Not for Publication: Because this report is one of progress, the data presented are often incomplete, and the conclusions reached may not be final. Consequently, permission to publish any of the information herein is withheld pending approval from the Alaska Cooperative Fish and Wildlife Research Unit.

Unit Roster

Federal Scientists

- Brad Griffith: Leader (effective February 15, 2011)
- A. David McGuire: Assistant Leader-Ecology and Acting Leader
- Abby Powell: Assistant Leader-Wildlife
- Mark Wipfli: Assistant Leader-Fisheries

University Staff

- Karen Enochs: Fiscal Professional (retired July 30, 2011)
- Holly Neumeyer: Travel Coordinator
- Kathy Pearse: Administrative Assistant
- Maria Russell: Fiscal Professional (effective May 1, 2011)

Unit Students

Current

- Jeremy Carlson, MS Fisheries (Wipfli)
- Roy Churchwell, PhD Biological Sciences (Powell)
- Christopher Harwood, MS Biology (Powell)
- Philip Joy, PhD Fisheries (Wipfli)
- Erin Julianus, MS Biology (McGuire and Hollingsworth)
- Sarah Laske, PhD Fisheries (Wipfli and Rosenberger)
- Nicole McConnell, MS Biology (McGuire)
- Jason McFarland, MS Biology (Wipfli)
- Jason Neuswanger, PhD Biological Sciences (Wipfli and Rosenberger)
- Vijay Patil, PhD Biological Sciences (Griffith and Euskirchen)
- Megan Perry, MS Biology (Wipfli)
- Natura Richardson, MS Biology (Wipfli)
- Matt Sexson, PhD Biological Sciences (Powell and Peterson)
- Lila Tauzer, MS Interdisciplinary (Powell and Prakash)
- Jason Valliere, MS Fisheries (Margraf)
- Teri McMillan Wild, MS Wildlife Biology (Powell)

Graduated in CY 2011

- Amy Churchill, MS Biology (McGuire)
- David Esse, MS Fisheries (Margraf)
- Heather “River” Gates, MS Wildlife Biology (Powell)
- Laura Gutierrez, MS Biology (Wipfli)
- Jeff Perschbacher, MS Fisheries (Margraf)
- Jennifer Roach, PhD Biology (Griffith and Verbyla)
- David Roon, MS Biology (Wipfli)
- Audrey Taylor, PhD Biological Sciences (Powell)

Post-Doctoral Researchers

- Rebecca Bentzen (Powell)
- Héléne Genet (McGuire)
- Kirsty Gurney (Wipfli)

- Zhaosheng Fan (McGuire)
- Kristofer Johnson (McGuire)
- Caroline Lundmark (Griffith and Euskirchen)
- Samuel Nicol (Griffith and Hunter)
- Jennifer Roach (Griffith)
- Fengming Yuan (McGuire)

University Cooperators

- Perry Barboza, Department of Biology and Wildlife(DBW)/Institute of Arctic Biology (IAB)-UAF
- F. Stuart Chapin, III, DBW/IAB
- Courtney Carothers, School of Fisheries and Ocean Sciences (SFOS)-UAF
- Eugénie Euskirchen, IAB
-

Affiliated Post-Doctoral Researchers

This is the Annual Report for the Alaska Cooperative Fish and Wildlife Research Unit, highlighting activities for calendar year 2011. The Unit engages in research on living natural resources for a variety of State and Federal agencies. As an unbiased research organization, the Unit provides information requested and funded by these agencies. When studies are completed, the agencies use the information to assist in their natural resource management efforts. Most of the research is conducted by graduate students, many of whom go on to work for the agencies upon graduation.

The Alaska Unit was established in 1950, providing over half a century of research dedicated to helping conserve and enhance the living natural resources of the State and the Arctic Region. The Unit is part of a larger and even older program, the 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-

- Mark Wipfli: Led field trip to collect aquatic invertebrates and discuss wetland ecology with 22 7th-grade students and their teacher on Wetland Ecology Field Day, Watershed School, Fairbanks School District. (Exhibit/Field Trip/Tour)
- Mark Wipfli: Led aquatic ecology team for the 2-day BioBlitz public education outreach event sponsored by USFS, NOAA, ADFG, and USFWS, Juneau, AK. (Public Meeting/Talk)

Invited Seminars

Griffith, B. March 2011. Climate, large mammals and wetlands. USGS, Ecosystems Strategic Science Planning Team Symposium, Menlo Park, CA. Invited speaker.

Griffith, B. February 2011. Inconvenient answers: Experiences at the interface between biological research and public policy. Cooperative Research Units New Scientist Training Session, Reston, VA. Invited speaker.

Mark Wipfli: Linkages among ecosystems that drive freshwater productivity: Consequences of environmental change. Presented to the Western Alaska Landscape Conservation Cooperative, Anchorage, AK. Invited speaker.

Mark Wipfli: Linkages among ecosystems that drive freshwater productivity: Consequences of environmental change. Presented to the International Submerged Lands Management Workshop, Girdwood, AK. Workshop plenary speaker.

Mark Wipfli: Linking ecosystems, food webs, and fish production: Nutrient and prey subsidies in salmonid watersheds. Presented to the School of Fisheries and Ocean Sciences, UAF.

Papers Presented

Bali, A., V. Alexeev, R.G. White, D.E. Russell, A.D. McGuire, and G.P. Kofinas. August 2011. Phenology of mosquito activity within the summer ranges of caribou herds in northern Alaska. 2011 Arctic Ungulate Conference, Yellowknife, Northwest Territories, Canada. (Contributed Oral)

Bentzen, R. L. and A. N. Powell. September 2011. Population dynamics of King Eiders breeding in northern Alaska. 4th International Sea Duck Conference, Seward, AK. (Contributed Oral)

Churchwell, R., A. Powell, S. Kendall, and S. Brown. December 2011. Tidal influences on food availability to shorebirds on coastal mudflats of the Arctic National Wildlife Refuge, Alaska. 17th Annual Alaska Shorebird Group Meeting, Anchorage, AK. (Invited Oral)

Churchwell, R.T., S. Kendall, S. Brown, and A. Powell. 2011. Shorebird use of Arctic Refuge coastal mudflats. Invited speaker, Alaska Sealife Center monthly seminar, Seward, AK. (Invited Oral)

4th Western Hemisphere Shorebird Group Meeting, Vancouver, BC. (Contributed Oral)

Griffith, B. January 2011. Yukon River Basin: Lake change and biodiversity. Yukon River Basin Investigators Meeting, Portland, OR. (Contributed Oral)

Griffith, B. March 2011. Effects of climate change on the Yukon River Basin: Changes in water and implications for wildlife habitat, human subsistence, and climate regulation. Alaska Cooperative Fish and Wildlife Research Unit Coordinating Committee meeting, University of Alaska Fairbanks. (Contributed Oral)

Grosse, G., J. Harden, M.R. Turetsky, A.D. McGuire, P. Camill, C. Tarnocai, S. Frolking, T. Schuur, T. Jorgenson, S. Marchenko, and V. Romanovsky. February 2011. Vulnerability of high latitude soil carbon in North America to disturbance. Third North American Carbon All-Investigators Meeting, New Orleans, LA. (Contributed Oral)

Harwood, C. and A. Powell. August 2011. Breeding ecology of Whimbrels in interior Alaska. 4th Western Hemisphere Shorebird Group Meeting, Vancouver, BC. (Contributed Oral)

Hayes, D.J., D.P. Turner, G. Stinson, A.D. McGuire, Y. Wei, T.O. West, L.S. Heath, B.H. de Jong, B.G. McConkey, R. Birdsey, W.A. Kurz, A.R. Jacobson, D.N. Huntzinger, Y. Pan, W.M. Post, and R.B. Cook. December 2011. Reconciling estimates of the contemporary North American carbon balance among an inventory-based approach, terrestrial biosphere models, and atmospheric inversions. Fall Meeting of the American Geophysical Union, San Francisco, CA. (Contributed Oral)

Hayes, D.J., D.P. Turner, G. Stinson, Y Wei, T.O. West, B. deJong, A.D. McGuire, R. Cook, and W.M. Post III. August 2011. Towards better-constrained assessments of the carbon balance of North America in the 21st century: A comparison of recent model and inventory-based estimates. Annual Meeting, Ecological Society of America, Austin, TX. (Contributed Oral)

Kasischke, E.S., E.S. Kane, J.A. O'Donnell, N.L. Christensen, S.R. Mitchell, M.R. Turetsky, D.J. Hayes, E. Hoy, K.M. Barrett, A.D. McGuire, and F. Yuan. December 2011. Feedbacks between climate, fire severity, and differential permafrost degradation in Alaskan black spruce forests – implications for carbon cycling. Fall Meeting of the American Geophysical Union, San Francisco, CA. (Invited Oral)

Klapstein, S.J., M.R. Turetsky, A.D. McGuire, J.W. Harden, and J.M. Waddington. December 2011. Controls on ebullition and methane emissions in Alaskan peatlands experiencing permafrost thaw. Fall Meeting of the American Geophysical Union, San Francisco, CA. (Contributed Poster)

McGuire, A.D. December 2011. The importance of representing interactions among permafrost dynamics, soil warming, and fire in modeling soil carbon responses of northern high latitude terrestrial ecosystems to climate change. Fall Meeting of the American Geophysical Union, San Francisco, CA. (Invited Oral)

McGuire, A.D. October 2011. DOS-TEM Modeling Perspective. Workshop to identify data needs for improving model representations of soil carbon responses to

salmon avatars? Annual Meeting, American Fisheries Society, Seattle, WA. (Contributed Oral)
Sexson, M.G., M.R. Petersen, and A.N. Powell. September 2011. Then and now: a comparison in the distribution of Spectacled Eiders at nonbreeding areas in the past 15 years. 4th International Sea Duck Conference, Seward, AK. (Contributed Oral)
Steen, V. and A. Powell. March 2011. Potential effects of climate change on waterbirds in the Prairie Pothole Region, USA. AFO/COS/WOS Joint Meeting, Kearney, NE. (Contributed Poster)
Steen, V., A. N. Powell, and S. Skagen. March 2011. Potential effects of climate change on the distribution of wetland-associated birds in the Prairie Pothole Region, USA. Waterbird Society Annual Meeting, Grand Island, NE. (Invited Oral)
Taylor, A., R. Lanctot, T. Williams, A. Kitaysky, and A. Powell. August 2011. Evaluating physiologic metrics for assessing site quality for species with varying molt strategies. 4th Western Hemisphere Shorebird Group Meeting, Vancouver, BC. (Contributed Oral)
Waldrop, M.P., J. McFarland, C.I. Czimczik, E.S. Euskirchen, T. Amendolara, G.J. Scott, M.R. Turetsky, J.W. Harden, and A.D. McGuire. December 2011. Changing sources of respiration between a black spruce forest and themokarst bog. Fall Meeting of the American Geophysical Union, San Francisco, CA. (Contributed Poster)
Wild, T., S. Kendall, N. Guldager, and A. Powell. March 2011. Breeding Smith's Longspur habitat associations and predicted distribution in the Brooks Range, Alaska. AFO/COS/WOS Joint Conference, Kearney, NE. (Contributed Oral)
Wipfli, M. September 2011. Riparian forest conditions influence food supplies for stream salmonids: Managing for increased aquatic productivity. Annual Meeting, American Fisheries Society, Seattle, WA. (Contributed Oral)
Wipfli, M., A.E. Kohler, B. Lewis, and G. Servheen. September 2011. Marine-derived nutrients and nutrient loss mitigation: Where we've been and where we might be headed. Annual Meeting, American Fisheries Society, Seattle, WA. (Contributed Oral)
Yuan, F., A.D. McGuire, S. Yi, E.S. Euskirchen, T.S. Rupp, A.L. Breen, T. Kurkowski, E.S. Kasischke, and J.W. Harden. December 2011. Effects of future warming and fire regime change on boreal soil organic horizons and permafrost dynamics in interior Alaska. Fall Meeting of the American Geophysical Union, San Francisco, CA. (Contributed Poster)
Yuan, F., S. Yi, A.D. McGuire, K.D. Johnson, J. Liang, J. Harden, and E.S. Kasischke. February 2011. Dynamical basin-

