Alaska Cooperative Fish and Wildlife Research Unit

Annual Research Report—2009

October 14, 2011

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In memory of Nick Hughes, 1962–2009

Not for Publication: Because this report is one of progress, the data presented are often incomplete, and the conclusions reached may not be final.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

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- Rebecca Bentzen, PhD Biological Sciences (Powell)
- Jonathon Gerken, MS Fisheries (Margraf)
- Bessie Green, MS Biology (Wipfli)
- Deena Jallen, MS Fisheries (Margraf)
- Meagan Krupa, PhD Biological Sciences (Wipfli and Chapin)

Post-Doctoral Researchers

- Kirsten Barrett (USGS Mendenhall Postdoctoral Fellow, co-sponsored with Carl Markon, USGS Alaska Science Center) (McGuire)
- Daniel Hayes (McGuire)
- Kris Johnson (McGuire)
- Shuhua Yi (McGuire)
- Fengming Yuan (McGuire)

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University Cooperators

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Cooperators

- Brian Barnes–Director, Institute of Arctic Biology, University of Alaska Fairbanks
- Denby Lloyd–Commissioner, Alaska Department of Fish and Game
- Geoff Haskett–Director, Region 7, US Fish and Wildlife Service
- Michael Tome–Unit Supervisor, Cooperative Research Units, US Geological Survey

monetary value of this support is not known, a listing of the assistance is provided for each project in this report.

Benefits

Students Graduated:

- Wipfli, M. S. 2009. Rainforest-River-Ocean Connections: Nutrient and Energy Pathways that Fuel Riverine Food Webs. Plenary address for a workshop sponsored by the Alaska Sea Grant Marine Advisory Program, Petersburg, AK.
- Wipfli, M. S. 2009. River Ecology and Salmon. Training seminar for a teacher training workshop sponsored by COSEE (Centers for Ocean Sciences and Educational Excellence), Fairbanks, AK.

Papers Presented

Benson, E. R., M. S. Wipfli, and N. F. Hughes. May 2009. Environmental variation, whole stream metabolism, and benthic macroinvertebrates in a subdrainage of the Yukon River, subarctic Alaska. Annual Meeting, North American Benthological Society, Grand Rapids, MI.

Benson, E. R., M. S. Wipfli, and N. F. Hughes. November 2009. Environmental variation and whole stream metabolism in the Chena River, interior Alaska. Annual Meeting, Alaska Chapter, American Fisheries Society, Fairbanks, AK.

Churchill, A., A. D. McGuire, and M. R. Turetsky. September 2009. Plant physiological and environmental controls on primary production in Alaskan peatlands. International Conference on the Role and Importance of Peatlands in the Global Carbon Cycle: Past, Present, and Future, Prague, The Czech Republic.

Collins, S. F., C. V. Baxter, A. Marcarelli, and M. S. Wipfli. May 2009. Adult riparian insect response to experimental in-stream salmon nutrient additions in Idaho. Annual Meeting, North American Benthological Society, Grand Rapids, MI.

Davis, K., S. Alin, A. Barr, P. Coble, R. Cook, S. Denning, P. Griffith, D. Hayes, L. Heath, D. Huntzinger, A. Jacobson, A. King, W. Kurz, A. D. McGuire, S. Ogle, W. Post, B. Raczka, D. Ricciuto, A. Richardson, K. Schaefer, P. Thornton, S. Wofsy, and many data contributors. September 2009. Towards well-constrained continental flux estimates: Progress in the North American Carbon Program. Eighth International Carbon Dioxide Conference, Jena, Germany.

Gerken, J., F. J. Margraf, and R. Brown. May 2009. Identification and characterization of inconnu spawning habitat in the Sulukna River, Alaska. Annual Meeting, Western Division, American Fisheries Society, Albuquerque, NM. (Best Student Paper)

Green, E. C., E. R. Benson, L. Gutierrez, J. R. Neuswanger, M. T. Perry, M.S. Wipfli, N.F. Hughes, and M.J. Evenson. September 2009. Ecology of juvenile Chinook salmon in the Chena River, interior Alaska. International Polar Year Conference, Whitehorse, YT, Canada.

Green, E. C., M. T. Perry, J. Neuswanger, E. R. Benson, L. Gutierrez, M. S. Wipfli, M. Evenson, and N. F. Hughes. September 2009. The ecology of juvenile Chinook salmon in the Chena River, Interior Alaska. Student Conference, Association of Canadian Universities for Northern Studies (ACUNS), Whitehorse, YT, Canada.

Green, E. C

stream fish really eating? Annual Meeting, American Fisheries Society, Nashville, TN.

Gutierrez, L., M. S. Wipfli, N. F. Hughes, and E. C. Green. May 2009. Temporal patterns of terrestrial and aquatic invertebrate prey abundance for juvenile Chinook salmon in a subdrainage of the Yukon River, Alaska. Annual Meeting, North American Benthological Society, Grand Rapids, MI.

Gutierrez, L., M. S. Wipfli, N. F. Hughes, and E. C. Green. November 2009. Patterns of prey abundance for juvenile Chinook salmon in the Chena River, interior Alaska. Annual Meeting, Alaska Chapter, American Fisheries Society, Fairbanks, AK.

Harden, J. W., M. R. Turetsky, M. Conlin, E. Kane, A. D. McGuire, and K. L. Manies. May 2009. The influence of seasonal thaw and water table dynamics on soil carbon and trace gas flux in an ecosystem grandient in Interior Alaska. Spring Meeting, American Geophysical Union, Toronto, Canada.

Kane, E., M. Turetsky, M. Waddington, J. Harden, and A. D. McGuire. May 2009. Seasonal ice and drainage controls over solute chemistry in a rich boreal fen: A field water table manipulation study in Interior Alaska. Spring Meeting, American Geophysical Union, Toronto, Canada.

Kasischke, E. S., S. J. Goetz, A. D. McGuire, and D. J. Hayes. December 2009. An overview of the role of disturbance in the terrestrial carbon budget. Fall Meeting, American Geophysical Union,an7 0 Td [(D.)6(Td [(s7d ( )Tj 0.UJ 0.008T7oI)2(e)-,bs7d6bon)5()]

Neuswanger, J. R., N. F. Hughes, M. S. Wipfli, and L. H. Kelly. September 2009. Accessible 3-D video methods for in situ fish measurement and behavioral analysis. Annual Meeting, American Fisheries Society, Nashville, TN.

Neuswanger, J. R., N. F. Hughes, M. S. Wipfli, and L. H. Kelly. November 2009. Improved 3-D analysis for underwater video, with applications to wild juvenile Chinook salmon foraging behavior. Annual Meeting, Alaska Chapter, American Fisheries Society, Fairbanks, AK.

Perry, M. T., N. F. Hughes, M. S. Wipfli, J. R. Neuswanger, and M. J. Evenson. September 2009. Growth of juvenile Chinook salmon in an interior Alaska river: responses to food abundance and temperature. Annual Meeting, American Fisheries Society, Nashville, TN.

Perry, M. T., N. F. Hughes, M. S. Wipfli, J. R. Neuswanger, and M. J. Evenson. November 2009. Growth responses of juvenile Chinook salmon ( ) to food abundance and temperature in the Chena River, interior Alaska. Annual Meeting, Alaska Chapter, American Fisheries Society, Fairbanks, AK.

Powell, A. N. and S. Oppel. September 2009. Movements and survival of first- and second-year king eiders in the Bering and Chukchi seas. 16th Wildlife Society Conference, Monterey, CA.

