Alaska Cooperative Fish and Wildlife Research Unit

Annual Research Report Ñ 2010
October 14, 201 1

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Not for Publication: Because this report is one of progress, the data presented are often incomplete, and the conclusions reached may not be final.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,

Unit Roster

Federal Scientists

¥ Brad Griffith: Assistant Leader -Wildlife
¥ A. David McGuire: Assistant Leader -Ecology and Acting Leader
¥ Abby Powell: Assistant Leader -Wildlife
¥ Mark Wipfli: Assistant Leader -Fisheries

University Staff

¥ Karen Enochs: Fiscal Office r
¥ Holly Neumeyer : Travel Coordinator
¥ Kathy Pearse: Administrative Assistant

Unit Students

Current

¥ Jeremy Carlson, MS Fisheries (Margraf)
¥ Amy Churchill, MS Biology (McGuire)
¥ Roy Churchwell, PhD Biological Sciences (Powell)
¥ David Esse, MS Fisheries (Margraf)
¥ Heather ÒRiverÓ Gates, MS Wildlife Biology (Powell)
¥ Laura Gutierrez, MS Biology (Wipfli)
¥ Christopher Harwood, MS Biology (Powell)
¥ 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)
¥ Jeff Perschbacher, MS Fisheries (Margraf)
¥ Jennifer Roach, MS Biology (Griffith and Verbyla)
¥ David Roo n, MS Biology (Wipfli)
¥

Post-Doctoral Researchers

- ¥ Kirsten Barrett (USGS Mendenhall Postdoctoral Fellow, co- sponsored with Carl Markon, USGS Alaska Science Center) (McGuire)
- ¥ Rebecca Bentzen (Powell)
- ¥ Daniel Hayes (McGuire)
- ¥ Kris tofer Johnson (McGuire)
- ¥ Caroline Lundmark (Griffith and Eu skirchen)
- ¥ Samuel Nicol (Griffith and Hunter)
- ¥ 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 o f Fisheries and Ocean Sciences (SFOS) - UAF
- ¥ EugŽnie Euskirchen, IAB
- ¥ Teresa Hollingsworth, Boreal Ecology Cooperative Research Unit (BECRU)- UAF
- ¥ Kris Hundertmark, DBW/IAB
- ¥ Christine Hunter, DBW/IAB
- ¥ Katrin Iken, SFOS
- ¥ Glenn Juday, Forest Sciences Depa rtment - UAF
- ¥ Gordon Kruse, SFOS - UAF
- ¥ Mark Lindberg, DBW/IAB
- ¥ Anupma Prakash, Geophysical Institute - UAF
- ¥ James Reynolds, Emeritus UAF
- ¥ Amanda Rosenberger, SFOS
- ¥ Roger Ruess, DBW/IAB
- ¥ Trent Sutton, SFOS
- ¥ Dave Verbyla, SALRM
- ¥ Frank v on Hippel, UAA
- ¥ Donald Walker, IAB

Affiliated Students

Current

- ¥ Matthew Albert, MS Fisheries (Sutton)
- ¥ Brittany Blain, MS Fisheries (Sutton)
- ¥ Kevin Foley, MS Fisheries (Rosenberger)
- ¥ Sophie Gilbert, PhD Biology (Hundertmark)
- ¥ Christie Hendrich, MS Fisheries (Kruse)
- ¥ Tyler Lewis, MS Wildlife (Lindberg)
- ¥ Jamie McKellar, MS Fisheries (Iken and Sutton)
- ¥ Katie Moerlein, MS Fisheries (Carothers)
- ¥ Heather Scannell (Sutton and Margraf)
- ¥ Nicholas Smith (Sutton)
- ¥ Jason Stolarski (Sutton and Prakash)
- ¥ Ken Tape, PhD Biol ogy (Ruess)
- ¥ Mark Winterstein, MS Biology (Walker and Hollingsworth)

Graduated in CY 20 10

¥ David Gustine, PhD Biology (Barboza)
¥ Aleya Nelson, MS Wildlife (Lindberg and Rabe)

Cooperators

¥ Brian Barnes ÐDirector, Institute of Arctic Biology, University of Alaska Fairbanks
¥ Denby Lloyd ÐCommissioner, Alaska Department of Fish and Game (retired December 1 , 2010) and Cora Campbell ÐCommissioner, Alaska Department of Fish and Game (appointed December 22, 2010).
¥ Geoff Haskett ÐDirector, Region 7 , US Fish and Wildlife Service
¥ F. Joseph Margraf ÐUnit Supervisor, Cooperative Research Units, US Geological Survey

This is the Annual Report for the Alaska Cooperative Fish and Wildlife Research Unit, highlighting activities for calendar year 2010. 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 Biological Resources 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

impacts. Fall Meeting of the American Geophysical Union, San Francisco, CA. (Contributed Oral)

Bentzen, R., A. N. Powell, and R. Suydam. November 2010. Strategies for nest site selection by king eiders. 14th Alaska Bird Conference, Anchorage, AK. (Contributed Oral)

Churchill, A.C., A.D. McGuire, and M.R. Turetsky. August 2010. Responses of primary productivity and annual biomass in Alaskan boreal peatlands to changing hydrology and permafrost. Annual Meeting of the Ecological Society of America, Pittsburgh, PA. (Contributed Poster)

Churchill, A.C., T.N. Hollingsworth, A.D. McGuire, and M.R. Turetsky. December 2010. Response of vegetation structure and function to experimental drought and flooding in an Alaskan fen. Fall Meeting of the American Geophysical Union, San Francisco, CA. (Contributed Poster)

Churchwell, R., S. Kendall, S. Brown, and A. Powell. November 2010. Shorebird use

loading of DOC to Arctic river net works. Fall Meeting of the American Geophysical Union, San Francisco, CA. (Contributed Oral)

McConnell, N.A., A.D. McGuire, J.W. Harden, E.S. Kane, and M.R. Turetsky. December 2010. Controls on ecosystem and root respiration in an Alaskan peatland. Fall Meeting of the American Geophysical Union, San Francisco, CA. (Contributed Poster)

McGuire, A.D. and T.R. Christensen. October 2010. Regional Carbon Cycle Assessment and Processes: Arctic Tundra. Regional Carbon Cycle Assessment on Lands and Oceans Workshop, Viterbo, Italy. Invited. (Invited Oral)

McGuire, A.D. April 2010. Keynote: Sensitivity of the carbon cycle in the Arctic to climate change. Symposium on Spatio- Temporal Patterns in the Carbon Balance of Northern High Latitude Regions. Stockholm University. Stockholm, Sweden. (Invited Oral)

McGuire, A.D. August 2010. Recent impacts of climate change in Alaska and other boreal regions. XXIII IUFRO World Congress, Seoul, South Korea. (Invited Oral)

McGuire, A.D. October 2010. Feedbacks of northern high -latitu de terrestrial ecosystems to the climate system. Department of Energy Climate Change Workshop on Experiments in High Latitude Ecosystems, Fairbanks, AK. Invited. (Invited Oral)

McGuire, A.D., D.J. Hayes, D.W. Kicklighter, M. Manizza, Q. Zhuang, M. Chen, M. J. Follows, K.R. Gurney, J.W. McClelland, J.M. Melillo, and B.J. Peterson. March 2010. The changing carbon cycle of the Arctic. State of the Arctic Conference, Miami, FL. (Contributed Oral)

McGuire, A.D., D.J. Hayes, D.W. Kicklighter, Q. Zhuang, M. Chen, K .R. Gurney, J.W. McClelland, J.M. Melillo, B.J.Peterson, and R.G. Prinn. July 2010. Analysis of the carbon balance of boreal Asia from 1997 Ð2006. International Conference on Environmental Observations, Modeling and Information Systems, Tomsk, Russia. (Invi ted Oral)

Neuswanger, J.C., N.F. Hughes, M.S. Wipfli, and L.H. Kelly. May 2010. Improved 3 -D

Powell, A. N. and S . Backensto. October 2010. Nesting ecology of Common Ravens in an Arctic industrial landscape. The Wildlife Society, 17th Annual Conference, Snowbird, UT. (Contributed Oral)

Rinella, D.J., M.S. Wipfli, and C. Stricker. August 2010. Relationships among spaw ning salmon abundance, stable isotope measures of marine -derived nutrient assimilation, and the fitness of stream -dwelling fishes. 7th International Conference on Application of Stable Isotope Techniques to Ecological Studies, Fairbanks, AK. (ISOECOL abstr act) (Contributed Oral)

Roon, D.A., M.S. Wipfli, T.L. Wurtz, and A. Prakash. June 2010. Invasive European bird cherry affects ecological processes within Alaska streams and riparian forests. Joint American Society of Limnology and Oceanography & North Amer icd O2 A-5(gCeC)6(a)2(n)3(y,t)-1(h)-5( )]TJ 0Sl2(ol)5 Tc 12.254 0 Td ()-1d33.571149 Tr4(i)3(y,t)-1lJ5-4(

Wipfli, M.S., and C.V. Baxter. May 2010. Managing salmon returns and riparian forests to benefit salmonids and their riverine habitats: Seein g the unseen. International Symposium: Advances in the Population Ecology of Stream Salmonids, Luarca, Asturias, Spain. (APESS abstract) (Contributed Oral)

Wipfli, M.S., N.F. Hughes, M.J. Evenson, E.R. Benson, E.C. Green, L. Gutierrez, J.R. Neuswanger, and M.T. Perry. November 2010. Environmental processes affecting juvenile Chinook salmon in the Chena River, interior Alaska. Annual Meeting, Alaska Chapter, American Fisheries Society, Juneau, AK. (Contributed Oral)