Hayes, D.J., A.D. McGuire, D.W. Kicklighter, T.J. Burnside, and J.M. Melillo. 2011. The effects of land cover and land use change on the contemporary carbon balance of the arctic and boreal ecosystems of northern Eurasia. Chapter 6 in Eurasian Arctic Land Cover and Land Use in a Changing Climate (edited by G.

- Esse, David A. 2011. Characteristics of the Sulukna River spawning population of inconnu, Yukon River drainage, Alaska. MS thesis, University of Alaska Fairbanks. 55 pp.
- Gates, H. River. 2011. Reproductive ecology and morphometric subspecies comparisons of dunlin (Calidris alpina), an arctic shorebird. MS thesis, University of Alaska Fairbanks. 78 pp.
- Gutierrez, Laura. Terrestriali0u t05aD [(cos5(,)8( )8c)5(i)8(es2(r)6(.)7( )8(es2(o)3(l)8f)8(e)4ro)

were collected to verify maturity and spawning readiness, and to determine age distributions of mature males and females. Spawning abundance was estimated and post-spawning migration timing was identified. Otoliths were analyzed optically to

The Use of Aerial Imagery to Map In-Stream Physical Habitat Related to Summer Distribution of Juvenile Salmonids in a Southcentral Alaskan Stream

Student Investigator:

Ongoing Aquatic Studies

Seasonal Movements of Northern Pike in Minto Flats, Assessment of Mark-Recapture Experiment, and Effect of Selected Environmental Factors on Movement

Student Investigator: Matthew Albert, MS Fisheries
Advisor: Trent Sutton
Funding Agency: Sport Fish Division, ADFG (Base Funding)
In-Kind Support: Personnel, vehicles, boats, and field equipment provided by ADFG

Northern pike are an important sport and subsistence fish inInterior Alaska. Detaiequiportorsct5( )7 i

populations and local fisheries. The primary objective is to determine how temporal changes in North Slope climate are affecting growth rates of Dolly Varden char. Secondary objectives include characterizing annual lipid fluctuations, refining bioelectrical impedance models, and determining the precision of common aging structures. Dolly Varden will be sampled twice annually during spring and fall.

Process-based Modeling of the Behavior, Growth, and Survival of Juvenile Chinook Salmon at the Micro- and Mesohabitat Scales in the Chena River

Student Investigator: Jason Neuswanger, PhD Biological Sciences
Co-Advisors: Mark Wipfli and Amanda Rosenberger
Funding Agencies: AYKSSI, ADFG; IAB; Department of Biology and Wildlife (DBW), UAF

Stock-recruitment analyses suggest that the Chena River Chinook salmon population is positively affected by low to medium river flows during each generation's first summer, but this efflonool2(,)-5n25(iu(c)2(e(f)8(l)o)-3d)-5(( )1(e,-1.22 Td .1d [(io)-5el)5(ab)-1(n)6

bottlenecks that cause density dependent mortality, (3) develop a model capable of predicting the effect of stream temperature on juvenile growth, (4) test whether the growth model can be used to predict annual growth and annual variation in smolt size, and (5) determine whether there is a positive correlation between smolt size and the productivity of a brood year in terms of recruits per spawner for the Chena River. We monitored individual growth of juvenile Chinook salmon along the natural temperature gradient in the Chena River using stereo-videogrammetry and conducted a mark-

MDN 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; and Norton Sound Economic Development Corporation (NSEDC)

Marine-derived nutrients (MDN) imported to freshwater eco

regulate them will assist management agencies as oil and gas development occurs through the Arctic Coastal Plain.