Rinella, D. J., M. S. Wipfli, C. Stricker, and R. Heintz. May 2009. Relationship between spawning salmon abundance and fitness of stream-dwelling fishes,

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

Variation in Age and Size at Maturity of Lake Clark, Alaska Sockeye Salmon

Student Investigator: Elizabeth Benolkin, MS Fisheries
Advisor: F. Joseph Margraf
Funding Agency: USGS

: Libby Benolkin graduated from the University of Alaska Fairbanks in December 2009. Her thesis abstract follows:

Salmon returning to Lake Clark, Alaska are a valuable subsistence, commercial and ecological resource, and are an important component of the larger Kvichak River escapement. Average escapement to the Kvichak River declined sharply during 1996-2005, prompting studies to investigate age and size at maturity, key life history traits of salmon linked to reproductive success and survival. We examined potential factors which may influence sockeye salmon age and size at maturity: spawning habitat and ocean environment, and examined variation in both traits over time. Sockeye salmon age and length at maturity differed among spawning locations and between brood years, but no consistent patterns were observed among habitat types. Age and length at maturity differed over time; the proportion of older marine age 3 fish was larger in recent brood years, while fish were smaller during 1997-2001 compared to 1976-1980. Sea surface temperatures and coastal upwelling appeared to be important indicators of fish length, highlighting the importance of the ocean environment in salmon growth. These results demonstrate the complexity and importance of both the freshwater and ocean ecosystems in variation in age and size at maturity, and indicate that trends may not necessarily be similar among systems or years.

Identification and Characterization of Inconnu Spawning Habitat in the Sulukna River, Alaska

Student Investigator: Jonathon Gerken, MS Fisheries
Advisor: F. Joseph Margraf
Funding Agency: Koyukuk/Nowitna National Wildlife Refuge/USFWS

: Jon Gerken graduated from the University of Alaska Fairbanks in December 2009. His thesis abstract follows:

Inconnu are present throughout much of the Yukon River drainage in Alaska, but only five spawning areas have been identified. Spawning habitat requirements are therefore thought to be very specific; however, the physical qualities of these habitats have only been characterized in general terms. The Sulukna River is one of five identified inconnu spawning areas within the Yukon River drainage. A systematic sampling design was used in September and October of 2007-2008 to define Sulukna River spawning locations. Presence of inconnu was identified using hook and line sampling methods and spawning was verified by

catching broadcast eggs in plankton nets. Small-scale, large-scale, and chemical habitat variables were sampled at transects located every 1.8 river kilometer (rkm). Project results indicate that spawning habitat was confined to a narrow reach of approximately 20 rkm. Spawning habitat occurred significantly more often in transects characterized with substrate between 6 and 12 cm, a width to depth ratio between 15 – 36, and water conductivity between 266 – 298 µS/cm. Similar studies on other known spawning habitats would reveal whether these qualities are common to all inconnu spawning populations or unique to the Sulukna River.

Ecological Linkages between Headwater Streams and Riparian and Downstream Habitats in the Eastern Cascade Range, Washington, USA

Student Investigator: Elizabeth C. Green, MS Biology
Advisor: Mark Wipfli
Funding Agency: Bonneville Power Authority/DOE

: Bessie Green graduated from the University of Alaska Fairbanks in December 2009. Her thesis abstract follows:

I examined how headwater streams are ecologically linked with the terrestrial environment and upstream waters. I examined relationships between fish (rainbow and cutthroat trout), invertebrates, and habitat in 15 headwater streams in two ecoregions (wet, dry) and timber harvest scenarios (logged, unlogged) in the Wenatchee River sub-basin in the eastern Cascade Mountain Range, Washington state, USA. Fish biomass, density, and size were not related to ecoregion nor to logging history. Invertebrate drift manipulations in 13 streams influenced fish movement (fish moved downstream in sites that were not supplemented with food) and diet (fish consumed less prey when drifting invertebrates were removed), but not fish growth or abundance. This study demonstrated that fish utilize drifting prey originating from upstream fishless waters, and that they are not able to compensate for the loss of this food. Headwater forest management may affect fish populations by altering prey resources where fish are food-limited.

