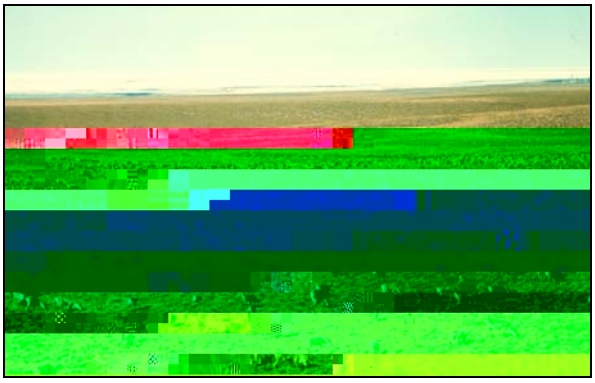
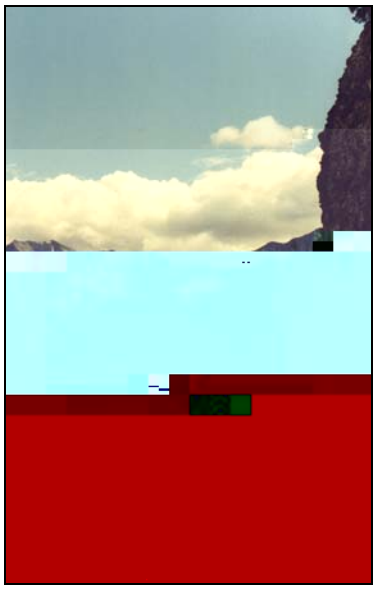
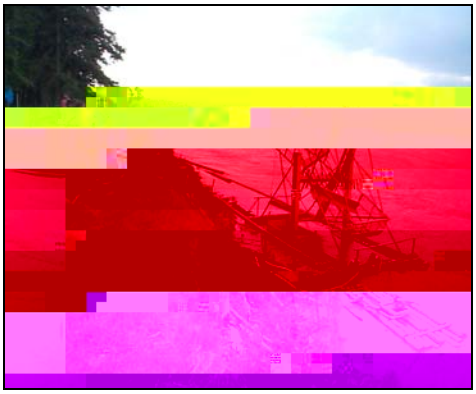
Caribou in Arctic National Wildlife Refuge.
Photo by Brad Griffith.





Lake Clark.
Photo by Alex Wilkens.



Recovery fishwheel, Kantishna River. Photo by Peter Cleary.

Upper Ugashik Narrows,looking toward Upper Ugashik Lake with Mt.Peulik in the background.
Photo by Joe Margraf.

Contents

Prepared 27 February 2003

Unit Roster

Federal Scientists

- Griffith, Brad: Assistant Leader-Wildlife
- Margraf, F. Joseph: Leader

Faculty Cooperators

- Buck, Loren, School of Fisheries and Ocean Sciences (SFOS), Fisheries Industrial Technology Center, UAF, Kodiak
- Cook, Joseph A., Department of Biological Sciences, Idaho State University, Pocatello
- Finney, Bruce P., SFOS/Institute of Marine Science (IMS), UAF
- Follmann, Erich H., Department of Biology and Wildlife (DBW), Institute of Arctic Biology (IAB), UAF
- Gharrett, Anthony J., SFOS, UAF, Juneau
- Hughes, Nicholas F., SFOS, UAF
- Laursen, Gary A., DBW, UAF
- Lindberg, Mark, IAB, UAF
- Mann, Daniel, IAB, UAF
- McRoy, C. Peter, SFOS/IMS, UAF
- Rexstad, Eric A., DBW/IAB, UAF
- Reynolds, James B., Emeritus UAF
- Rupp, Scott, Forest Sciences Department, UAF
- Winker, Kevin S., UA Museum/DBW/IAB, UAF

Affiliated Students

Current

- Flannery, Blair G., MS Fisheries-Juneau (Gharrett)
- French, H. Blair, MS Wildlife (Follmann)
- Gamble, Brook, MS Wildlife (Buck/Murphy)
- Holliman, F. Michael, PhD Fisheries (Reynolds)
- Lake, Bryce, MS Wildlife (Lindberg)
- Safine, David, MS Wildlife (Lindberg)
- Schmidt, Joshua, MS Wildlife (Rexstad)

Graduated (during CY)

- Dion, Cheryl A., MS Fisheries (Hughes and Reynolds)
- Whitman, Matthew S., MS Fisheries (Hughes)
- Wilkens, Alexander X, MS Biology (Hughes)

Cooperators

- Allen, David-US Fish and Wildlife Service
- Barnes, Brian M.-University of Alaska Fairbanks
- Davison, Robert P.-Wildlife Management Institute
- Rue, Frank, Alaska Department of Fish and Game

Introduction

This is the Annual Report for the Alaska Cooperative Fish and Wildlife Research Unit, highlighting activities for calendar year 2002. 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

Unit Cost-Benefit Statements

In-Kind Support

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

Benefits

Students Graduated: 4
Presentations: 21
Scientific and Technical Publications: 18

Graduate Committee Assignments

- Adler, Corey - MS Wildlife (Griffith)
- Braile, Thomas - PhD Biology (Powell)
- Carlson, Matthew - MS Wildlife (McGuire)
- Dion, Cheryl - MS Fisheries (Margraf)
- Duffy, Paul - PhD Interdisciplinary (McGuire)
- Finstad, Greg - PhD Interdisciplinary (Griffith)
- Flora, Bjorn - MS Biology (Griffith)
- Herzog, Mark - PhD Wildlife (McGuire)
- Holliman, F. Michael - PhD Fisheries (Margraf)
- Johnson, Andrew - MS Zoology (Powell)
- MacLean, Scott - MS Fisheries(Margraf)
- Overton, Anthony - PhD Fisheries (Margraf)
- Riordan, Brian - MS Natural Resource Management (McGuire)
- Schmidt, Joshua - MS Wildlife (Powell)
- Sowl, Kristine - MS Wildlife (Powell)
- Vogel, Jason - PhD Interdisciplinary (McGuire)
- Walker, Johann - MS Wildlife (Powell)
- Walton, James - MS Biology (McGuire)
- Whitman, Matthew S. - MS Fisheries (Margraf)
- Zhu, Lijie - MS Interdisciplinary (McGuire)

Courses Taught

- Biological Aspects of Global Change (McGuire - 3 credit hours and 3 students. Spring 2002.)
- Contemporary Issues in Fisheries Science (Margraf - 1 credit hour and 8 students. Spring 2002.)
- Endangered Species Management (Powell - 3 credit hours and 8 students. Spring 2002.)
- Foraging Ecology (Griffith - 2 credit hours. Spring 2002.)
- Quantitative Fisheries Science (Margraf - 3 credit hours and 8 students. Spring 2002.)
- Regional Systems Dynamics and Modeling (McGuire - 4 credit hours and 20 students. Fall 2002.)

University Committees and Workgroups

- Chair, Faculty Search Committee (Margraf)
- Chair, Subcommittee on Graduate Admissions Procedures in the Department of Biology

- Member, Technical Advisory Team for Fisheries for U.S. Fish and Wildlife Service, Region 7, Refuges (Margraf)
- Member, Technical Advisory Team for Peer Review for U.S. Fish and Wildlife Service, Region 7, Refuges (Margraf)
- Member, Technical Team, Western Snowy Plover Recovery Team (Powell)

Outreach and Information Transfer

- Alaska Bird Observatory Seminar Series (Powell)
- Griffith, B., L. M. Comly, M. Chilelli, K. R. Rock, J. M. Scott, T. H. Tear, and J. W. Carpenter. 1998. Annotated bibliography of wildlife translocations. http://mercury.bio.uaf.edu/~bgriffit.faculty/translocation.ssi (Griffith)
- Presented a talk, "Ecology of King Eiders on Alaska's North Slope," at the Minerals Management Service Seminar Series in Anchorage
- Reviewer for Alaska High School Symposium (annually). (McGuire)
- Science for Alaska Series, Sponsored by Geophysical Institute, 4 lecture series throughout Alaska, Satellite tracking caribou. (Griffith)
- Spatial Ecology Lab Web Page: http://picea.sel.uaf.edu (McGuire)

Papers Presented

Ras, L. B., J. Margraf, D. L. Bounds. March 2002. Ecology and management of nutria on the Eastern Shore of Maryland. West Virginia Chapter of The Wildlife Society Meeting.

Knudsen, E. E., E. W. Symmes, and F. J. Margraf. April 2002. Using a life history approach to evaluate salmon escapement management scenarios. Annual Meeting, Western Division, American Fisheries Society, Spokane, WA.

McGuire, A. D. April 2002. The role of atmospheric carbon dioxide, climate, and disturbance in the carbon balance of the terrestrial biosphere in the twentieth century: Global and regional perspectives. Workshop on Terrestrial Ecosystems Responses to Atmospheric and Climatic Change (TERACC), Durham, NH. Invited.

Calef, M. P., A. D. McGuire, T. S. Rupp, E. M. Debevec, H. E. Epstein, and H. H. Shugart. August 2002. Land cover change in the western Arctic: Development of a logistic regression model. Annual Meeting, