. Euskirchen, M.R. Turetsky, J.W. Harden, K. Manies, M. Jones, and A.D. McGuire. December 2012. Carbon balance and greenhouse gas fluxes in a thermokarst bog in interior Alaska: Positive and negative feedbacks from permafrost thaw. American Geophysical Union 45th Annual Fall Meeting, San Francisco, CA. (Contributed Oral)

Wild, T., S. Kendall, and A.N. Powell. October 2012. How many Smith's Longspurs are in Alaska's Brooks Range?: Estimating breeding density of a polygynandrous species. 15th Annual Alaska Bird Conference, Anchorage, AK. (Contributed Oral)

Zhang, Y. A.D. McGuire, H. Genet, W.R. Bolton, V.E. Romanovsky, G. Grosse, M.T. Jorgenson. December 2012. Modeling thermokarst dynamics in Alaska ecosystems. American Geophysical Union 45th Annual Fall Meeting, San Francisco, CA. (Contributed Poster)

Zhuang, Q., X. Zhu, C. Prigent, J.M. Melillo, A.D. McGuire, R.G. Prinn, and D.W. Kicklighter. December 2012. Influence of changes in wetland inundation extent on net fluxes of carbon dioxide and methane in northern latitudes from 1993 to 2004. American Geophysical Union 45th Annual Fall Meeting, San Francisco, CA. (Contributed Oral)

Scientific Publications

Benson, E.R., M.S. Wipfli, J.E. Clapcott, and N.F. Hughes. 2012. Relationships between ecosystem metabolism, benthic macroinvertebrate densities, and environmental variables in a sub-arctic Alaskan river. Hydrobiologia DOI 10.1007/s10750-012-1272-0

Bentzen, R. and A.N. Powell. 2012. Population dynamics of king eiders breeding in Alaska. Journal of Wildlife Management 76(5):1011-1020, DOI:10.1002/jwmg.335

Callaghan, T.V., M. Johansson, O. Anisimov, H.H. Christiansen, A. Instanes, V. Romanovsky, S. Smith, and contributing authors (including A.D. McGuire). 2012. Changing permafrost and its impacts. Chapter 5 in Snow, Water, Ice, and Permafrost in the Arctic (SWIPA). Arctic Monitoring and Assessment Programme (AMAP), Oslo, Norway, pp. 5-1 to 5-22.

Falke, J.A., L.L. Bailey, K.R. Bestgen, and K.D. Fausch. 2012. Colonization and extinction in dynamic habitats: an occupancy approach for an assemblage of fishes in a Great Plains river. Ecology 93:858-867.

Harden, J.W., C.D. Koven, C.-Lu Ping, G. Hugelius, A.D. McGuire, P. Camill, T. Jorgenson, P. Kuhry, G.J. Michaelson, J.A. O'Donnell, E.A.G. Schuur, C. Tarnocai, K. Johnson, and G. Grosse. 2012. Field information links permafrost carbon to physical vulnerabilities of thawing. Geophysical Research Letters 39, L15704, 6 pages, doi:10.1029/2012GL051958.

Hayes, D.J., D.P. Turner, G. Stinson, A.D. McGuire Y. Wei, T.O. West, L.S. Heath, B. deJong, B. McConkey, R. Birdsey, W.A. Kurz, A. Jacobson, D.N. Huntzinger, Y. Pan, W.M. Post, and R.B. Cook. 2012. Reconciling estimates of the contemporary North American carbon balance among terrestrial biosphere models, atmospheric inversions and a new approach for estimating net ecosystem exchange from inventory-based data. Global Change Biology 18:1282-1299, doi:10.1111/j.1365-2486.2011.02627.x.

Huntzinger, D.N., W.M. Post, Y. Wei, A. Michalak, T.O. West, A. Jacobson, I.T. Baker, J.M. Chen, K.J. Davis, D.J. Hayes, F.M. Hoffman, A.K. Jain, S. Liu, A.D. McGuire, R.P. Neilson, B. Poulter, B.M. Raczka, H. Tian, P. Thornton, E. Tomelleri, N. Viovy, J. Xiao, N. Zeng, M. Zhao, and R. Cook. 2012. North American Carbon Project (NACP) Regional Interim Synthesis: Terrestrial biospheric model intercomparison. Ecological Modelling 232:144-157.

McGuire, A.D. 2012. Ecosystem Element Cycling. Pages 779-798 in A.H. El-Shaarawi and W.W. Piegorsch, eds. Encyclopedia of Environmetrics, 2nd Edition. John Wiley & Sons Ltd, Chichester, UK. doi 10.1002/9780470057339.vae011.pub2.

McGuire, A.D., T.R. Christensen, D. Hayes, A. Heroult, E. Euskirchen, J.S. Kimball, C. Koven, P. Lefleur, P.A. Miller, W. Oechel, P. Peylin, M. Williams, and Y. Yi. 2012. An assessment of the carbon balance of Arctic tundra: Comparisons among observations, process models, and atmospheric inversions. Biogeosciences 9:3185-3204, doi:10.5194/bg-9-3185-2012.

Meretsky, V.J., L.A. Maguire , F.W. Davis , D.M. Stoms, J.M. Scott , D. Figg, D.D. Goble, B. Griffith, S.E. Henke, J. Vaughn, and S.L. Yaffee. 2012. A State-Based National Network for Effective Wildlife Conservation. BioScience 62(11):970-976. DOI: 10.1525/bio.2012.62.11.6

Muskett, R.R. 2012. Remote Sensing, Model-Derived and Ground Measurements of Snow Water Equivalent and Snow Density In Alaska. International Journal of Geosciences 3(5):1127-1136, doi: 10.4236/ijg.2012.35114.

Muskett, R.R. 2012. Multi-Satellite and Sensor Derived Trends and Variation of Snow Water Equivalent on the High-Latitudes of the Northern Hemisphere. International Journal of Geosciences 3(1):1-13, doi: 10.4236/ijg.201231001.

Muskett, R.R. and V.E. Romanovsky. 2012. Multi-Satellite-Derived changes in Energy and Mass of Russian Permafrost Regions. Proceedings of the Tenth International Conference on Permafrost 1(1):277-282, ISBN 987-5-905911-01-9, http://www.ticop2012.org/, The Northern Publisher Salekard, Salekhard, Yamal-Nenets Autonomous District, Russia.

O'Donnell, J.A., M.T. Jorgenson, J.W. Harden, A.D. McGuire, M.Z. Kanevskiy, and K.P. Wickland. 2012. The effects of permafrost thaw on soil hydrologic, thermal and carbon dynamics in an Alaskan peatland. Ecosystems 15:213-229, doi: 10.1007/s10021-011-9504-0.

Powell, A.N. and R.S. Suydam. 2012. King Eider (*Somateria spectabilis*), The Birds of North America Online (A. Poole, Ed.). Ithaca: Cornell Lab of Ornithology; Retrieved from the Birds of North America Online: http://bna.birds.cornell.edu/bna/species/491; doi:10.2173/bna.491.

Rinella, D.J., M.S. Wipfli, C.A. Stricker, and R.A. Heintz. 2012. Salmon returns and consumer fitness: Marine-derived nutrients show saturating effects on growth and energy storage in stream-rearing juvenile salmonids. Canadian Journal of Fisheries and Aquatic Sciences 69:73-84.

Roach, J.K., B. Griffith, and D. Verbyla. 2012. Comparison of three methods for long-term monitoring of boreal lake area using Landsat TM and ETM+ imagery. Canadian Journal of Remote Sensing 38(4):427-440.

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Theses and Dissertations of Unit-Sponsored Graduate Students

- McConnell, Nicole A. 2012. Controls on ecosystem respiration of carbon dioxide across a boreal wetland gradient in Interior Alaska. MS thesis, University of Alaska Fairbanks. 44 pp.
- Moerlein, Katie J. 2012. A total environment of change: Exploring social-ecological shifts in subsistence fisheries in Noatak and Selawik, Alaska. MS thesis, University of Alaska Fairbanks. 105 pp.

- Perry, Megan T. 2012. Growth of juvenile Chinook salmon (*Oncorhynchus tshawytscha*) as an indicator of density-dependence in the Chena River. MS thesis, University of Alaska Fairbanks. 77 pp.

Reports are listed as Completed or Ongoing, in the categories of Aquatic, Terrestrial, or Ecological Studies. The List of Abbreviations appears on the final page of the report.

Completed Aquatic Studies

Growth of Juvenile Chinook Salmon (*Oncorhynchus tshawytscha*) as an Indicator of Density-Dependence in the Chena River

Student Investigator: Megan Perry, MS Biology
Advisor: Mark Wipfli
Funding Agencies: Arctic-Yukon-Kuskokwim Sustainable Salmon Initiative (AYKSSI); Department of Biology and Wildlife (DBW); and Alaska Department of Fish and Game (ADFG)

Note: Megan Perry graduated from the University of Alaska Fairbanks in August 2012. Her thesis abstract follows:

In management of Pacific salmon, it is often assumed that density-dependent factors, mediated by the physical environment during freshwater residency, regulate population size prior to smolting and outmigration. However, in years following low escapement, temperature may be setting the upper limit on growth of juvenile Chinook salmon *Oncorhynchus tshawytscha* during the summer rearing period. Given the importance of juvenile salmon survival for the eventual adult population size, we require a greater understanding of how density-dependent and independent factors affect juvenile demography through time. In this study we tested the hypotheses that (1) juvenile Chinook salmon in the Chena River are food limited, and (2) that freshwater growth of juvenile Chinook salmon is positively related with marine survival. We tested the first hypotheses using an *in-situ* supplemental feeding experiment, and the second hypothesis by conducting a retrospective analysis on juvenile growth estimated using a bioenergetics model related to return per spawner estimates from a stock-recruit analysis. We did not find evidence of food limitation, nor evidence that marine survival is correlated with freshwater growth. However, we did find some evidence suggesting that growth during the freshwater rearing period may be limited by food availability following years when adult escapement is high.