River Features Associated with Chinook Salmon Spawning Habitat in Southwest Alaska

Student Investigator: Deena M. Jallen, MS Fisheries
Advisor: F. Joseph Margraf
Funding Agency: USc 0.3557 0 W2(g)(F)3(i)73(i0cqC(s)2(3(.)8( )8n)-1(g)-.c)-1(h)-1(g)3(t)7(o)H

observations were collected along 75 rkm (river kilometers) of the Tuluksak River primarily within the Yukon Delta National Wildlife Refuge. Habitat and salmon observations were grouped into strata along the length of the river for comparison and analysis. Chinook salmon were observed spawning in the upper 45 rkm of the study area. Map-based observations of elevation and channel sinuosity correlate better with Chinook salmon spawning than in stream habitat measurements along the Tuluksak River. The upper boundary of Chinook salmon spawning in the Tuluksak River was outside of our study area. The lower boundary for Chinook salmon spawning habitat on similar rivers might be determined by examining elevation, sinuosity, and channel features from remote images or maps prior to conducting field studies.

Urban Stream Management: Interdisciplinary Assessment of an Alaskan Salmon Fishery

Student Investigator: Megan B. Krupa, PhD Biology
Co-Advisors: Mark Wipfli and F. Stuart Chapin III
Funding Agencies: National Science Foundation Integrated Graduate Education and Research Traineeship (IGERT), UAF Resilience and Adaptation Program (RAP)

: Megan Krupa graduated from the University of Alaska Fairbanks in May 2009. Her dissertation abstract follows:

The Lower Ship Creek Fishery in the city of Anchorage, Alaska is one of the state's most popular sport fisheries. After years of channelization and development, this social-ecological system (SES) continues to experience the effects of urbanization and is struggling to achieve robustness. I applied a robustness framework to the management of this fishery because of its semi-engineered nature. This framework uses interdisciplinary methods to study the interrelationships between the fishery's socio-economic and ecological components. Robustness is more appropriate than resilience as an analytical framework because of the relative insensitivity of the engineered components to ecological feedbacks. On Lower Ship Creek, the engineered hatchery fish continue to thrive despite declining stream conditions. The robustness of this fishery contributes to the resilience of the city by increasing local food and recreation options and supporting a diverse set of businesses. To study the robustness of this SES in the context of the resilience of Anchorage, I first combined historical photos and existing Ship Creek data with research conducted on other streams to create an environmental history of the creek. This history then was used to describe how eras of urban development have altered the creek's ecosystem processes and created new ecological constraints related to 1) loss of wetlands and riparian vegetation; 2) erosion, pollution, and channelization; 3) loss of fish species; and 4) flow alteration and habitat loss. Using Lovecraft's (2008) typology, I proposed

economic incentive to work more cooperatively in the future. I then explored the interrelationship of the SES's socio-economic and ecological subsystems, using Anderies et al.'s (2004) framework. I applied Ostrom's design principles (1990) to sport fisheries to explore the reasons why agencies have not cooperated to produce a more robust fishery. This SES fails to meet three of the design principles: it lacks 1) an equal proportion of benefits and costs, 2) collective-choice arrangements, and 3) user and biophysical monitoring. I then suggest how to improve the design and increase the robustness of this SES. This study proposes that the maintenance of semi-engineered systems is important both for local users and for the resilience of states and countries. In the context of global trends toward increasing urbanization, this study provides an interdisciplinary approach to increasing the robustness of urban streams and building resilience within states and countries.