Wipfli, M.S., N.F. Hughes, M.J. Evenson, E .R. Benson, E.C. Green, L. Gutierrez, J.R. Neuswanger, and M.T. Perry. May 2010. Environmental processes affecting juvenile Chinook salmon in an interior Alaska river. International Symposium: Advances in the Population Ecology of Stream Salmonids, Luarca, Asturias, Spain. (APESS abstract) (Invited Poster)

Wullschleger, S.D., L.D. Hinzman, A.D. McGuire, S.F. Oberbauer, W.C. Oechel, R.J. Norby, P.E. Thornton, E.A. Schuur, H.H. Shugart, J.E. Walsh, and C.J. Wilson. December 2010. Climate change experiments in Arctic ecosystems: Scientific strategy and design criteria. Fall Meeting of the American Geophysical Union, San Francisco, CA. (Contributed Oral)

Scientific Publications

Belant, J.R., B. Griffith, Y. Zhang, E.H. Follmann, and L.G. Adams. 2010. Populatio n-level resource selection by sympatric brown and American black bears in Alaska. Polar Biology 33:31 -40. DOI 10.1007/s00300 -009- 0682- 6.

Bentzen, R.L., A.N. Powell, L.M. Phillips, and R.S. Suydam. 2010. Incubation behavior of king eiders on the coastal plain of northern Alaska. Polar Biology 33(8): 1075 -1082, DOI: 10.1007/s00300- 010- 0787- y.

Binckley, C., M.S. Wipfli, R.B. Medhurst, K. Polivka, P. Hessburg, B. Salter, and J.Y. Kill. 2010. Ecoregion and land -use influence invertebrate and detritus transport from headwater streams. Freshwater Biology 55:1205 -1218.

Chapin, F.S. III, A.D. McGuire, R.W. Ruess, T.N. Hollingsworth, M.C. Mack, J.F. Johnstone, E. Kasischke, E.S. Euskirchen, J.B. Jones, M.T. Jorgenson, K. Kielland, G.P. Kofinas, M.R. Turetsky, J. Yarie , A.H. Lloyd, and D.L. Taylor. 2010. Resilience to climate change in AlaskaÕs boreal forest. Canadian Journal of Forest Research 40:1360- 1370. doi:10.1139/X10 -074.

Euskirchen, E.S., A.D. McGuire, F.S. Chapin, and T.S. Rupp. 2010. The changing effects of Alaska boreal forests on the climate system. Canadian Journal of Forest Research 40:1336- 1346. doi:10.1139/X09 -209.

Griffith, B., C. Cuyler, R.G. White, L.G. Adams, D.E. Russell, D.C. Douglas, A. Gunn, and R.D. Cameron. 2010. No evidence of trophic mismatc h for caribou in Greenland. Science. http://www.sciencemag.org/cgi/eletters/325/5946/1355

Gustine, D.D., P.S. Barboza, and J.P. Lawler. 2010. Dynamics of body protein and the implications for reproduction in captive muskoxen (Ovibos moschatus) during winter. Physiological and Biochemical Zoology 83(4):687 -697.

Heintz, R.A., M.S. Wipfli, and J.P. Hudson. 2010. Identification of marine -derived lipids in juvenile coho salmon and aquatic inse cts through fatty acid analysis. Transactions of the American Fisheries Society 139:840 -854.

Kane, E.S., M.R. Turetsky, J.W. Harden, A.D. McGuire, and J.M. Waddington. 2010. Seasonal ice and hydrologic controls on disroon.nisn.See( )5(o[a4(r)4(o)1(l)25/)5(59o)1rro(o)g2(r)4(o( )5(o(in)

Kasischke, E.S., D. Verbyla, T.S. Rupp, A.D. McGuire, K.A. Murphy, J.L. Allen, E.E. Hoy, R. Jandt, P. Duffy, M. Calef, and M. R. Turetsky. 2010. AlaskaÕs changing fire regime Ð Implications for the vulnerability of its boreal forests. Canadian Journal of Forest Research 40:1313- 1324. doi:10.1139/X10 -098.

Latty. C.J., T.E. HollmŽn, M.R. Petersen, A.N. Powell, and R.D. Andrews. 201 0. Abdominally implanted transmitters with percutaneous antennas affect the dive performance of common eiders. Condor 122(2):314 -322.

McGuire, A.D., D.J. Hayes, D.W. Kicklighter, M. Manizza, Q. Zhuang, M. Chen, M.J. Follows, K.R. Gurney, J.W. McClelland, J .M. Melillo, B.J. Peterson, and R. Prinn. 2010. An analysis of the carbon balance of the Arctic Basin from 1997 to 2006. Tellus 62B:455 -474. doi:10.1111/j.1600 -0889.2010.00497.x

McGuire, A.D., F.S. Chapin III, and R.W. Ruess, Special Editors. 2010. The Dyn amics of Change in AlaskaÕs Boreal Forests: Resilience and Vulnerability in Response to Climate Warming. Foreword. Canadian Journal of Forest Research 40:1195 -1196.