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
Advisor: Amanda Rosenberger
Funding Agency: Anchorage Field Office, USFWS (RWO 174)
In-Kind Support: Technical assistance and equipment provided by USFWS

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 the upstream limit and distribution of juvenile coho salmon by size and age class and to associate spatial patterns in juvenile fish abundance with habitat features. We continuously sampled headwater tributaries of the Little Susitna drainage to investigate spatial patterns in fish distribution, in conjunction with a streamwide habitat assessment. We used backpack electrofishers to sample fish throughout 200-m stream reaches. We performed mark-recapture of juvenile coho salmon on separate occasions to evaluate our sampling efficiency and validate our 1-pass CPUE as a reliable measure of fish presence and abundance. During 2010 and 2011, habitat characteristics were measured on 83 stream reaches and 77 reaches were sampled for fish. We performed mark-recapture on 27 reaches

objective in this study was to determine if yelloweye rockfish had reproduced in the years following a barotrauma event and recompression with a deepwater release device. The second objective was to identify if embryo quality was affected in recaptured fish versus fish with no known capture event. These objectives were

Habitat Use and Genetic Analysis of Main Stem and Tributary Spawning Chinook Salmon in the Togiak River, Alaska

Student Investigator: Stephanie Meggers, M.S. 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, U.S. Fish and Wildlife
Service Conservation RTdtii30t-s1(Fa)F2(6u)1a(l1)5(i1)2(v)2(a)6(s) S(o)2(3)2(b)]E30 s7 1S(206)4(To)8(

Completed Wildlife Studies

Postbreeding Ecology of Shorebirds on the Arctic Coastal Plain of Alaska

Student Investigator: Audrey R. Taylor, PhD Biology
Advisor: Abby Powell
Funding Agencies: Coastal Marine Institute, UAF; Angus Gavin Migratory Bird Research Fund, UA Foundation; Migratory Bird Management, and Arctic National Wildlife Refuge, USFWS; Arctic Field Office, BLM; BPXA, Inc.; and ConocoPhillips Alaska Inc.

Note: Audrey Taylor graduated from the University of Alaska Fairbanks in May 2011. Her di 3(si)3(ra2 0 Tc s J 0p7 2)TJ2 i 1(i)TJ2 7(o)2 0 1(i) TJ 0.3t3(1(e7 i)3(07 2)TJ2)5134 J2 i

Reproductive Ecology and Morphometric Subspecies Comparisons of Dunlin (Calidris alpina), an Arctic Shorebird

Student Investigator: Heather River Gates, MS Wildlife Biology
Advisor: Abby Powell
Funding Agency: Migratory Bird Program, USFWS

Note: River Gates graduated from the University of Alaska Fairbanks in December 2011. Her thesis abstract follows:

The Arctic region provides globally important breeding and migratory habitat for abundant wildlife populations including migratory shorebirds. Due to their remote breeding locations, basic information on breeding ecology, annual productivity, and factors that regulate their populations are poorly studied. Wildlife biologists managing migratory bird populations require detailed information on avian breeding biology, in addition to information on migration ecology including connectivity of migratory stop-over and wintering locations. To address information gaps in fecundity, I conducted an experimental study investigating the renesting ecology of Dunlin (Calidris alpina arcticola) by removing clutches at two stages of incubation and by following adults marked with radio transmitters to their replacement clutch. In contrast to predictions for Arctic-breeding species, Dunlin had high (82-95%) rates of clutch replacement during early incubation and moderate (35-50%) rates during late incubation. Female body condition and date of clutch loss were important variables explaining propensity for females to replace a clutch; larger females that lost their nest early in the season were more likely to renest than smaller females who lost their nest later in the season. To delineate Dunlin subspecies in areas where they overlap, I used morphological and molecular approaches to determine sex and subspecies of five subspecies of Dunlin breeding in Alaska and eastern Russia. This analysis yielded discriminant function models to correctly classify unknown individuals to sex (79-98%) and subspecies (73-85%) via morphometric measures. Correct classification of mixed assemblages of subspecies improved when sex, determined though molecular techniques, was known. The equations I derived using discriminant function models can be used to identify the sex and subspecies of unknown Dunlin individuals for studies investigating breeding and migration ecology.