Ongoing Aquatic Studies

Growth and Reproductive Status of Razor Clams (*Siliqua patula*) in Eastern Cook Inlet

Student Investigator: Jamie McKellar, MS Fisheries
Co-Advisors: Katrin Iken and Trent Sutton
Funding Agencies: Sport Fish Division, ADFG (Base funding); State Wildlife Grant, U.S. Fish and Wildlife Service (USFWS)
In-Kind Support: Personnel, vehicles, and equipment provided by ADFG

Growth, survival and recruitment rates may be changing in the important razor clam *Siliqua patula* stock targeted by sport and personal use diggers on the east side of Cook Inlet. A basic population assessment (the ability to track year classes as they age and to measure annual growth) is compromised by a lack of life history information that enables accurate age determination. This project will estimate duration and timing of adult spawning, track juvenile clam growth by month, and improve the recognition of annular growth rings. The East Cook Inlet razor clam fishery, located between the Kasilof and Anchor Rivers on the Kenai Peninsula, is the only major recreational razor clam fishery in Alaska. The purpose of this study is to enhance our knowledge of life history patterns of the razor clam on eastern Cook Inlet beaches. Quantification of life history traits will result in more accurate age determination, which can lead to the development of better stock-recruitment models. Objectives were accomplished with monthly (May–October) sampling of juvenile and adult razor clams to examine growth rates and sexual maturity. Additionally, sediment samples were taken between May through October to detect the presence of newly settled clams. Spawning occurs primarily in July and August at Clam Gulch and Ninilchik. An absence of juvenile razor clams and low numbers of sexually mature adult razor clams seem to indicate that recruitment in 2009 and 2010 was not as successful at Clam Gulch as at Ninilchik. Clams at Ninilchik were found to be mature at a smaller size and age than previously documented. Fisheries managers need to respond appropriately to population changes in order to protect the sustainability of this stock.

Foraging Behavior and Population Dynamics of Chinook Salmon in the Chena River

Student Investigator: Jason Neuswanger, PhD Biological Sciences
Co-Advisors: Mark Wipfli and Amanda Rosenberger
Funding Agencies/Partners: AYKSSI, ADFG; Institute of Arctic Biology (IAB); DBW, UAF Graduate School

Stock-recruitment analyses suggest that the Chena River Chinook salmon population is affected by river discharge during each generation’s first summer, but this effect and its mechanistic causes are poorly understood. The fundamental behavioral ecology of juvenile Chinook salmon in this type of system has not been established well enough to explain the observed population-level relationships with discharge and understand their predictive utility and consequences. These fish forage in tighter groups than previously studied salmonids, so the competitive mechanisms driving density dependence may be different. They also spend a large amount of time and energy pursuing and rejecting inedible debris, which substantially affects bioenergetics calculations. The objectives of this study were to (1) clarify the relationship between discharge and population dynamics of Chinook salmon in the Chena River, (2) develop an efficient 3D video measurement system to measure fine-scale juvenile Chinook behavior, (3) quantify the time these fish spend pursuing debris rather than prey, and calculate its implications for growth and competition, and (4) characterize the mechanisms of intra-school territorial competition. Custom software was written to measure and analyze 3D spatial data from video footage. It is being used to quantify the feeding behaviors of individual juvenile Chinook salmon as they grow through the 30-80 mm fork length range. A variety of modeling techniques are being used or extended (including bioenergetics, foraging, home range, and stock-recruitment models) to examine population-level implications of individual behavior. Population analysis suggests that discharge drives much of the inter-annual variation in Chinook recruitment in the Chena River, with high discharge years being detrimental. This may be caused by movement out of the Chena into lower-capacity tributaries in high discharge years. The feeding behavior of juvenile salmon in the main stem Chena has some unique characteristics, including 3-dimensional territoriality and persistent distraction by inedible debris, that may allow fish to feed successfully at higher population densities than they can in shallower tributaries. Knowledge of environmental influences on juvenile survivorship will help managers predict the strength of each year class before the adults return to spawn. Fundamental research on the mechanisms of juvenile salmonid foraging and competition is relevant and transferable to a broad range of riverine salmonid ecosystems.

Contributing Factors of Juvenile Sockeye Salmon Growth with Emphasis on Potential Competition with Three-Spined Stickleback

Student Investigator: Natura Richardson, MS Biology
Advisor: Mark Wipfli
Funding Agencies: ADFG; DBW (Teaching Assistantship)
In-kind support: Field support and personnel provided by ADFG

Sockeye salmon utilize lakes as nursery habitat for 1-3 years before entering the ocean. To improve marine survival, sufficient growth is necessary and dependent on lake conditions, prey availability, and fish community assemblage. Current and future changes in environmental conditions may lead to changes in sockeye rearing habitat, which could change growth potential and ultimately survival. Since 2001, the Afognak Lake sockeye salmon run has experienced widely variable adult returns. In some years these returns have failed to achieve sustainable yields according to Alaska Department of Fish and Game (ADFG). In 2003, ADFG initiated smolt, adult, and limnology investigations to better understand the causes for the high variability in the Afognak sockeye returns, but studies on lake juveniles were lacking. The objective of this study is to understand factors that both contribute to and limit juvenile sockeye salmon growth during their freshwater rearing stage. Throughout the summer season of 2012, we collected diet and energy density samples of juvenile sockeye salmon and three-spined sticklebacks as well as environmental and limnological parameters of Afognak Lake. Diet composition, niche overlap, and environmental parameters will be examined to investigate conditions that lead to potential competition and food limitations. Using field-based data, a bioenergetics model of growth for juvenile sockeye salmon will be constructed to assess parameters that have the greatest influence on growth. This study will not only result in a useful juvenile sockeye salmon growth model but also contribute to a better understanding of interspecific interactions, community structure, and food web dynamics within sockeye nursery lakes.

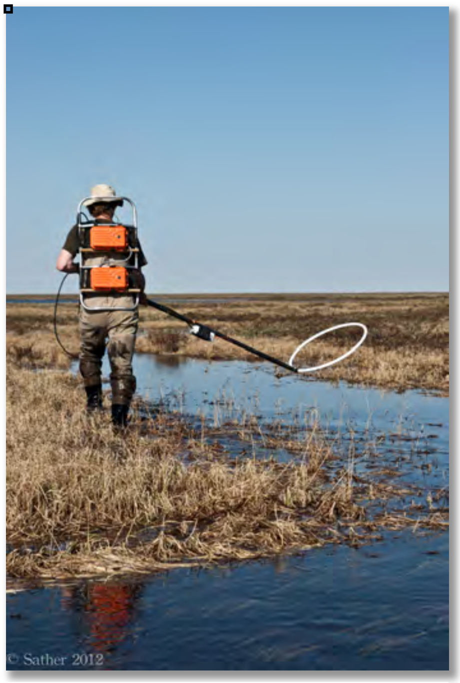
Marine-Derived Nutrient Effects on Chinook and Coho Salmon Productivity

Student Investigator: Philip Joy, PhD Fisheries
Advisor: Mark Wipfli
Funding Agencies: Alaska Sustainable Salmon Fund (AKSSF): Sport Fish Division, ADFG; Norton Sound Economic Development Corporation (NSEDC)

Marine nutrients imported to freshwater systems by migrating salmon, or marine-derived nutrients (MDN), have been identified as a significant variable affecting growth and survival of juvenile salmon. The effects on stock productivity, however, have not been assessed directly. Given that larger smolt are associated with higher marine survival, understanding the impacts of MDN on juvenile growth, size, and abundance may ultimately improve managers' ability to forecast return rates of adult salmon. The objectives of this study are to identify the degree and route of MDN assimilation in rearing Chinook and coho salmon and determine the effect on growth and size. Two-thousand twelve (2012) was the second year of a three-year project. Chinook and coho salmon smolt productivity is being examined with mark-recapture experiments on migrating smolt. MDN assimilation and growth are being assessed using stable isotope and stomach content analysis, while growth will be assessed using RNA:DNA ratios from muscle and Length Frequency Data Analysis (LFDA). Results from the 2011 field season indicated seasonal fluctuations in MDN assimilation rates indicative of substantial usage of MDN subsidies during the spawning season and significant predation on salmon fry by migrating Chinook and coho salmon smolt. The relationship between MDN assimilation and the growth and condition of juvenile salmon is currently being analyzed. Results from this study will quantify the importance of MDN to Chinook and coho salmon stock productivity and improve forecasting models based on these relationships.

Seasonal Movements of Arctic Grayling (*Thymallus arcticus*) in a Small Beaded Stream on the Arctic Coastal Plain, Alaska

Student Investigator: Kurt Heim, MS Fisheries
Advisor: Mark Wipfli
Funding Agencies: USFWS (RWO 168) and Bureau of Land Management (BLM) (RWO 179)
In-Kind Support: Field logistics provided by BLM



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The Arctic Coastal Plain is a unique landscape with a mosaic pattern of seasonally interconnected lakes and streams that support abounding populations of Arctic grayling; however, we know little about their habitat needs and migrations. Oil and gas development of this area has the potential to alter hydrology; thus, understanding local grayling ecology is a management need. The objective of this study is to track grayling movements in a representative beaded stream habitat and develop models to relate these movements to environmental variability and individual level attributes. We implanted Passive Integrated Transponder (PIT) tags into 575 grayling and tracked their movements within Crea Creek using an array of radio-frequency identification antennae. Grayling immigrated into Crea Creek in June shortly after the breakup of ice, when stream discharge peaked. As flows receded to low summer levels in July, many of these fish emigrated from the system. These emigrants were primarily adults, while the group that remained in the system was primarily juveniles. These movements and the presence of young-of-the-year grayling in the headwaters indicate that adults are making a spawning run into Crea Creek. Monitoring throughout the summer indicates that grayling continue to immigrate into Crea Creek; however, immigrants during the low-flow period display short residence times and limited upstream travel compared to June immigrants. Our study demonstrates the importance of beaded stream habitats to grayling and the need for continuous unobstructed access during the entire ice-free period.

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Development and Calibration of Bioelectrical Impedance Analysis as a Measure of energetic status of arctic grayling (*Thymallus arcticus*)

Student Investigator: Undergraduate Technician (to be named)
Advisor: Jeff Falke
Funding Agency: Cooperative Research Unit Program, USGS
In-Kind Support: Fish sample collection and site access provided by ADFG

Relatively little information is available on how the energetic status of salmonids fluctuates across life stages, seasons, and environments at the individual level. Much of this uncertainty results from the relative difficulty (i.e., expense) of obtaining precise estimates of proximate composition (PC). Moreover, PC analysis is expensive, time consuming, lethal, and not practical for repeated measures, field applications, or large numbers of individuals. Recent advancements in bioelectrical impedance analysis (BIA) show promise in developing precise non-lethal estimates of individual fish condition. Development of rapid, precise, and non-lethal methods of estimating energetic status are critical for successful fisheries management and for contributing toward our understanding of bioenergetics and the flow of energy through populations, communities, and ecosystems. The main objective of this research is to build and validate BIA models for arctic grayling. Grayling will be collected from streams and lakes near Fairbanks, Alaska, sacrificed, weighed, measured, and BIA measures of resistance and reactance recorded. Samples will be frozen and transported to UAF where they will be analyzed for proximate composition using standardized methods. Models will be built relating PC metrics to BIA measurements using generalized linear models. Sampling will occur in spring and fall 2013. Lab PC analysis will be conducted from August 2013 to May 2014. Quantifying the range of variation in late-summer energy density within a population may contribute towards the ability to predict overwinter survival. Moreover, linking environmental characteristics to energy allocation through time would provide insight into conditions that ultimately influence individual performance and population productivity, with implications for conservation, management, and restoration actions.

Thermal Criteria for Nevada Coldwater Stream Fishes

Student Investigator: Amy Mills, Technician
Advisor: Jeff Falke
Funding Agency: Nevada Division of Environmental Protection (NDEP)
In-Kind Support: Sample collection and logistics provided by NDEP

Past efforts to set thermal standards for coldwater fishes have focused on overly detailed or not detailed enough (i.e., insufficiently documented) criteria based upon point estimates of acute and chronic exposure. As a result, traditional temperature metrics are poorly suited to describe instream conditions that can be affected by management, and as a consequence, often fail to protect populations and set unrealistic expectations for natural thermal conditions. A need exists to update and develop protective criteria and monitoring designs for thermal conditions that support coldwater stream fishes in the state of Nevada. This project has two main objectives: (1) to develop a matrix of recommended temperature standards for coldwater stream fishes in Nevada, and (2) to review approaches for monitoring thresholds that incorporate spatio-temporal variability in stream water temperatures. Recommended temperature standards will be based on a combination of literature review and analysis of the current distribution of coldwater fishes and thermal regimes in the state. Spatio-temporal variability in water temperature metrics will be assessed using existing temperature data and a subset collected during this project. Water and air temperature data were collected in summer 2012 from 54 sites in the Reese River and Stewart Creek, Nye County, Nevada. Analyses are in progress. Current numeric criteria for mainstem habitats exist, but sources are poorly documented. Smaller streams are currently classified by water quality, and within each category a single criterion is applied across the year. New thermal criteria for Nevada's coldwater fishes are needed that are clear, consistent, supportable, and easily measurable.

Distribution Patterns and Habitat Associations of Juvenile Coho Salmon in High Gradient Headwater Tributaries of the Little Susitna River, Alaska

Student Investigator: Kevin Foley, MS Fisheries Science
Advisor: Amanda Rosenberger
Funding Agency: Anchorage Field Office, USFWS (RWO 174)
In-Kind Support: USFWS provided technical assistance and equipment

The upper Little Susitna River provides habitat for Pacific salmon runs faced with increased watershed development and fishing pressure. We lack a full understanding of juvenile rearing habitat and factors that limit Pacific salmon within the region. Conservation practices in the form of culvert pipe replacement are currently underway within the upper Little Susitna River watershed. These efforts are prioritized with little consideration to the capacity of these areas to bear and support salmon populations. My primary objective was to determine how habitat characteristics affected sampling efficiency of juvenile coho salmon and to validate low-effort backpack electrofisher sampling. We conducted closed population mark-recapture events as a baseline measure of fish abundance and detailed habitat measurements to determine how the efficiency of single-pass backpack electrofisher was influenced by stream habitat characteristics. We found that habitat characteristics had no measurable effect on sampling efficiency along the range of conditions within these headwater systems. Single-pass catch of mark-recapture reaches explained 94.8% of the observed variation within predictive models of abundance estimates. Absolute errors of abundance estimates based upon single-pass catch numbers were off on average by 110 fish, whereas relative errors of predicted abundance estimates were off by an absolute percentage of 24%. Results from this project will allow for a more strategic management of these populations, helping managers improve accuracy and establish reliable and unbiased population estimates. In turn, these estimates may be coupled with detailed measures of habitat to help prioritize replacement of culvert pipes within systems throughout the region.

Winter Movement Patterns and Habitat Use of Kotzebue Region Inconnu

Student Investigator: Nicholas Smith, MS Fisheries
Advisor: Trent Sutton
Funding Agency: Office of Subsistence Management, USFWS (RWO 177)
In-Kind Support: Field camp logistics and equipment during field season provided by Fairbanks Fish and Wildlife Field Office and Selawik National Wildlife Refuge, USFWS; Equipment during field season provided by ADFG

Inconnu of the Selawik and Kobuk River drainages are considered separate stocks. However, the two stocks overwinter as a mixed stock within Hotham Inlet and Selawik Lake, and to date no evaluation of inconnu migration and distribution during the wintering period relative to physico-chemical attributes within these drainages has been conducted. Inconnu provide an important subsistence food resource for this region of Alaska. To effectively manage the inconnu of this region, winter movement and habitat use need to be identified. The primary objectives of this study are to examine the distribution patterns of inconnu in the Selawik and Kobuk River drainages during the wintering period and determine whether water depth, temperature, or salinity influence winter habitat selection. These objectives were accomplished using acoustically tagged inconnu and automated submersible receivers affixed with archival tags. Preliminary results indicate that Selawik and Kobuk River inconnu display a high degree of spatial overlap during the wintering period, and therefore exhibit similar patterns of water depth, temperature, and salinity use. These data will allow managers to determine the appropriateness of winter stock-specific harvest guidelines in the region.

Factors Influencing Chinook Salmon Spawning Distribution in the Togiak River, Alaska

Student Investigator: Stephanie Meggers, MS Fisheries
Co-Advisors: Andrew Seitz and Anupma Prakash
Funding Agency: Office of Subsistence Management, USFWS (RWO 191)
In-Kind Support: Anchorage Fish and Wildlife Field Office and Togiak National Wildlife Refuge

Chinook salmon populations are declining in the Togiak River, but the reasons for the decline are currently unknown. However, traditional ecological knowledge indicates that the spawning distribution of Chinook salmon has shifted from tributaries to the mainstem, with significantly more Chinook salmon spawning in the mainstem than in tributaries. I will attempt to describe physical factors influencing Chinook salmon spawning habitat availability and distribution that may influence overall abundance. The objective of this project is to describe habitat characteristics associated with Chinook salmon spawning using digital optical and FLIR imagery collected over the Togiak River. I will use radiotelemetry data in a GIS framework to determine areas of high- and low-density Chinook salmon spawning areas. Next, remote sensing imagery collected over mainstem and tributary areas will be analyzed to describe and compare the physical habitat characteristics of high- and low-density spawning areas. Areas with a low density of Chinook salmon spawning activity will have different habitat characteristics than areas with a high density of spawning activity. Information from this project will aid in understanding habitat characteristics important for Chinook salmon spawning that can be derived from remote sensing imagery, which may provide an alternative method to ground-based studies.

Completed Wildlife Studies

No Unit-sponsored Biology and Wildlife Conservation candidates graduated in 2012.

Ongoing Wildlife Studies

Ecology of Shorebird Use of Mudflats on Major River Deltas of the Arctic National Wildlife Refuge, Alaska

Student Investigator: Roy Churchwell, PhD Biological Sciences
Advisor: Abby Powell
Funding Agencies: USFWS; U.S. Bureau of Ocean Energy Management (BOEM); USGS; and Arctic Landscape Conservation Cooperative (LCC)
In-kind Support: USFWS provided housing and logistical support

There is little knowledge of shorebird biology in the Arctic and what draws these birds to littoral delta mudflats during the post-breeding period; it is thought that food resources may influence shorebird use and distribution. The Arctic National Wildlife Refuge is investigating these questions to manage and preserve shorebird species and habitat along the refuge's coast. Potential impacts to the coast have developed through offshore oil development and climate change. We will determine shorebird distribution in relation to invertebrate food resources spatially and temporally and investigate how resource differences among study sites influence length of stay and shorebird physiological parameters. We have completed four field seasons and collected roughly 1,600 invertebrate core samples, captured 240 semipalmated sandpipers, and completed 70 shorebird survey days. We found two groups of benthic invertebrates (freshwater and marine) with different life histories: freshwater invertebrates can withstand freezing and inhabit the mudflat year-around, while saltwater invertebrates are not freeze tolerant, migrate to the lagoon in the winter, and recolonize the mudflat each summer. Several shorebird populations using this habitat are declining, and some are listed as species of concern in the U.S. Shorebird Conservation Plan and by the U.S. Fish and Wildlife Service. This research will give insight into how climate change may influence shorebird habitat.

Spatiotemporal Distribution and Habitat Use of Non-Breeding Spectacled Eiders

Student Investigator: Matt Sexson, PhD Biological Sciences
Advisor: Abby Powell
Funding Agencies: BOEM; USGS; USFWS; BLM; National Fish and Wildlife Foundation (NWFW); North Pacific Research Board
In-kind Support: ConocoPhillips Alaska, Inc. provided field camp logistics and supplies; BLM provided field camp logistics and field work assistance; Columbus Zoo, OH, Mesker Park Zoo, IN, and Point Defiance Zoo, WA, provided veterinarians

Spectacled Eiders are sea ducks that spend 9 to 12 months of the year in Arctic and sub-Arctic seas along the coasts of Russia and Alaska. The species is listed as "threatened" under the U.S. Endangered Species Act. The species' circannual distribution and patterns of habitat use at sea are understudied. Information regarding the distribution and habitats used by Spectacled Eiders will help managers identify potential threats to the species away from breeding areas. This information is also needed to improve industrial development plans in the Chukchi and Beaufort seas, and to understand population level effects resulting from ecosystem changes. The primary objective of our study is to assess the distribution, migratory patterns, and habitat use of Spectacled Eiders at sea. We implanted satellite transmitters in Spectacled Eiders to collect location data from each individual over a 2-year period. Data were summarized to describe spatiotemporal patterns in distribution and migration. Data will also be incorporated into habitat use models and accompany a population genetics study. We marked 129 Spectacled Eiders at breeding sites in northern and western Alaska over 4 years (2008-2011). In spring and fall, eiders were located in distinct areas of the Bering, Chukchi, Beaufort, and East Siberian seas. In winter, all eiders used an area in the northern Bering Sea. Site fidelity among females was higher than males. Information regarding the spatiotemporal patterns of Spectacled Eiders at sea is valuable to conservation and recovery efforts. In addition, this information is necessary when planning the development of offshore natural resources in the Chukchi and Beaufort seas, mitigating for commercial and research vessel traffic in the Arctic, and understanding potential effects of changing prey regimes and habitat components such as sea ice.

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

Student Investigator: Christopher M. Harwood, MS Wildlife Biology
Advisor: Abby Powell
Funding Agency: Kanuti National Wildlife Refuge, USFWS; UA Foundation (Angus Gavin Bird Research); IAB Student Travel Award
In-Kind Support: Equipment used during field season provided by AKCFWRU

Studies of Whimbrel breeding ecology are limited in North America, despite suspected population declines and an official designation as a species of conservation concern in both the U.S. and Canada, as well as Alaska specifically. The ecology and distribution of the species in interior Alaska have been particularly understudied. This research addresses critical information gaps identified in conservation status reviews of Whimbrels including breeding distribution, habitat associations, and factors affecting breeding success. Our first objective was to establish benchmark metrics on the breeding ecology of a local population of Whimbrels at Kanuti National Wildlife Refuge (NWR) in north-central Alaska for 2011–2012. Additionally, we will identify potential breeding locations for the entire Interior of Alaska in spring 2013. We collected information on timing, breeding success, habitat associations, and the factors affecting these attributes, during two summers of intensive field research. We are now using known breeding season locations within a GIS-based spatial analysis to identify and predict breeding sites elsewhere in the Interior. We will conduct surveys of these areas to determine presence and absence, with further refinement of the spatial model following the spring inventory.

The Kanuti NWR Whimbrel population has shown annual variability in both breeding propensity and success. Identification of a second, disjunct local population there suggests a species with a patchy distribution and a metapopulation structure in the Interior. An investigation into known breeding locations Interior-wide has revealed generally clustered, albeit few, observations. Migratory birds like the Whimbrel are officially regarded as "trust species" of the USFWS and thus must be managed as such both locally on Kanuti NWR and regionally in Alaska. This research addresses information gaps about the species at both spatial scales.

Breeding Ecology of Two Sympatric Shorebirds in the Alaskan Arctic

Student Investigator: Kelly Overduijn, MS Wildlife Conservation
Advisor: Abby Powell
Funding Agency: Alaska Science Center, USGS (RWO 194)

There is growing concern about the impacts of climate change on the breeding ecology of arctic shorebirds. Possible impacts include potential shifts in the timing and abundance of food resources such as invertebrates and berries, and habitat changes related to increased shrub cover. American Golden-Plovers and Pacific Golden-Plovers are two closely related species that breed sympatrically on Alaska's Seward Peninsula, but differ in phenology and use different nesting microhabitats along an elevational gradient. Habitat change can alter the abundance and type of food resources that are available to shorebirds and change the quantity and quality of potential nesting and brood-rearing areas. This work will contribute to understanding habitat needs of these two species, thus aiding in the development of conservation plans for shorebirds. The overall objective of this study is to examine the breeding ecology of American and Pacific Golden-Plovers relative to phenology, food resources, and habitat use. We will locate nests, monitor reproductive success, document chick growth, classify habitat in brood-rearing areas, and collect invertebrates throughout the brood-rearing period. A pilot season was conducted in 2012 to determine the feasibility of this study, and plans are underway for collecting data in 2013 and 2014. This research will elucidate the effects of shrub increase on shorebird habitat use and implications for reproductive success as well as the effects of seasonal phenology changes on shorebird breeding ecology.

Infection Rates, Parasitemia Levels, and Genetic Diversity of Hematozoa in New World Waterfowl

Student Investigator: Matthew Smith, MS Wildlife Biology and Conservation
Advisor: Kevin McCracken
Funding Agency: Alaska Science Center, USGS (RWO 199)

Blood parasite infections have been documented in numerous species of migratory waterfowl. High rates of these hematozoa infections can have adverse fitness effects on an avian population. With the advent of rising global temperatures, it is expected that these vector-born illnesses will increase in both prevalence and distribution. Because waterfowl are migratory and inhabit a broad range of habitat types, they are an ideal study species for the examination of hematozoa infection rates. Investigation into prevalence rates and genetic distribution of these infections will provide additional insight toward the adverse effects on the health of a population. The objectives of this study are to investigate the prevalence rate and genetic diversity of South American waterfowl, as well as develop and optimize molecular methodology for quantifying relative parasitemia rates for hematozoa infections. A total of 813 blood samples were collected from South American waterfowl between

2010 and 2012. We are currently using genetic techniques to screen these samples for infection of three separate genera of blood parasites. The development of methodology for quantifying relative parasitemia rates will be accomplished through a combination of qPCR techniques and microscopic examination of blood smears from samples that are to be collected in fall 2013. We expect results from this study to be environmentally dependent. Samples collected from habitat less suitable for insect vectors are likely to show a lower prevalence rate for all genera of parasites. We also hope to identify any species-specific or geographically dependent patterns. The results of this study will provide information toward investigation of adverse fitness effects of blood parasite infections.

Protein Availability for Caribou in the Summer Ranges of the Central Arctic and Teshekpuk Herds

Student Investigator: Lindsay VanSomeren, MS Wildlife Biology and Conservation
Advisor: Perry S. Barboza
Funding Agency: Alaska Science Center, USGS
In-Kind Support: ADFG, BLM

Caribou migrate from dry upland habitats to coastal wetlands of the North Slope of Alaska each summer and encounter a wide range of forage abundance and quality. Caribou must produce milk and gain body protein and fat through summer for both reproduction and survival over winter. Although several studies have described forage quality on calving grounds, we do not have enough data on both forage biomass and forage quality to assess the food available to these herds or to predict changes in food for continued production of these herds. The objective of this study is to quantify the amount of digestible protein available for the Central Arctic and Teshekpuk Lake herds at two scales: (1) across the summer range, and (2) over the course of a season in up to 3 consecutive years (2011–2013). We measured biomass and collected seven species of forage for analyses of protein and compounds that reduce protein availability (phenols and tannins). We developed an in vitro method to analyze forages for digestibility that was validated against measures of digestibility in captive animals. Sedges were more abundant than forbs but typically lower in protein (11 – 21% vs. 16 – 28%) and less digestible (37 – 45% vs. 79 –100%) early in the summer. Early season willows were highly digestible (60 – 79%) and typically had a high protein content (16 – 26%). We can use these data to assess the potential effects of habitat change on productivity of caribou herds, especially in light of a changing climate.

Completed Ecological Studies

Partitioning of Soil Respiration along Moisture Gradients in Alaskan Landscapes

Student Investigator: Nicole McConnell, MS Biology
Advisor: A. David McGuire
Funding Agency: Geologic Division, USGS (RWO 178)

Permafrost and thick organic soil layers are common to most wetlands in interior Alaska, where wetlands regionally have functioned as important long-term soil carbon sinks. Boreal wetlands are diverse in both vegetation and nutrient cycling characteristics, which together serve as important controls on carbon cycling. Graduate student Nicole McConnell analyzed 5 years of growing season soil CO_2 fluxes along a gradient of vegetation and permafrost extent in a boreal wetland complex. In general, the communities underlain by surface permafrost had colder and drier surface soils and also tended to have lower ecosystem respiration (ER) relative to communities without surface permafrost. While there were few relationships between soil temperature, water table position, and thaw depth on instantaneous ER within communities, mean monthly ER increased exponentially with surface soil temperature across all communities except the rich fen, where ER had low temperature sensitivity. Across the gradient, the highest and lowest ER were observed at two adjacent fens with different hydrology that both had relatively warm and wet surface soils. Nicole determined that root respiration contributed ~40% to ER at both of these fens. Despite similar levels of aboveground and belowground plant biomass, ER in the sedge/forb fen appeared to be more sensitive to variation in vascular green area, while ER in the rich fen was more sensitive to root biomass. The results of this study suggest that direct measures of soil redox status, nutrient availability, and CO_2 fluxes in different plant tissues would provide a better understanding of variation in ecosystem CO_2 fluxes from northern wetlands.

Soil Climate and Its Control on Wetland Carbon Balance in Interior Boreal Alaska: Experimental Manipulation of Thermal and Moisture Regimes

Postdoctoral Researcher: Zhaosheng Fan
Faculty: A. David McGuire
Funding Agency: National Science Foundation

It is important to understand the fate of carbon in boreal peatland soils in response to climate change because a substantial change in release of this carbon as CO_2 and CH_4 could influence the climate system. Postdoctoral researcher Dr. Zhaosheng Fan synthesized the results of a field water table manipulation experiment conducted in a boreal rich fen into a process-based model to understand how soil organic carbon (SOC) of the rich fen might respond to projected climate change. This model, the peatland version of the dynamic organic soil Terrestrial Ecosystem Model (peatland DOS-TEM), was calibrated with data collected during 2005–2011 from the control treatment of a boreal rich fen in the Alaska Peatland Experiment (APEX). The performance of the model was validated with the experimental data measured from the raised and lowered water-table treatments of APEX during the same period. The model was then applied to simulate future SOC dynamics of the rich fen control site under various CO_2 emission scenarios. The results across these emissions scenarios suggest that the rate of SOC sequestration in the rich fen will increase between year 2012 and 2061 because the effects of warming increase heterotrophic respiration less than they increase carbon inputs via production. However, after 2061 the rate of SOC sequestration will be weakened and, as a result, the rich fen will likely become a carbon source to the atmosphere between 2062 and 2099. During this period, the effects of projected warming increase respiration so that it is greater than carbon inputs via production. Although changes in precipitation alone had relatively little effect on the dynamics of SOC, changes in precipitation did interact with warming to influence SOC dynamics for some climate scenarios.