McGuire, A.D., R.W. Macdonald, E.A.G. Schuur, J.W. Harden, P. Kuhry, D.J. Hayes, T.R. Christensen, and M. Heimann. 2010. The carbon budget of the northern cryosphere region. Current Opinion in Environmental Sustainability 2:231 -236. doi:10.1016/j.cosust.2010.05.003

McGuire, A.D., R.W. Ruess, A. Lloyd, J. Yarie, J.S. Clein, and G. Juday. 2010. Vulnerability of white spruce tree growth in interior Alaska in response to climate variability: Dendrochronological, demographic, and experimental perspectives. Canadian Journal of Forest Research 40:1197 -1209. doi:10.1139/X09 -206.

Medhurst, R.B., M.S. Wipf

Research Reports

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

Thermal Limitations on Chinook Salmon Spawning Habitat in the Northern Extent of Their Range

Student Investigator: Samantha Decker , MS Fisheries
Advisor: F. Joseph Margraf
Funding Agency: Sport Fish Division, Alaska Department of Fish and Game

Note : Sam Decker graduated from the University of Alaska Fairbanks in May 2010 . Her thesis abstract follows:

Pacific salmon (Oncorhynchus) habitat models attempt to balance research efficiency with management effectiveness, however, model transferability between regions remains elusive. To develop efficient habitat models, we must understand the critical elements that limit habitat. At the northern edge of the geographic range for Chinook salmon, O. tschawytscha , water temperature is a probably a limiting habitat factor. This study investigated the spatial and temporal correspondence between water temperature and Chinook salmon spawning on t he Chena River, Alaska. Water temperatures were monitored at 21 stations across 220 river kilometers during the 2006 and 2007 spawning seasons and compared to known thermal requirements for egg development. While an absolute upstream thermal boundary to sp awning was not discovered, we describe potential temporal limitations in thermal conditions over the spawning season. Our results show that 98.5% of Chinook salmon selected spawning habitat in which their eggs have a 90% probability of accumulating 450 ATUs before freeze up. This suggests not only temperature conditions limit salmon spawning habitat, but also, as expected, water temperatures temporally limit accessible Chinook salmon spawning habitat at the northern edge of their range. This project documen ts new spawning habitat for the Anadromous Waters Catalog and broadens the geographical range of Chinook salmon thermal habitat research. It also contributes to the understanding of the processes that define salmon habitat, while providing a baseline for f urther investigations into water temperature in other thermal regimes.

identify spawning habitat for fall chum salmon Oncorhynchus keta and model habitat selection from spatial distributions of tagged individuals in the mainstem Tanana River, Alaska. I hypothesized that the presence of groundwater, which pr ovides thermal refugia for overwinter incubation, would be most important for fall chum salmon. Models included braiding, sinuosity, open water surface area (indicating significant groundwater influence), and open water persistence (consistent presence of open water for a 12 year period according to satellite imagery). Candidate models containing open water persistence were selected as most likely. Persistent open water areas were further examined using forward -looking infrared (FLIR) imagery; marked differ ences between sites were observed in the extent of thermal influence by groundwater. Persistent open water sites with strong groundwater influence appear to serve as core areas for spawning salmon; the importance of stability through time suggests the lega cy of successful reproductive effort in these areas for this homing species. This study indicates that not only the presence of groundwater is important for spawning chum, but its persistence and extent of groundwater influence.

Relationships between Ec osystem Metabolism, Benthic Macroinvertebrate Densities, and Environmental Variables in a Sub- Arctic Alaskan River

Student Investigator: Emily Benson, MS Biology
Advisor: Mark Wipfli
Funding Agency: AYKSSI , ADFG

Note : Emily Benson

Marine - Derived Nutrients in Riverine Ecosystems: Developing Tools for Tracking Movement and Assessing Effects in Food Webs on the Kenai Peninsula, Alaska

Student Investigator: Daniel Rinella, PhD Biology
Advisor: Mark Wipfli Marie
Funding Agency: Gulf Ecosystem Monitoring Program , Exxon Valdez Oil Spill Council
In - Kind Support: Kachemak Bay Research Reserve; Environment and Natural Resources Institute/UAA

Note : Dan Rinella graduated from the University of Alaska Fairbanks in May 2010. His dissertation abstract fol(t)41ow-4(s)4(:)]2