Ongoing Wildlife Studies

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

grounds in northern Alaska, 2006-2009. Juveniles and subadults wintered in three regions around the Bering Sea (southwestern Alaska, northern Bering Sea, and the Kamchatka Peninsula), using multiple discrete sites, but did not move between regions within a winter. Large winter ranges and lack of fidelity to the juvenile

2011). In spring and fall, eiders were located in distinct areas of the Bering, Chukchi, and east Siberian seas. In winter, all marked 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 WiWi

also identified that warming and fire regime changes are approximately equivalent in their effects on soil C storage, and analysis of interactions between wildfire and warming suggests that the loss of organic horizon thickness associated with wildfire made deeper soil C stocks more vulnerable to loss. Sub-basin analyses indicate that simulated C stock changes were primarily sensitive to the fraction of burned forest area within each sub-basin. The fraction of area burned across the entire YRB between 1960 and 2006 is approximately at the sink-to-source transition point identified by the sub-basin analyses. We conclude that it is important for large-scale biogeochemical and earth system models to represent the dynamics of organic soil horizon thickness and structure in applications to assess changes in regional C dynamics of boreal forests responding to changes in climate and fire regime.

The Response of Plant Community Structure and Productivity to Changes in

Ongoing Ecological Studies

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

Researchers: Amy Churchill, MS Biology, and Zaosheng Fen (Post-Doctoral Researchers)
Faculty: A. David McGuire
Funding Agency: NSF

Boreal ecosystems contain about 30% of the world's soil carbon (C), largely in peatlands. Recent studies indicate strong climatic controls on northern peatland C balance and show that water bodies in some wetland regis3u in

Research Coordination Network: Vulnerability of Permafrost Carbon

Post-Doctoral Researcher: Zhaosheng Fan
Faculty: A. David McGuire
Funding Agency: NSF

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 21st 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 first year of this

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

Implications of Climate Variability for Optimal Monitoring and Adaptive Management in Wetland Systems

Postdoctoral Researcher: Sam Nicol
Faculty: Brad Griffith and Christine Hunter
Funding Agencies: USGS (RWO 172)
In-kind support: USFWS; AKCFWRU

The lakes of the prairie pothole region (PPR) and Alaska provide habitat that is crucial for breeding waterfowl. Evidence suggests that climate is changing the water balance of the lakes in both regions which may affect the future of breeding waterfowl. National Wildlife Refuge managers operating in the PPR and Alaska need to understand how climate will affect their refuges and how to change their management practices to adapt to future climate scenarios. Our goal is to enhance the potential for monitoring and adaptive management of the habitats of waterbirds that will be affected by changing global temperatures. In Alaska we used remote sensing data to predict the power to detect changes in lake area over Alaskan refuges. In the PPR we applied an adaptive management approach to give specific water levels that should be maintained at each refuge pool under both an increasing and decreasing inflow scenario. Three of the six Alaskan refuges studied are drying. The power to detect change is low. In the PPR all study refuges are located on rivers so are not greatly affected by the changes in inflow that we predict under either climate scenario. In Alaska, small trends in lake area are hard to detect but have big effects over time. A refuge-wide monitoring scheme carried out over at least a decade is the only way to detect change. In the PPR, we gave specific weir heights to manage expected future inflows. Management is similar under increasing and decreasing inflow scenarios.