A Total Environment of Change: Exploring Social-Ecological Shifts in Subsistence Fisheries in Noatak and Selawik, Alaska

Student Investigator: Katie Moerlein, MS Fisheries
Advisor: Courtney Carothers
Funding Agency: Office of Subsistence Management, USFWS (RWO 182)

Note: Katie Moerlein graduated from the University of Alaska Fairbanks in May 2012. Her thesis abstract follows:

Arctic ecosystems are undergoing rapid changes as a result of global climate change, with significant implications for the livelihoods of Arctic peoples. In this thesis, I use ethnographic research methods to detail prominent environmental changes observed and experienced over the past few decades and to document the impact of these changes on subsistence fishing practices in the Iñupiaq communities of Noatak and Selawik in northwestern Alaska. Using in-depth key informant interviews, participant observation, and cultural consensus analysis, I explore local knowledge and perceptions of climate change and other pronounced changes facing the communities of Noatak and Selawik. I find consistent agreement about a range of perceived environmental changes affecting subsistence fisheries in this region, including lower river water levels, decreasing abundances of particular fish species, increasingly unpredictable weather conditions, and increasing presence of beaver, which affect local waterways and fisheries. These observations of environmental changes are not perceived as isolated phenomena, but are experienced in the context of accompanying social changes that are continually reshaping rural Alaska communities and subsistence economies. Consequently, in order to properly assess and understand the impacts of climate change on the subsistence practices in Arctic communities, we must also consider the total environment of change that is dramatically shaping the relationship between people, communities, and their surrounding environments.

Ongoing Ecological Studies

Identifying Indicators of State Change and Forecasting Future Vulnerability in Alaskan Boreal Ecosystems

Postdoctoral Researcher: Héléne Genet
Faculty: A. David McGuire
Funding Agency: Department of Defense (DoD)

This study is designed to understand the mechanistic connections among vegetation, the organic soil layer, and permafrost ground stability in Alaskan boreal ecosystems. Permafrost is a major control over the structure and function of boreal ecosystems, and the soil organic layer mediates the effects of a changing climate on the ground thermal regime and permafrost stability. Understanding the links between vegetation, organic soil, and permafrost is critical for projecting the impact of climate change on permafrost in ecosystems that are subject to abrupt anthropogenic and natural disturbances (fire) to the organic layer. This study will combine field measurements (Objective 1) with models (Objective 2) to detect and predict state changes in boreal ecosystems of Interior Alaska in response to changing climate and land management. Objective 1, which is being led by the University of Florida, is to determine mechanistic links among fire, soils, permafrost, and vegetation succession in order to develop and test field-based ecosystem indicators that can be used to directly predict ecosystem vulnerability to state change. Activities to develop these indicators include (a) monitoring vegetation recolonization, soils, and permafrost on a previously existing network of sites located in recent, severe wildfires adjacent to, and on, Department of Defense (DoD) lands in Interior Alaska; (b) extending this network to include parallel measurements from sites located in recent prescribed fires and fuel treatments on DoD lands; and (c) conducting studies of vegetation stand history and organic layer re-accumulation on an established network of mid-successional boreal ecosystems adjacent to, and on, DoD lands in Interior Alaska. Objective 2, which is being led by the University of Alaska Fairbanks, is to forecast landscape change in response to projected changes in climate, fire regime, and fire management. We will conduct four activities to be able to accurately forecast how fire regime and fire management will interact with climate change to shape the future structure, function, and distribution of Alaskan boreal ecosystems on DoD and surrounding lands. These activities include (a) incorporating field data sets on vegetation, soils, and permafrost into a model of landscape fire dynamics and into a model of ecosystem structure and function; (b) coupling these two stand-alone models so that the influence of a changing climate on permafrost and vegetation can be assessed together with natural and managed changes in the fire regime; (c) evaluating the performance of the coupled model using retrospective statistical datasets of past fire regime and forest structure in Interior Alaska; and (d) projecting future landscape distribution of vegetation and permafrost using the coupled model in combination with different scenarios of climate change, fire regime, and fire management. The University of Florida conducted field research in support of objective 1 during summers 2011 and 2012. Dr. Héléne Genet, who is a postdoctoral researcher at the University of Alaska Fairbanks, is responsible for the further development and application of the model of ecosystem structure and function in the project. During the past year Dr. Genet has focused on improving the spatial and temporal resolution of fire severity on soil organic horizons and to evaluate its long-term consequences on forest composition in Interior Alaska. Existing field observations were analyzed to build a predictive model of the depth of burning of soil organic horizon after a fire. The model includes descriptors of fire, climate, and topography characteristics.

Research Coordination Network: Vulnerability of Permafrost Carbon

Postdoctoral Researcher: Yujin Zhang
Faculty: A. David McGuire
Funding Agency: National Science Foundation

The objective of the Vulnerability of Permafrost Carbon Research Coordination Network (RCN) is to link biological C cycle research with well-developed networks in the physical sciences focused on the thermal state of permafrost. This interconnection will produce new knowledge through research synthesis that can be used to quantify the role of permafrost C in driving climate change in the 21^{st} century and beyond. This will be achieved by synthesizing information in a format that can be assimilated by biospheric and climate models, and that will be contributed to future assessments of the Intergovernmental Panel on Climate Change (IPCC). Our proposed activities to reach this goal are (1) organization of an interrelated sequence of meetings and working groups designed to synthesize existing permafrost C research, and (2) formation of a consortium of interconnected researchers to disseminate synthesis results about permafrost C to other scientific networks and activities. These two research coordination activities are aimed at developing and disseminating algorithms that encapsulate the new process knowledge and datasets in support of model development. The second year of this project has produced significant advancements in both of these areas. The initial workshop that we held in Year 1 was followed by a second workshop in Year 2 held in conjunction with the American Geophysical Union (AGU) meeting in San Francisco, CA. Here, over 50 participants from a range of institutions and career levels met for a full day to discuss issues surrounding the magnitude, timing, and form of carbon loss from permafrost to the atmosphere in a warmer world. This workshop was held the day before the official start of AGU, and so we were able to capitalize on travel funds that were already being used to attend the AGU meeting. This meeting brought in a number of new participants into the network; we essentially doubled the size of the network from the initial attendance at the first workshop. Working group leads gave presentations about the synthesis databases that were in progress as a result of the Seattle meeting in Year 1. A third workshop was held at the end of Year 2 in Tampa, Florida. This workshop consisted of the steering committee plus the leads and co-leads of each working group. The purpose of the meeting of the leadership was to present draft products from each of the working groups and to think about future cross-group synthesis opportunities. Three of the five working groups had draft manuscripts and databases to present, including the Carbon Quantity, and Carbon Quality, and An/aerobic working groups. The Thermokarst and the Modeling working groups presented current progress on database synthesis and protocol development. The second activity of the workshop was to solicit and prioritize synthesis products that would be conducted by members of the network over the course of the 4-year RCN project. This activity was achieved with a combination of overview presentations by product lead/co-leads followed by discussions to identify cross-group synthesis potential and remaining gaps. These discussions will be summarized in a workshop report and used to update the product scoping papers that were an outcome of the initial RCN meeting in Year 1. Scaling was an issue identified by multiple working groups and will likely be a theme carried into future RCN meetings. Finally we also discussed important themes of communicating within and outside the network in order to more efficiently keep members informed and able to input ideas.

Development and Application of an Integrated Ecosystem Model for Alaska

Postdoctoral Researchers: Amy Breen, Héléne Genet, Reginald Muskett, and Yujin Zhang
Student Investigators: Tobey Carman (MS Computer Science) and Elchin Javarov (PhD Geophysics)
Faculty: A. David McGuire, T. Scott Rupp, Vladimir Romanovsky, Eugénie Euskirchen, and Sergey Marchenko
Funding Agencies: USGS and USFWS (RWO 190)

Our primary goal in this project is to develop a modeling framework that integrates the driving components for and the interactions among disturbance regimes, permafrost dynamics, hydrology, and vegetation succession/migration for the state of Alaska. This framework will couple (1) a model of disturbance dynamics and species establishment (the Alaska Frame-Based Ecosystem Code, ALFRESCO); (2) a model of soil dynamics, hydrology, vegetation succession, and ecosystem biogeochemistry (the dynamic organic soil/dynamic vegetation model version of the Terrestrial Ecosystem Model, TEM), and (3) a model of permafrost dynamics (the Geophysical Institute Permafrost Lab model, GIPL). Together, these three models comprise the Integrated Ecosystem Model (IEM) for Alaska and Northwest Canada. The IEM provides an integrated framework to provide natural resource managers and decision makers an improved understanding of the potential response of ecosystems due to a changing climate and to provide more accurate projections of key ecological variables of interest (e.g., wildlife habitat conditions). In this study our objectives are to (1) synchronously couple the models, (2) develop data sets for Alaska and adjacent areas of Canada, also known as the Western Arctic, and (3) phase in additional capabilities that are necessary to address effects of climate change on landscape structure and function. During the past year we have made progress on the development of data sets to drive the IEM, the coupling of the three component models, modeling the dynamics of tundra ecosystems, and the development of conceptual framework for modeling thermokarst disturbance. The data set development sub-group achieved several goals including defining the bounds of the study, taking an inventory of candidate data sets to use, outlining several long-term strategies, and creating the initial set of inputs for the coupled model. After completion of requirements gathering and model analysis, the model coupling sub-group settled on a coupling design that allowed each submodel to be maintained independently by each modeling group, with minimal changes to individual code sets. A number of changes have been made to each submodel to allow the models to work as coherently within a common application framework, in order to standardize interaction between the models. The overall goal of the treeline and tundra fire sub-group was to improve the ability to forecast changes in landscape structure and function through incorporating treeline and tundra fire dynamics into ALFRESCO and TEM. Both shrub and graminoid tundra were included as vegetation types in ALFRESCO, with transitions occurring between the vegetation types due to fire, succession, or tree colonization and establishment. The TEM has been parameterized and calibrated for shrub, wet sedge, heath, and graminoid tundra types. The thermokarst/wetland subgroup has developed a conceptual framework for the Alaska Thermokarst Model, which will be developed over the next year.