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 in interior Alaska. Detailed study of seasonal movements of northern pike in Minto Flats is lacking. These movements need to be better understood to improve management of the fisheries that occur in Minto Flats. Additionally, little is known regarding environmental factors that affect northern pike movements in Alaska. The study objective are to (1) describe seasonal movements of northern pike in the Minto Lakes portion of Minto Flats and how these m ovements may be related to certain environmental factors and (2) evaluate assumptions of population closure and mixing of marked and unmarked individuals used for the mark - recapture experiment conducted by ADFG in 2008 in the Minto Lakes study area. In Mar ch 2008 and 2009, ADFG implanted 80 and 40 northern pike , respectively, with radio - telemetry tags (in addition to 83 radio - tagged fish that remained from a previous pilot study). These tagged fish were tracked with a boat daily for two 8- day periods each month f rom May ÐAugust. Aerial and snow machine telemetry surveys were conducted during winter - spring 2008- 09. Water level and temperature loggers were deployed for both the 2008 and 2009 field seasons. A portable weather station was deployed for the duration of field work. In late April, northern pike located in over - wintering areas in the Chatanika River made an en- mass movement into the study area that coincided with ice - out in the Chatanika River and Goldstream Creek. Post - spawn (late May/e arly June) fish dispersed to summer locations, primarily within the study area. Water temperatures varied widely by location and time of day. Mixing rates of fish appear to be highest during early summer. Tagged fish began out - migration to the Chatanika Ri ver in late September and continued into Decem ber. A better understanding of northern p ike

capable of estimating Dolly Varden proximate composition non- lethally Objectives will be accomplished through a co mbination of field work on the Ivishak River and lab analyses. Data collected in the field (length, weight, and BIA data) will complement lab procedures (proximate analysis, increment analysis, and remote sensing techniques). Biological impedance analysis produces superior estimates of proximate content in Dolly Varden relative to traditional weight - length approaches. These data will characterize se5(e0(t)2(i)4( )8(c)5(o)]TJ 8c)5(h)4(af)]T34(r)7(i)9(zo9(zo9uTJ 8c)5te)4( )85(o)]TJ s(ox)184( )8n

In the late 1970s and early 1980 s burbot stocks started to decline throughout southcentral Alaska in response to intense sportfishin g pressure. Many lake s in the Upper Copper Upper Susitina Management Area (UCUSMA) started to experience depleted local stocks that forced the Alaska Department of Fish and Game (ADF G) to

Longitudinal Distrib ution 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 , US FWS (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 an d fishing pressure. We lack a full understanding of juvenile rearing habitat and factors that limit the distribution and production of Pacific salmon within the region. Restoration and conservation practices in the form of culvert pipe replacement are curr ently underway within the upper Little Susitna River watershed. These efforts are prioritized with little consideration to the differential 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 distributions and abundance with habitat features. I used backpack electrofishers to sample juvenile coho salmon to their upper distribution limit within two headwater streams, measured all fish captured, and collected scale and otolith samples for aid with aging. Habitat assessed in a stream- wide manner included a suite of common variables of known importance to rearing juvenile salmon. Pr eliminary results suggests multiple age classes of juvenile coho are using these areas for rearing and are contiguously present throughout the stream to their upper distribution limit, with older juveniles more dominant in middle to lower stream areas. Res ults from this project will allow for a more strategic and informed

Completed Wildlife Studi es

Waterbird Distribution and Habitat in the Prairie Pothole Region, U.S.A.

Student Investigator: Valerie Steen, MS Biology
Advisor : Abby Powell
Funding Agency: Region 6 , US FWS (RWO 156)

Note: Valerie Steen graduated from the Un iversity of Alaska Fairbanks in December 2010. Her thesis abstract follows:

The Prairie Pothole Region (PPR) of north- central North America provides some of the most critical wetland habitat continent - wide to waterbirds. Agricultura l conversion has resulted in widespread wetland drainage. Furthermore, climate change projections indicate a drier future, which will alter remaining wetland habitats. I evaluated Black Tern (Chlidonias niger) habitat selection and the potential impacts of climate change on the distribution of waterbird species. To examine Black Tern habitat selection, I surveyed 589 wetlands in North and South Dakota in 2008 - 09, then created multivariate habitat models. I documented breeding at 5% and foraging at 17 %0101 Tc (n)4(n)4(e9gi)554w54min(t)4(02 Tc -18537 Tc 2

a landfill, garbage in subadult gull diet decreased. Using stable isotope analysis of gull chick feathers, I found that the diet samples (pell ets and food remains) I used in these analyses overestimated gull use of birds and underestimated use of fishes, but usually accurately portrayed relative importance of garbage. Biases in these samples should be considered when assessing the potential impa ct of gulls on their prey.