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, many apparent drying lakes in Alaska exhibit large annual fluctuations in lake area as a result of spring flooding. The ecological significance of lake drying is unclear and cannot be quantified without separating the effects of lake drying from the influence of flooding and other forms of disturbance. The objective of this study is to estimate the influence of lake 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 and field surveys to fit statistical and simulation models of plant biodiversity, productivity, and dynamics of carbon and nitrogen. In 2010 and 2011, we completed vegetation surveys at 130 lakes. We also sampled aboveground net primary

productivity (ANPP) and soil characteristics, including soil moisture, carbon, and nitrogen, at a subset of eight lakes in 2011. Preliminary results indicate that frequently flooded lake-margin communities have rapid transitions from grass/sedge vegetation to upland forest, elevated soil moisture, and reduced soil nitrate

archived field data from the 1970s. 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 shift and additionally suggests 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 continuous habitat shifts.

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)

Temperatures in the boreal forest have risen by 3–4°C over the past 60 years, compared to a global mean increase of 0.6°C.

environment, and a connection between their population dynamics and changes in populations of prey fish species has been hypothesized. In this study 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 sympatrically 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 nesting 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 loons may be affected by changes in prey resources associated with climate change, fisheries activities, and offshore oil and gas development in the Arctic.

Detection of Climate-linked Distributional Shifts of Breeding Waterbirds across North America

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

Extensive and long-term sampling is necessary to identify demographically important changes in the distribution of wildlife populations that may be linked to climate processes. Few survey data streams exist for such an assessment. The Waterfowl Breeding Population and Habitat Survey is one notable exception to this limitation. This survey, conducted annually through the leadership of the Division of Migratory Bird Management of the U.S. Fish and Wildlife Service (USFWS), samples 5 million square kilometers and covers prairies, parklands, boreal forest, and coastal habitats. Additional surveys similarly cover tundra areas of the U.S. and Canada. Data from these surveys are used annually in an adaptive management and decision framework that provides objective model output for how harvest regulations across the continent should be implemented to maintain existing populations. We propose to estimate rates of species colonization or extinction (i.e., “occupancy”) using a spatially and temporally explicit model. We will also model the relationship between occupancy and habitat and climate covariates. These analyses will identify how distributions of waterbirds for much of the continent are responding to climate processes. 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

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

process. Additionally, Arctic systems can act as harbingers of climate change for lower latitudes and provide information for developing strategies to preserve ecosystems. On the Arctic Coastal Plain (ACP) of Alaska, a complex of streams, lakes, and wetlands dominates the landscape and provides essential habitat and food resources to many bird and fish species. Understanding the role of fishes on the ACP is a critical component of understanding food web function and whether controls of aquatic community structure are top-down (predator driven) or bottom-up (environmentally driven). In summer 2011 (year 1 of a 3-year study), we sampled the relative abundance of fish from streams and lakes at two sites on the ACP. The data were collected as part of a pilot study to understand fish distributions across the local landscape and inform project planning. Sampling revealed that fish distributions varied from system to system with differing assemblages of fish within each stream or lake. Of seven fish species found on the ACP in 2011, only the ninespine stickleback Pungitius pungitius was found at every sampling location. Because fish affect wildlife directly and indirectly through trophic linkages, understanding what controls Arctic food web structure can elucidate forthcoming changes due to climate warming.

Terrestrial-Aquatic Linkages: Controls on Riparian Prey Subsidies for Arctic Grayling on the North Slope

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Climate change and increased oil and gas activities on Alaska's North Slope pose probable es

terrestrial invertebrate prey inputs among riparian vegetation types. Terrestrial invertebrates are important food items for both juvenile and adult Arctic grayling in beaded streams on the Coastal Plain of the North Slope, Alaska. The findings of this study are expected to help guide future management of small

List of Abbreviations

ADFG Alaska Department of Fish and Game
AKCFWRU Alaska Cooperative Fish and Wildlife Research Unit