Collaborative Research on Characterizing Post-Fire Successional Trajectories in Tundra Ecosystems

Postdoctoral Researcher: Amy Breen
Principal Investigator: Scott Rupp
Co-Principal Investigator: Teresa Hollingsworth
Funding Agency: Alaska Science Center, USGS (RWO 195)
In-Kind Support: Housing while in the field in Kotzebue, AK, provided by BLM and NPS


Changes in fire regime are predicted to increase the extent and frequency of wildfires through the tundra region of Alaska in the coming century, yet the implication and consequences are poorly understood. As tundra fires become more frequent, accurate prediction of post-fire successional trajectories is critical due to impacts on wildlife habitat, permafrost degradation, carbon release, and range expansion of species from the neighboring boreal forest. Our study area is the Seward Peninsula and our objectives are to determine (1) if particular tundra vegetation communities are more prone to fire, (2) potential future scenarios for tundra fire and vegetation dynamics, and (3) how various tundra vegetation respond and accumulate fuel over time post-fire. This work is being accomplished via spatial analyses using GIS layers and remote sensing imagery, a retrospective time series analysis of historical fire regime, modeling, and fieldwork to quantify post-fire plant communities and fuel accumulation. Preliminary model simulations show warming causes an increase in the total area burned per decade, leading to conversion of graminoid tundra to shrub tundra and modest expansion of forest into previously treeless tundra through the 21st century. We are currently analyzing field data from 2012 and anticipate this work will be complete by fall 2013. This work will develop a conceptual modeling framework that integrates wildfire disturbance, vegetation succession and climate dynamics in tundra ecosystems in Western Alaska to inform land mangers of the implications of a changing fire regime.

Multi-Satellite and Ground-Based Assessments of Water Equivalent Mass Changes on the High-Latitude Northern Hemisphere

Postdoctoral Researcher: Reginald R. Muskett
Faculty: Vladimir E. Romanovsky
Funding Agencies: Arctic and Western Alaska LCC; NSF; and Alaska Climate Science Center, USGS, to Vladimir E. Romanovsky (RWO 190)

Geophysical measurements indicate physical changes occurring within the permafrost zones. Using ground-based and satellite-based geodetic measurements we are assessing the elements of water equivalent mass changes. Water equivalent mass (WEM) change is the cumulative sum of surface (including changes of snow water equivalent mass, discharge, and lake storage), and groundwater after removal of the atmospheric water equivalent mass and solid body mass changes. We utilize the Gravity Recovery and Climate Experiment (GRACE, satellites) and Global Positioning System (ground-based network) relative to the International Terrestrial Reference Frame. We quantify WEM changes and their relationship to permafrost thawing and degradation parallel with climate forcing and uncertainties. We apply methods of satellite geodesy and inverse theory and data spanning the satellite-information era. Our results are published in peer-reviewed journals and proceedings (*Note:* See Scientific Publications section of this report). Our results are useful for impact assessments of permafrost and climate changes on ecosystems, landscapes, and human infrastructures.

Evaluating Moose (*Alces alces gigas)* Browse and Habitat Resources and Resource Use in Response to Fire Dynamics on the Kanuti National Wildlife Refuge, Alaska

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

Evidence suggests that fire regimes in Interior Alaska are changing as a result of changes in climate, and there is a need to understand how these changes will alter moose habitat resources and ultimately, moose populations. Much is known about moose ecology and their response to fire on a general level, but the specific ways in which moose use burns through time are not well studied. Moose have been identified as a priority management species because they are a vital subsistence resource for many communities in Interior Alaska, a primary food source for several apex predators, and are an important part of boreal forest ecology in North America. As the warming climate continues to alter the environment, particularly in northern latitudes, managers are faced with the challenge of achieving pre-existing management goals for moose. This requires adaptive management strategies that have been developed based on an improved understanding of environmental conditions, specifically wildland fire, and their effects on habitat. The goal of this project is to evaluate the effect of fire history, plant community composition, and landscape characteristics on moose over-winter habitat forage resources and determine forage use on the Kanuti National Wildlife Refuge (NWR) (Game Management Unit 24B), Alaska. We collected information on summer browse quality and quantity within burn scars of varying ages in August 2012. We visited 23 sites along the Kanuti River and will revisit these sites in March

2013 to determine winter browse use by moose in these strata. Results will include estimates of browse quantity per burn (reported as shrub density/ha) and quality per burn (evaluated by measuring %C and N). Additionally, we will determine browse use by moose as a percentage of the total browse biomass available per burn. We will integrate our findings with knowledge of subsistence resource demand and harvest for four communities adjacent to Kanuti NWR. The results of this study will be useful in guiding land management decisions related to moose management objectives on the Kanuti NWR as burn scars age and progress through post-fire vegetative succession.

Implications of Climate Change for Biodiversity in Yukon River Basin Wetlands: Yukon Flats National Wildlife Refuge as a Test Case

Postdoctoral Researcher: Jennifer Roach
Faculty: Brad Griffith
Funding Agencies: USFWS; USGS (RWO 172)

Recent studies have identified net regional-scale declines in lake area in the Arctic and sub-Arctic that have been coincident with climate warming. Lakes are important breeding grounds for global migratory waterfowl populations, and the effect of lake area decline on avian species biodiversity, habitat, and aquatic food sources is unknown. The objectives of this study are to (1) build spatially explicit models of lake-specific biodiversity of four major taxa (birds, small mammals, vegetation, and aquatic invertebrates) based on broadly mapped landscape characteristics such as lake size, elevation, distance to rivers, land cover type, and surrounding habitat matrix, and (2) use these models to spatially and temporally project changes in biodiversity as a result of climate-induced changes in lake size, and (3) identify field-measured characteristics such as water chemistry and lake bathymetry that explain the residuals from these predictive models. Models will be built using estimates of avian, invertebrate, small mammal and vegetation biodiversity along with a suite of potential explanatory variables from a randomly spatially distributed sample of ~120 lakes in the Yukon Flats National Wildlife Refuge. Data collection is complete and waterfowl richness data analysis is in progress. Preliminary results suggest that lake waterfowl species richness is positively related to lake size, proportion of wetland vegetation surrounding the lake perimeter, proximity to rivers, and maximum lake size within 5 km. This information will provide land managers with spatially explicit projections of climate-induced changes on species biodiversity and will enable land managers to target specific habitats and species in conservation efforts.

Modeling Interactions between Climate Change, Lake Change, and Boreal Ecosystem Dynamics in the Yukon Flats National Wildlife Refuge

Student Investigator: Vijay Patil, PhD Biological Sciences
Co-Advisors: Brad Griffith and Eugénie Euskirchen
Funding Agency: USGS (RWO 172)

Interior Alaskan boreal lakes have been decreasing in size and abundance, which could act as an important climate feedback by altering rates of carbon sequestration and respiration. Lake drying could also affect plant community structure and biodiversity via altered successional pathways. However, small Alaskan lakes are subject to many other forms of disturbance such as spring flooding, which can obscure the ecological significance of lake drying. Our objective is to estimate the influence of drying and flooding regimes on terrestrial ecosystem dynamics in the Yukon Flats National Wildlife Refuge. We will meet this objective using a combination of remote sensing, field surveys, and modeling exercises. Between 2010 and 2012, we surveyed vegetation at 130 lakes. We also sampled aboveground net primary productivity (ANPP) and soil characteristics (moisture, carbon, and nitrogen) at a subset of 16 lakes. Two-thirds of soil and productivity samples have been analyzed, and results were presented at the 2012 American Geophysical Union meeting. Increasing lakes had the highest ANPP but the lowest pH levels, while flooding lakes had reduced shrub biomass and soil nitrate availability relative to other sites. Peat depth was not influenced by lake history. These findings are helping us to incorporate the effects of lake history into a process-based model that will be used to simulate the carbon dynamics of Alaskan peatlands in a changing climate. We are also using our survey data to inform models of current and future spatial patterns of vegetation in highly valuable habitats for waterfowl and other wildlife.

Changing Habitat and Seasonality in Arctic Alaska and Impacts to Migrating Caribou and Birds

Postdoctoral Researcher: Ken Tape
Faculty: Roger Ruess
Funding Agency: Alaska Science Center, USGS (RWO 196)

Warming in Arctic Alaska has led to accelerated coastal erosion and earlier seasonal disappearance of snow, among other things. There is a need to understand these changes and their effects on caribou and migratory birds so that land managers can better understand and predict the impacts of ongoing changes on those animals. Caribou and geese are integral subsistence and personal use resources. Monitoring and preservation of their habitat is therefore critical to maintaining the resource. Our primary objective is to inventory, provide, and interpret paired old and new imagery for several USGS groups studying birds and caribou in Arctic Alaska, and to use that data to identify landscape change. We are also exploring changes in seasonality and relating that to timing of animal migration. Scanning, georeferencing, and comparing time series of imagery revealed changes in goose habitat during the 20th century. We augmented the imagery with fieldwork specifying the nature of changes underway. I also developed a record of snowmelt timing from 1971–2010 using the Kuparuk River discharge records and a satellite snow-free index. I also deployed time-lapse cameras to monitor caribou and ptarmigan migrations in relation to spring snow cover. Results from repeat imagery and fieldwork indicate that coastal and near-coastal areas of the TLSA (Teshekpuk Lake Special Area) became inundated between 1960 and 1990, which triggered sedimentation and formation of salt marshes currently being exploited by Brant geese. Results from other projects established significant linkages between the timing of snow disappearance and arrival of avian migrants. The camera deployment yielded a novel method for quantifying caribou and ptarmigan migration timing and (forthcoming) correlations with snow cover. These data will help managers understand how migrants are responding to a variety of landscape changes associated with climate warming.