Common Ravens in AlaskaÕs North Slope Oil Fields: An Integrated Study Using Local Knowledge and Science

Student Investigator: Stacia Backensto, MS Interdisciplinary
Advisor : Abby Powell
Funding Agencies : Coastal Marine Institu te/UAF; Regional Resilience and Adaptation Program Fellowship (IGERT, NSF 0114423)/UAF; M inerals Management Service; USFWS; Center for Global Change Fellowship/UAF

Note: Stacia Backensto graduated from the University of Alaska Fairbanks in May 2010. Her thesis abstract follows:

Common ravens (Corvus corax) that nest on human structures in the Kuparuk and Prudhoe Bay oil fields on AlaskaÕs North Slope are believed to present a predation risk to tundra -nesting birds in this area. In order to gain more information about the history of the resident raven population and their use of anthropogenic resources in

a separate subspecies. Furthermore, life -history of spruce grouse on POW, which is temperate coastal rainforest, varies sufficiently from birds in mainland areas, mostly boreal forest, to warrant specific management. Therefore, I examined the ecology of spru ce grouse on POW to determine how timber harvest influences their survival and habitat selection and ultimately to provide recommendations for their conservation. During 2007 -2009, we found that the greatest variation in survival probability was attributed to breeding status. The annual survival of non -breeding birds was 0.72±0.082 (! ±SE s) while for breeding birds it was 0.08±0.099. Logging did not adequately predict survival, with no differences among habitats. Conversely, I found differences in selection among habitats. At the watershed scale, spruce grouse preferred unharvested forest. At both watershed and homerange scales, spruce grouse avoided edges and preferred roads. Road -related mortality was the largest known source of death. POW spruce grouse and mainland subspecies exhibit sufficiently different survival rates and habitat prefe rence to warrant specific management. We recommend limited road closures during periods when POW spruce grouse are most vulnerable due to the high rates of mortality associated with this preferred habitat.

Inter- Annual Variance in ! ^{15}N of Blood M etabol ites in a Northern Ungulate in W inter

Student Investigator: Dave Gustine (PhD Biological Sciences; graduated December 2010)
Advisor: Perry Barboza
Funding Agency: U.S. Geological Survey (RWO 162)

Can isotopic ratios of N (" ^{15}N) from routinely collected blood samples be used to assess nutritional constraints in winter for caribou populations? We are developing and refining a blood -based technique to assess body protein loss that will assist management agencies to ascertain mechani sms of population dynamics in caribou herds. We documented and explored the long -term patterns and variance in " ^{15}N in fractions of whole blood and assessed the utility of isotopic correlates of protein status to examine nutritional constraints and materna l investmen t in offspring in late winter. Specifically, we examined how age, body mass, winter and late winter locations, and winter severity varied with body protein loss in a herd of known annual population size and masses of calves at birth. Protein los s was evaluated with isotopic measures of nitrogen metabolites in blood fractions collected from caribou during late winter. We measured isotopes of N (! ^{15}N) in red blood cells, serum proteins, and serum amino acids in 172 blood samples from 116 adult fema le caribou of known age and body mass in the Denali herd across 14 years (1993 -2007). We evaluated correlates of ! ^{15}N for each blood fraction and 2 indices of protein status as well as the estimated the relative importance of year, age, body mass, and spat ial location in the models to estimate isotopic parameters. Linear regression was used to assess the effects of winter severity on isotopic parameters and to examine if maternal protein status in March influenced the birth mass of calves. We predict ed that variation in all factors (year, age, body mass, locations in winter and late winter, and winter severity) would affect the protein status of female caribou in the Denali herd. We expected that severe winters (year effect) would increase catabolism of body proteins and, thus, reduce the body protein available for reproduction (as indexed by birth masses of calves). Year had a strong effect on isotopic parameters and was typically the most important isotopic correlate. However, after controlling for age, bod y mass, and spatial location, year effects on isotopic parameters could

not be explained by winter severity for this low density, montane caribou herd. Similarly, isotopic correlates of protein status did not vary with birth masses of calves. Climate chang es in arctic and subarctic systems may increase the likelihood of more severe winter s and limit the availability of preferred winter forages for caribou . Unfortunately, assessing population -level impacts using ^{15}N in blood fractions may be difficult for low density, montane populations that typically have the nutritional and physiographic capacity to adapt to variable and often severe winter conditions. Indeed, body mass and isotopic indices suggest that adult females were typically in good to excellent n utritional condition in late winter regardless of winter severity. Blood -based approaches may be better suited for populations with larger annual variance in nutritional condition (e.g., migratory herds at higher densities).

Ongoing Wildlife Studies

Renesting Ecology of Arctic- breeding Dunlin on AlaskaÕs North Slope

Student Invest igator: Heather ÒRiverÓ Gates , MS Wildlife Biology
Advisor : Abby Powell
Funding Agencies: Migratory Bird Program , US FWS
In -Kind Support: Office space and computer support provided by USFWS

Renesting rates in arctic- breeding shorebirds are largely unknown and are presumed to be low due to femalesÕ physiological constraints, short nesting season, and limited food resources. Dunlin are a common arctic -breeder across the North Slope with populations that are reportedly declining. A better understanding of this demographic rate will increase the accuracy of reproductive productivity estimates. In 2007 -09, we conducted a study to evaluate how arctic -breeding Dunlin responded t o experimental clutch removal. We measured renesting propensity, mate and territory fidelity, and the interval between clutch removal and replacement clutch laying. We captured, radio- and color -marked approximately 20 adult Dunlin pairs and removed approximately 20 clutches during earl y incubation (2007 -2009) and late incubation (2008 and 2009). Eighty -seven percent of the females laid replacement clutches after early removal, while only 43% replaced clutches after late removal with an average renest ing

There is little knowledge of shorebird biology in the Arctic and what draws these birds to littoral delta mudflats during the post-breeding period, although shorebird biologists suspect food resources may influence shorebird behavior at this time. The Arctic National Wildlife Refuge is investigating these questions to manage and preserve shorebird species and habitat along the refugeÕs coast. Interest in this question grows as potential negative impacts to the coast have developed through off shore oil development and climate change. This study will determine shorebird distribution in relation to invertebrate food resources spatially and temporally and investigate how resource differences between study sites influence length of stay and shorebird physiological parameters. We will conduct shorebird surveys regularly in conjunction with collecting invertebrate core samples on delta mudflats during the post-breeding season. We will measure physiological parameters using blood samples from captured birds. Preliminary results indicate differences between deltas fed by glacial rivers and non-glacially influenced deltas. Freshwater invertebrates seem to decline in the non-

Completed Ecological Studies

Snow Cover and Biology in the Arctic

Research er : EugŽnie Euskirchen (Research Assistant Professor)
Faculty : A. David McGuire
Funding Agency : NSF

In terrestrial high -latitude regions, observations indicate recent change s in snow cover, permafrost, soil freeze -thaw transitions , and fire due to climate change. The responses of high latitude ecosystems to these changes may have consequences for the climate system. In the first study funded by this project (Euskirchen et al., Global Change Biology, 2006), we successfully simulated these changes and related them to changes in growing season length, productivity and net carbon uptake in extratropical regions (30û -90û N) for the period 1960Ð 2100. We have conducted three follow -up studies. In the first follow -up study (Euskirchen et al., Global Change Biology, 2007) w e found that increases in snow cove r-climate feedbacks during 1970Ð 2000 were nearly three times larger than during 191 0Ð1940 because the recent snow -cover change occurred in spring, when radiation load is highest, rather than in autumn. These changes in energy exchange warrant careful consideration in studies of climat e change, particularly with respect to associated changes in vegetation cover. In the second follow -up study (Euskirchen et al., Ecological Appliations, 2009a), we developed a new version of the Terrestrial Ecosystem Model (TEM, version 7.0) to include a dynamic vegetation component with competition among plant functional types for nitrogen and light. We performed model s imulations for the years 2002 Ð2100 under nine future climate scenarios for a region in northern Alaska extending from the ecotonal boreal forest to the Arctic Ocean. Our analysis indicates that the net primary productivity of the dominant plant functional types will increase to cause a decrease in summer albedo, leading to an overall atmospheric heating effect. However, this heating effect w as smaller than that due to changes in the snow season, including both the melting of snow in the spring and the return of snow in the autumn. In the third follow -up study (Euskirchen et al., Journal of Geophysical Research Ð Biogeosciences, 2009b) we examined how climate change affects on both fire regimes and snow cover duration will influence atmospheric heating effects of high latitude terrestrial ecosystems. Changes in summer heating due to changes in vegetation associated with fire showed a slight cooling effect due to increases in summer albedo. Over this same time per iod, decreases in snow cover caused a reduction in albedo, and result in a heating effect when holding the vegetation map from 2003 constan t. Adding both the summer negative change i n atmospheric heating due to changes in fire regimes to the positive changes in atmospheric heating due to changes in the length of the snow season resulted in a 3.4 W m^{-2} $decade^{-1}$ increase in atmospheric heating. We have written a synthesis paper summariz ing the results of these studies (Euskirchen et al., Canadian Journal of Forest Research, 2010). These findings highlight the importance of gaining a better understanding of the relative influences of changes in surface albedo on atmospheric heating due to both changes in vegetation and changes in snow cover duration. These studies are generally relevan t to climate change policy as they consider multiple ways in which terrestrial ecosystem responses to climate change can influence the climate system.