Ongoing Aquatic Studies

Spawning Stock Characteristics of Inconnu in the Sulukna River, Alaska

Student Investigator: David A. Esse, MS Fisheries
Advisor: F. Joseph Margraf
Funding Agency: Central Yukon Field Office/BLM
Other Support: Technical assistance and equipment provided by USFWS

Abundance and characteristics such as genetic structure, migratory movements, and age composition for spawning inconnu stocks within the Yukon River watershed are largely unknown. Inconnu are an important subsistence, commercial, and sport fish within Alaska. With the lack of information on abundance and characteristics of inconnu stocks within the Yukon River drainage, fisheries managers lack the tools necessary for informed harvest management decisions. The objectives of this study are to (1) determine the abundance and out-migration timing of Sulukna River inconnu; (2) determine if any individuals of this stock migrate to saltwater areas; and (3) determine the age structure of out-migrating inconnu. In 2008 and 2009, Dual-frequency Identification Sonar was used to document abundance of inconnu leaving the spawning grounds as well as the timing of out-migration. In 2008, from September 17 to October 10, 2,079 inconnu out-migrated past the sonar site. In 2009, from September 18 to October 8, 3,571 inconnu out-migrated. In both years 96% of out-migrants moved past the sonar site between 8 p.m and 9 a.m. Sagittal otoliths were collected and are being analyzed to determine age and amphidromy. With known inconnu spawning areas limited to five locations within the Yukon River drainage, these stocks and associated spawning habitats are extremely susceptible to exploitation and detrimental land use activities. Land and fisheries managers must be conservative when it comes to harvest and land use decisions associated with inconnu and inconnu spawning habitat until a comprehensive population assessment can be completed.

A Remote Sensing/GIS Based Approach to Identify Potential Fall-Run Chum Salmon Spawning Habitat in the Mainstem Tanana River, Alaska

Student Investigator: Lisa South, MS Fisheries
Co-Advisors: F. Joseph Margraf and Amanda Rosenberger
Funding Agency: Arctic-Yukon-Kuskokwim Sustainable Salmon Initiative (AYKSSP), Commercial Fisheries Division/ADFG

Chum salmon are extremely important for subsistence and commercial fisheries in Alaska. Spawning habitat by fall chum salmon is largely unknown in the mainstem area of the Tanana River. Increasing development and recreational use along the Tanana River pose possible habitat degradation concerns, and a greater knowledge of this area is needed for better management and research. The objectives of this study are to determine if fall chum are keying in on areas of upwelling water, identify differences in habitat in areas of upwelling water and areas of non-upwelling water, and create a predictive model of habitat use. Fish were implanted by ADFG with radio-transmitters, and movements were tracked through two spawning seasons. Upwelling areas were mapped during winter months (ice-free zones) by using Synthetic Aperture Radar (SAR) imagery provided by the Alaska Satellite Facility, and temperature regimes will be confirmed by temperature loggers and Forward Looking Infrared (FLIR) images. Fall-chum salmon were observed using upwelling water areas for spawning during the 2007-08 field season. In 2009 we collected temperature loggers from study sites and FLIR images to identify temperature regimes within these upwelling areas. Remotely sensed variables will be combined to create a predictive model of habitat us(n)5(r)4(A)-1rom

temperature loggers were deployed for both the 2008 and 2009 field seasons. A

Spawning and Recruitment of Razor Clams ( ) in East Cook Inlet

Student Investigator: J

Developing Monitoring Tools for Tracking Marine-Derived Nutrients in Alaska Watersheds

Student Investigator: Daniel J. Rinella, PhD Biology
Advisor: Mark Wipfli
Funding Agency: Gulf Ecosystem Monitoring Program/EVOS
In-Kind Support: Kachemak Bay Research Reserve; Environment and Natural Resources Institute/UAA

Although numerous studies have shown positive effects of marine-derived nutrients (MDN) from Pacific salmon on freshwater fishes, the amount of MDN required to maximize the growth and nutritional status of freshwater fishes is unknown. Identifying salmon spawner levels above which stream-dwelling fish cease to gain physiological benefits may be a direct and appropriate measure of the capacity of fish populations to utilize MDN. The objectives of this study were to determine (1) if growth rates and energy density in coho salmon parr and juvenile Dolly Varden reach an asymptote (i.e., saturate) with increasing MDN abundance and (2) what level of MDN abundance is required to elicit any saturation responses. We collected coho salmon ( ) parr and juvenile Dolly Varden ( ) during spring and fall from 11 streams on the Kenai Peninsula, southcentral Alaska, that varied widely in salmon spawner densities (0.1 to 4.8 kg/m^2). From these samples we measured RNA-DNA ratios (an index of recent growth rates) and energy density (kJ/g dry mass). RNA-DNA ratios and energy density indicated a saturation response where values increased rapidly with spawner abundance up to approximately 1 kg/m^2 and then leveled off somewhat (except for Dolly Varden