Investigating Recent Change in Habitat and Avian Communities at Creamer's Refuge, Fairbanks, AK

Student Investigator: Lila Tauzer, MS Biology and Wildlife Conservation
Advisor: Abby Powell
Funding Agencies: Alaska Space Grant, NASA; Angus Gavin Memorial Bird Research Grant, UAF; IAB Summer Fellowship; AKCFWRU, Calvin J. Lensink Graduate Fellowship
In-Kind Support: Alaska Bird Observatory

Changes in vegetation and birds have been documented worldwide and correlated with recent warming trends. Little baseline data exists in Alaska where change is predicted to be the most drastic. Our understanding of the extent and consequences of ecosystem change in boreal forest is insufficient. Land stewards are finding it increasingly difficult to effectively manage with the limited data available. My specific objectives were twofold: (1) to quantify habitat change in the last 35 years at Creamer's Refuge, and (2) to relate these finding to changes observed in the local avian community. First, I quantified change in vegetation structure using remote-sensing data and archived field data from the 1970's. Second, I assessed the simultaneous habitat-specific change in avian communities. Marked changes in both vegetation and birds have occurred during the last 35 years. While direction and magnitude of this change varied with habitat type, there has been an overall decrease in shrub habitat and increase in forest. Change in bird abundances reflected this successional shift and additionally suggest a drying trend. This study gives an indication of the spatial and temporal scale needed to accurately document environmental change in a boreal wetland ecosystem. Information gathered provides habitat-specific information about local ecosystem changes and about avian response to successional change.

Ecosystem Change in Boreal Wetlands and Its Relation to Wetland Associated Bird Communities

Student Investigator: Tyler Lewis, PhD Wildlife Biology
Co-Advisors: Mark Lindberg and Joel Schmutz
Funding Agencies: Yukon Flats National Wildlife Refuge, USFWS; and USGS (RWO 175)

Recent research has indicated a drying of boreal wetlands in response to climate warming, potentially altering the basic ecosystem structure of these wetlands. On the Yukon Flats, in eastern Interior Alaska, surface water area of wetlands was estimated to have decreased by 18% from 1952–2000. The Yukon Flats is one of the largest waterbird breeding grounds in North America, producing approximately 1.6 million ducks, geese, and swans annually. For our proposed research, we will compare existing data from the 1980s on water chemistry, invertebrate abundance, and waterbird distributions of boreal wetlands with contemporarily collected data, providing a unique opportunity to understand long-term ecosystem change associated with wetland drying. We will (1) document potential changes in water chemistry and aquatic invertebrate communities in response to drying of boreal wetlands, and (2) relate these changes to waterbird distribution and productivity, providing a crucial understanding of effects of boreal wetland change on continentally important waterbird populations. While we have no results to date, we expect redistributions of waterbirds to be positively related to increased nutrient and invertebrate levels in wetlands. Results from this research will provide a 2- to

3-decade perspective on boreal wetland change, providing a valuable perspective to the Yukon Flats National Wildlife Refuge for anticipating how much climate-driven ecological change to expect in their refuge over the next 20, 30, or 50 years.

Comparative Ecology of Loons Nesting Sympatrically on the Arctic Coastal Plain, Alaska

Student Investigator: Daniel Rizzolo, PhD Biological Sciences
Advisor: Mark Lindberg
Funding Agencies: US Bureau of Ocean Energy Management (BOEM); USGS (RWO 193)

Red-throated Loons are listed as a Bird of Conservation Concern by the USFWS due to a 53% population decline in Alaska that started in the late 1970s and continued into the early 2000s. The dependence of breeding red-throated loons on marine forage fish distinguishes them from Pacific loons, which use similar nesting habitat but forage primarily in their breeding lakes. Thus, like true seabirds, red-throated loon populations likely respond to changes in the marine environment, and a connection between their population dynamics and changes in populations of prey fish species has been hypothesized. We are using biochemical methods (C and N stable isotope ratios in blood, and fatty acid composition of adipose tissue) to characterize diet in red-throated and Pacific loons nesting on the Chukchi Sea coast. Differences in diet composition between these species are relevant to understanding how their contrasting use of the marine environment during breeding may contribute to their divergent population trends. To determine the potential fitness costs of variation in diet composition, we are examining associations between diet, adult condition, and productivity. These data will improve our understanding of red-throated loon population dynamics and aid in understanding how these species may be affected by changes in prey resources associated with climate change, fisheries activities, and offshore oil and gas development in the Arctic.

Estimating Effects of Climate on Settlement Patterns of Breeding Waterfowl in the U.S. and Canada

Postdoctoral Researcher: Mark W. Miller
Co-Principal Investigators: Mark Lindberg and Joel Schmutz
Funding Agency: USGS (RWO 192)

Climate is a major factor affecting the distributions of species and biomes. The global mean surface temperature increased by 0.74°C ± 0.18°C from 1906–2005, and by almost twice that amount over the latter 50 years. This temperature increase has been most pronounced in northern latitudes. Additional warming of up to 4°C over the next 100 years is predicted by some climate change models for the Prairie-Parkland Region (Johnson et al. 2010), the primary waterfowl production area of Canada and the United States. Such an increase could reduce the mid-continent breeding duck population by >70% even with a concomitant 15% increase in precipitation. Managing the continental duck population in the face of drastic climate change requires understanding how waterfowl have responded to historical spatio-temporal climatic variation. Our objective is to estimate effects of climate on the spring distribution or settlement patterns of breeding duck species in the Prairie-Parkland Region, Boreal Forest, and tundra of the United States and Canada, while accounting for potential confounding effects of variation in major land cover types. We are using Waterfowl Breeding Population and Habitat Survey data for the period 1958–2012. This survey, conducted annually by the Division of Migratory Bird Management of the U.S. Fish and Wildlife Service (USFWS) and the Canada Wildlife Service, samples 5 million square kilometers and covers prairies, parklands, boreal forest, and coastal habitats. We are relating annual counts of 17 duck species or species groups to annual temperature and precipitation throughout the study area, as well as to regional crop acreage, pond abundance and forest fires via multi-season occupancy models. Preliminary results focusing on temperature and precipitation indicate that occupancy of northern shovelers (*Anas clypeata*) in the Dakotas is inversely related to occupancy in the boreal forest. This inverse relationship may be driven by temperature. Occupancy in the Dakotas decreases and occupancy in the boreal forest increases with increasing winter temperature. The current best canvasback model also includes temperature and precipitation covariates. Models for other species and models containing other covariates are being generated. We anticipate that our results could affect monitoring design and the adaptive harvest management (AHM) process in several ways. One outcome may be a recommendation to eliminate some survey segments or strata or add in new ones. A second possibility is that the underlying demographic model structures that drive the adaptive management decision models may need to be modified to include progressive environmental change that is ultimately driven by climate. Our results and how they will impact future surveys and AHM will be presented both in publications and in meetings, including presentations at conferences, flyway meetings, and other appropriate venues. We will work closely through all phases of this project with USFWS colleagues.

Effects of Changing Habitat and Climate on Sitka Black-tailed Deer Population Dynamics on Prince of Wales Island, Alaska

Student Investigator: Sophie Gilbert, PhD Biological Sciences
Advisor: Kris Hundertmark
Funding Agencies: Division of Wildlife Conservation, ADFG; Tongass National Forest, USDA Forest Service; NSF
In-Kind Support: Assistance from ADFG personnel and US Forest Service personnel; ADFG provided equipment and vehicles during field season

Sitka black-tailed deer are a key subsistence resource in many areas of southeast Alaska, as well as a highly influential herbivore in the forest ecosystem. Currently, we lack a detailed understanding of how expected changes to habitat and climate will affect deer populations, and perhaps the least understood but most variable vital rate for deer populations is recruitment. Prince of Wales Island is one of the most heavily timber-harvested areas in Southeast Alaska; the ongoing successional changes to logged habitat will have unknown consequences for the deer population and the forest ecosystem, and for subsistence harvest. Our primary goals are to understand the effect of habitat and the interaction between habitat and weather, on deer reproduction and survival, and to identify specific causes of deer mortality. This has been accomplished by GPS-collaring adult does, radiocollaring offspring, monitoring survival, and monitoring weather and snowfall. This project will complete the final year of field data collection (3 years total) in early spring 2013. Data collection and analysis are ongoing. Fawn survival rates were 54%, 16%, and 52% for 2010, 2011, and 2012, respectively, and adult female survival rates during the same period were 90%, 86%, and 95% for those years. Analysis currently underway includes effects of habitat and weather on deer population dynamics, evaluation of relative importance of vital rates for different age classes, development of resource selection functions and risk functions in different habitat types, quantification of deer-bear predator-prey relationship, and modeling of deer population response to future climate and habitat-alteration scenarios. Understanding how habitat and winter weather variability affect deer population dynamics will allow us to project possible effects of different timber and hunting management scenarios on the deer population, as well as to factor in potentially interacting effects of changing climate. This will help managers ensure adequate supplies of deer for subsistence and recreational harvest in the future.

Climate-induced Mismatch between Breeding Shorebirds and Their Invertebrate Prey

Postdoctoral Researcher: Kirsty E. B. Gurney
Faculty: Mark Wipfli
Funding Agency: Alaska Science Center, USGS (RWO 185)

Climate is changing on the Arctic Coastal Plain (ACP). Although wildlife outcomes are unclear, survival and recruitment of breeding bird populations may decline if these consumers become temporally mismatched with their food resources. To accurately predict how avian consumers will respond to climate changes on the ACP, it is critical to understand relationships between birds, climate, habitat, and their food resources. This study focuses on understanding interactions between climate change and invertebrate food resources, which have received little attention so far. Our primary objective is to examine several mechanisms that are hypothesized to be responsible for variation in wetland invertebrate communities. Specifically, we will determine how invertebrate biomass, phenology, and community structure respond to changes in nutrient flux and temperature. We are using a series of field-based wetland observations and manipulations to assess changes in wetland invertebrate communities in response to increases in temperature and nutrient concentrations. This research program is in the data-gathering stage, and results are not yet available. Findings from this summer's work show that we have an effective experimental approach and are able to elevate the concentration of phosphate (believed to be the limiting nutrient) in our study ponds. Analyses of water temperature data also show that our technique for heating ponds is effective, raising average daily water temperatures of test ponds by approximately 4°C. Invertebrate prey on the breeding grounds is a key determinant of breeding success for migratory shorebird populations. Our study will thus increase the accuracy with which we can predict potential impacts of climate change on such populations.