Carbon R esponses along Moisture Gradients in Alaskan L andscapes

Student : Jon OÕDonnell, PhD Biological Sciences
Faculty : A. David McGuire
Funding Agency : Geologic Division , USGS (RWO 149)

High -

SOC there was a six -fold non -linear increase in SOC with latitude (i.e. temperature) where SOC was lowest in the Intermontane Boreal compared to the Arctic Tundra and Coastal Rainforest . Additionally, in upland systems SOC pools decreased as climate became more continental, suggesting that the lower productivity, higher decomposition rates and fire activity, common in continental climates, interacted to reduce SOC . For lowland systems, in contrast, these interactions and their impacts on SOC wer e muted or absent making SOC in these environments more comparable across latitudes.

drought treatment, natural flooding stimulated GPP in 2008. Our data reveal that directional changes in water table position created by our manipulations have a significant effect on both vegetation structure and function, and govern how vegetation responds to inter - annual variation. Understanding vegetation responses to environmental c hange over seasonal, annual, and decadal time scales will improve our understanding of peatland complexity and potential adaptations to future climate change. Based on the field studies, we will use models as tools to understand controls over CO_2 and CH_4 fluxes and DOC production at the ecosystem scale, and will incorporate insights gained from our research into a regional modeling effort to evaluate how changing hydrological and climate conditions in interior Alaska are influencing regional C dynamics. Am y Churchill is a graduate student on the project who started in January 2009 to study vegetation responses to the manipulations. Dr. Zhaosheng Fan, who started in January 2011, is conducting the modeling research.

Assessing the Impacts of Fire and Insect Disturbance on the Terrestrial Carbon Budgets of Forested Areas in Canada, Alaska, and the Western United States

Postdoctoral Researcher s: Fengming Yuan and Daniel Hayes
Faculty : A. David McGuire
Funding Agency : U.S. D epartment of Agriculture

The overall goal of the proposed research is to analyze the impacts of disturbances from insects and fi re on the terrestrial carbon budget for the forested ecoregions of Canada, Alaska and the western U.S. The following objectives are be ing addressed: (1) Develop ment of a consistent bottom - up methodology to estimate carbon consumed during fires; (2) modific ation of a process - based dynamic vegetation/biogeochemistry model to more accurately depict fuel consumption during fires,ct se-5(m)-10(in)-5(s)s,c-5(d)-5(fi)]TJ 0-3(e)-4(c)-3(t)-1(s)-3(a)

Fengming Yuan and Dan H ayes are the postdoctoral researchers conducting the research with TEM in this project.

Partitioning of Soil Respiration along Moisture Gradients in Alaskan Landscapes

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

The Alaskan interior contains enormous carbon re serves in vegetation and soils. As a result of changing temperatures, we anticipate enhanced releases of carbon dioxide, methane, and dissolved organics to streams and ocean waters. How carbon responds to changing climate will affect carbon dynamics will likely depend on interactions wi th soil moisture, which is quite variable in Alaskan landscapes. One of the challenges of modeling carbon responses to a changing climate is the proper representation the response of decomposition, to changes in soil climate. Because measurements of soil respiration include both decomposition (heterotrophic respiration) and plant respiration (autotrophic respiration), it is important to separate out these components to properly interpret how decomposition is responding to changes in soil climate. In summer 2010, graduate student Nicole McConnell conducted e cosystem respiration and root respira tion measurements at the Alaskan Peatland Experiment sites loca ted in the Bonanza Creek LTER. Ecosystem respiration measurements were taken using 60cm x 60cm static flu x chambers and PP- systems CO_2 gas analyzers. Root respiration measurements were taken by destructively harvesting roots and placing them in a 5cm diameter root cuvette attached to a PP -systems CO_2 gas analyzer. Ecosystem respiration was found to vary between years and along some sites at APEX. Root respiration was found to vary among species . These data will be incorporated into a soil respiration model to understand how the partitioning of soil respiration into heterotrophic and autotrophic components chan ge during the summer growing season.

Magnitude, Rate, and Heterogeneity of Surface Water Area Changes in

dynamics and community composition. I will be using a combination of field and remote sensing dat a collected from the Yukon Flats National Wildlife Refuge to fit statistical and simulation models of plant biodiversity and community dynamics. Vegetation surveys were completed at 58 lakes in the Yukon Flats during the projectÕs first field season in sum mer 2010, and these data are currently being

from 1952 Ð2000. The Yukon Flats is one of the largest waterbird breeding grounds in North America , producing approximately 1.6 million ducks, geese, and swa ns 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 in creased 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 clim ate- driven ecological c hange to expect in their refuge over the next 20, 30, or 50 years.

Climate Change and Subsistence Fisheries in Northwest Alaska

List of Abbreviations

ADFG	Alaska Department of Fish and Game
AKCFWRU	Alaska Cooperative Fish and Wildlife Research Unit
AYKSSI	Arctic - Yukon- Kuskokwim Sustainable Salmon Initiative
BLM	Bureau of Land Management
DBW	Department of Biology and Wildlife, UAF
DOE	Department of Energy
GIS	Geographical Information System
IAB	Institute of Arctic Biology, UAF
MMS	Minerals Management Service4(n)3(t)7( )8846(n)3(t)7( )884 0 0 st rgc(e)1(m)-5(eJA-4(Sr)1(e.867 0 T