with increasing light intensity under some conditions; in addition, primary production rates were highest at intermediate stream flows, and community respiration rates were lowest at intermediate stream flows. Benthic macroinvertebrate densities were lowest at highest stream flows. Data from this study will contribute to the long-term goal of understanding the environmental factors that affect river food webs in interior Alaska that support juvenile Chinook salmon.

Patterns of Prey Abundance for Juvenile Chinook Salmon in the Chena River, Interior Alaska

Student Investigator:

temperature limits juvenile Chinook salmon growth, (2) investigate if seasonal

Completed Wildlife Studies

Reproductive Patterns in King Eiders

Student Investigator: Rebecca McGuire Bentzen, PhD Biological Sciences
Advisor: Abby Powell
Funding Agencies: Coastal Marine Institute/UAF; ConocoPhillips Alaska, Inc.; BLM; NSB; MMS; and USGS

Rebecca Bentzen graduated from the University of Alaska Fairbanks in December 2009. Her dissertation abstract follows:

Mammalian predation, avian predation, female body condition and food availability on the breeding ground are likely the main factors influencing nesting success in tundra-nesting waterfowl. These driving factors are mediated by the primary life history characteristics; incubation behavior, female body size, nesting associations, and nest site selection. I created a conceptual model illustrating how these factors are inter-related and how they impact nest success through a variety of pathways to better understand the evolution of a species' nesting strategy and patterns observed in the field. The importance of the driving factors likely varies between sites and with the species nesting strategy. Given the conceptual model, I predicted the difference

Diet of Glaucous Gulls on Alaska's North Slope

Student Investigator: Emily Weiser, MS

Smith's Longspur distribution and abundance is the critical first step in developing a conservation plan. Changes in the distribution and condition of breeding habitat due to climate change will be difficult to predict without an understanding of current habitat associations.

Renesting Ecology of Arctic-breeding Dunlin on Alaska's North Slope

Student Investigator: Heather "River" Gates, MS Wildlife Biology
Advisor: Abby Powell
Funding Agency: Migratory Bird Program/USFWS
In-Kind Support: Vehicle, technical assistance, and equipment provided by USFWS during field season; purchase of VHF radios/IAB

Renesting rates in arctic-breeding shorebirds are largely unknown and are presumed to be low due to females' 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 2007brewiiyN-3(c)5 Tc4101

Survival of Prince of Wales Spruce Grouse in Southeast Alaska

Student Investigator: Aleya Nelson, MS Wildlife Biology
Advisor:

protein status and demographic or environmental parameters. These analyses will set the context for estimates of protein status using excreta collected from four Alaskan caribou herds from 2006-2008. To date, we have collected 1060 excreta samples (feces and snow urine) from the winter ranges of the Western Arctic, Central Arctic, Denali, and Chisana caribou herds. All aspects of field work were completed for this project in April 2008. We predict that variation in all factors (diet, demography, and environment) will affect the protein status of female caribou in the Denali herd. Specifically, we predict that severe winters will limit the body protein available for reproduction and this limitation will be evident in our isotopic measure of protein status; the results and implications from this work are pending. Regarding the population-level comparisons using excreta, the Central Arctic and Chisana herds had poorer estimates of protein status than the Western Arctic and Denali herds. The amount of shrubs in the winter diets of caribou had a positive effect on protein status across herds and years. Climate changes in arctic and subarctic systems may increase the likelihood of more severe winters and limit the availability of preferred winter forages for caribou. Unfortunately, assessing population-level impacts using excreta may be difficult as caribou exhibit a diversity of physiological adaptations to deal with spatial and temporal variance in environmental conditions. In addition, variation in forage selection may also alter the estimation of protein status from isotopes. Selection of forages that are high in N such as shrubs may enable caribou

Completed Ecological Studies

Synthesis of Arctic System Carbon Cycle Research Through Model-

Ongoing Ecological Studies

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

Student Investigator: Amy Churchill, MS Biology
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 regions in Alaska are drying, while other regions are becoming wetter. Central to peatland C balance is the role and fate of soil hydrology, which controls both vegetation and belowground C processes. This project addresses hydrology-warming-carbon cycle interactions by manipulating water tables and environmental temperatures in peatlands. Net primary production and net C fluxes (CO_2

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 was 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 ( ) we examined how climate change effects 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 period, decreases in snow cover caused a reduction in albedo, and result in a heating effect when holding the vegetation map from 2003 constant. Adding both the summer negative change in 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. 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 relevant to climate change policy as they consider multiple ways in which terrestrial ecosystem responses to climate change can influence the climate system.

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: Fengming Yuan
Faculty: A. David McGuire
Funding Agency: USDA

The overall goal of the proposed research is to analyze the impacts of disturbances from insects and fire on the terrestrial carbon budget for the forested ecoregions of Canada, Alaska, and the western U.S. The following objectives are being addressed: (1) development of a consistent bottom-up methodology to estimate carbon consumed during fires; (2) modification of a process-based dynamic vegetation/ biogeochemistry model to more accurately depict fuel consumption during fires, mortality from fires and insect disturbance, effects of climate and insects on net primary production, and forest succession as a function of disturbance type and severity; and (3) assessment of

include collaborations with CFS scientists working on modeling of the carbon cycle, as well as scientists from the USGS and USFS who have expertise and field

insights from this research have the potential to inform models of C exchange in boreal landscapes.

Assessing the Role of Deep Soil Carbon in Interior Alaska: Data, Models, and Spatial/Temporal Dynamics

Postdoctoral Researcher: Kristofer Johnson
Faculty: A. David McGuire
Funding Agency: Geologic Division/USGS (RWO 163)

This study involves two efforts to improve the current state of knowledge of soil carbon in Alaska: (1) compilation and synthesis of available existing data in the development of statistical models that will estimate soil carbon storage at 1-km resolution across the landscape based on associations between landscape features and fir

to changing climate will affect carbon dynamics and will likely depend on interactions with 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 of 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 this study we will conduct a study that measures soil respiration along a moisture gradient in interior Alaska and collects ancillary data that will allow us to separate out the decomposition and plant respiration components of soil respiration. We will use this understanding to inform models how to represent this partitioning. Nicole McConnell is a new graduate student who began in September 2009 and will conduct the partitioning research in this study.

2010 Yukon River Basin Studies—Yukon Flats Tree Ring Data Bases For NDVI Comparison.

Principal Investigator: Glenn P. Juday
Funding Agency: USGS (RWO 181)
In-Kind Support: UAFGl803 -1.22 Td ( )Tj 0.0255 Tc 0 -1.244 TD ae4(epb.3se55 Tc 0 -1.2a)1(1o)6(

Magnitude, Rate, and Heterogeneity of Surface Water Area Changes in National Wildlife Refuges in Interior Alaska

Student Investigator: Jennifer Roach, MS Biological Sciences
Advisor: Brad Griffith
Funding Agencies: USFWS; USGS

Recent studies have identified substantial losses in surface water area in sub-Arctic boreal regions since 1950, and this trend has been coincident with climate warming in these regions. However, the magnitude, heterogeneity, and mechanisms behind changes in surface water area in Alaskan National Wildlife Refuges are not known. Changes in the amount of surface water in National Wildlife Refuges could alter critical

susceptible to change and about the ecological impacts of this change, potentially allowing for more accurate climate change projections.

List of Abbreviations

ADFG