Impacts of Fishes on Arctic Freshwater Food Webs in a Changing Climate

Student Investigator: Sarah Laske, PhD Fisheries
Co-Advisors: Mark Wipfli and Amanda Rosenberger
Funding Agency: Alaska Science Center, USGS (RWO 188)
I**n-Kind Support:** School of Fisheries and Ocean Sciences provided Teaching Assistantship

The relationship that organisms have with one another and their environment is likely to change as global temperatures rise. Arctic ecosystems, where the rate of warming is twice the global average, are ideal for studying climate change effects. The particular consequences of warming in the Alaskan Arctic are unknown.

However, it is likely that hydrologic regimes will be altered, impacting aquatic communities and food web dynamics. The role of biotic and abiotic controls on Arctic lake food web structure will be investigated by addressing the following hypotheses: (1) lake community composition and food web structure differ with the degree of surface water connectivity; (2) fish predation and number of consumer levels affect food web structure; (3) the effect of a fish species in structuring lake food webs depends on its relative position within the food web; and (4) fish diet composition and trophic position differ with the assemblage of sympatric fish species. We sampled fish and invertebrates from 16 waterbodies of four treatment types: disconnected fishless ponds, low-connectivity ponds containing fish, disconnected lakes containing fish, and well-connected lakes containing fish. Degree of surface water connectivity influenced fish community composition. Well-connected lakes had greater fish species richness (6 spp.) than lakes with poor or no connectivity (1 sp.). Preliminary investigation of invertebrate taxa richness suggests that waterbodies with fish contain greater invertebrate richness (16–17 taxa) than those without fish (9–10 taxa). The results of this study will help guide management of Arctic species and provide necessary baseline ecological information for freshwater ecosystems on the Arctic Coastal Plain.

Feeding Ecology of Arctic Grayling (*Thymallus arcticus*) in a Small Tundra Stream on the Arctic Coastal Plain, Alaska

Student Investigator: Jason J. McFarland, MS Biological Sciences
Advisor: Mark Wipfli
Funding Agency: Bureau of Land Management (BLM) (RWO 179)
In-Kind Support: Field camp logistics and equipment provided by BLM; Teaching Assistantship provided by Department of Biology and Wildlife

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Climate change and increased oil and gas activities on Alaska's North Slope pose probable threats to ecological processes in aquatic ecosystems. The Arctic Coastal Plain (ACP) is an ecologically and biologically poorly understood area, particularly with the food webs that support fishes. Understanding the structure and function of these lotic systems is paramount to understanding how the future Arctic aquatic habitats and ecosystems will be influenced by changes in climate and land use. The ACP comprises a water-dominated landscape consisting of complex networks of interconnected lakes and small streams. The small size of these streams makes them potentially very susceptible to impacts from land use and climate change. These understudied, yet abundant waterways provide habitat for multiple species of fish, with Arctic grayling being the most common and widespread. To evaluate how potential habitat changes may affect Arctic grayling we must first understand the basic ecology of these aquatic habitats and of the fishes that inhabit them. The objectives of this study are to measure abundance of terrestrial and aquatic invertebrate prey for Arctic grayling, and measure prey intake by these fish, from June through August. We estimated terrestrial invertebrate prey inputs to streams with differing riparian plant species, invertebrate drift along the stream profile representing lake vs. stream sources of food, and grayling diets in June, July, and

August. Preliminary results suggest large differences in terrestrial invertebrate prey inputs among different riparian vegetation types and that aquatic invertebrates are more important food items to Arctic grayling than are terrestrial prey. Arctic grayling are not commonly known to be piscivorous, although we consistently found large amounts of ninespine stickleback (*Pungitius pungitius*) in their guts, especially larger grayling, suggesting that these fish rely heavily on piscivory.

Interactions of Fire and Thermokarst Affecting Ecological Change in Alaska

Student Investigator: Dana Nossov, PhD Biological Sciences
Co-Advisors: Knut Kielland and Torre Jorgenson
Funding Agency: USGS (RWO 189)
In-Kind Support: BNZ-LTER, DoD

Permafrost underlies ~70% of the landscape of Alaskan boreal region and is vulnerable to thawing from climate warming. Wildfire is a widespread disturbance that can trigger rapid permafrost degradation. The vulnerability of permafrost to degradation and the ecological effects can vary widely within a region. Permafrost strongly influences ecosystem processes, vegetation, and hydrology, and the pattern of its degradation has important implications from local to global scales. A better understanding of the interactions between fire and permafrost in the context of a heterogeneous environment is needed to be able to predict and plan for future ecological changes. The initial objective of this study is to assess the response of permafrost and vegetation to fire across different landscape types in interior Alaska. We are addressing this objective by (1) determining rates of vegetation change and thermokarst in relationship to fire history across upland and lowland landscapes through analyzing a time series of aerial imagery; (2) comparing the vegetation, soil, and permafrost characteristics in burned and unburned spruce stands across a topographic and soil textural gradient; and (3) evaluating the impact of fire over time on vegetation, soils, and permafrost in a vulnerable ice-rich lowland using a chronosequence approach of different-aged burns. We expect to find differences across the landscape in the response of permafrost to fire depending on topography, hydrology, soil texture, and vegetation. This study will help to clarify the controls on permafrost degradation and ecological change in response to fire amidst a changing climate.

Climate Change and Subsistence Fisheries in Northwest Alaska

Principal Investigator: Courtney Carothers
Student Investigator: Katie J. Moerlein, MS Fisheries (graduated March 2012)
Funding Agency: Office of Subsistence Management, USFWS (RWO 182)

Climate change is predicted to have widespread implications for resource harvesting in Arctic communities. Few studies have specifically addressed current or potential impacts of climate change on subsistence fisheries in Alaska. This study uncovers the implications of climatic changes on local subsistence practices. This information may guide future adaptive management regarding subsistence use. Our primary objective is to document local observations of climate change relevant to subsistence fisheries in three Northwest Arctic Borough communities: Noatak, Selawik, and Shungnak. We conducted semi-structured ethnographic interviews with elders and active subsistence harvesters to explore knowledge about climate and ecological changes related to subsistence fisheries. Based on these interview data, we developed a survey instrument to systematically assess agreement about climate change observations and subsistence fishery impacts using cultural consensus analysis. During 2012, we finished collecting survey data and completed the analysis of data. Analysis of cultural consensus data reveals that Noatak, Selawik, and Shungnak subsistence fishers display an overall consensus about observations of environmental change. Despite overall consensus among survey respondents, we did find some variation in answer patterns to individual questions. For some observations of change, such as increasing erosion and permafrost melting, we found high levels of agreement. For other observations, such as changing precipitation levels, we found much less agreement among respondents. A better understanding of the current and potential impacts of climate and related ecological changes on these fisheries will assist the U.S. Fish and Wildlife Service in taking an adaptive approach to managing subsistence fisheries.

Plant Community Succession on Drying Lakes in the Yukon Flats, Alaska

Student Investigator: Mark Winterstein, MS Biology
Advisor: Teresa Hollingsworth
Funding Agency: USGS Climate Effects Network (RWO 180); Long Term Ecological Research (LTER)
In Kind Support: Bonanza Creek LTER provided field personnel and lab use

Increases in mean annual temperature and its effect on ecosystem properties has been linked to the reduction in the total surface area and number of closed-basin lakes in the Yukon Flats, Alaska. These drying events expose lacustrine sediments to colonization by terrestrial vegetation and initiate plant community succession. The objectives of this study are to (1) determine the environmental variables controlling the change in plant communities as lakes dry; and (2) investigate how rapidly plant communities are changing post-drying. Fourteen drying lakes were selected based on decreasing lake area from satellite imagery in the years 1985 and 2009. Plant functional group abundance, shrub and tree density, and soil moisture were sampled along transects between existing lake edge and historic lake edge. Plant communities were identified from changes in dominant functional group abundances, and within each community type vascular and non-vascular plant species cover, soil samples, and thaw depths were collected. Temporal variability in plant communities will be measured using Landsat satellite imagery and correlated to changing lake areas over time. Ordination results indicate plant communities are strongly correlated to a gradient of soil moisture from current lake shore to historic lake shore. Total carbon and nitrogen are inversely correlated to distance from current lake shore. The results from this study will provide baseline data for the greater scientific community for the modeling of ecosystem processes, services, and wildlife habitat.

List of Abbreviations

ADFG	Alaska Department of Fish and Game
AKCFWRU	Alaska Cooperative Fish and Wildlife Research Unit
AKSSF	Alaska Sustainable Salmon Fund
AYKSSI	Arctic-Yukon-Kuskokwim Sustainable Salmon Initiative
BLM	U.S. Bureau of Land Management
BOEM	U.S. Bureau of Ocean Energy Management
DBW	Department of Biology and Wildlife, UAF
DoD	U.S. Department of Defense
DOE	U.S. Department of Energy
GI	Geophysical Institute, UAF
GIS	Geographical Information System
IAB	Institute of Arctic Biology, UAF
NASA	U.S. National Aeronautics and Space Administration
NDEP	Nevada Department of Environmental Protection
NFWF	National Fish and Wildlife Foundation
NPS	U.S. National Park Service
NSB	North Slope Borough
NSF	National Science Foundation
NWR	National Wildlife Refuge
PI	Principal Investigator
RSA	Reimbursable Services Agreement
RWO	Research Work Order
SFOS	School of Fisheries and Ocean Sciences, UAF
UAF	University of Alaska Fairbanks
USDA	U.S. Department of Agriculture
USFWS	U.S. Fish and Wildlife Service
USGS	U.S. Geological Survey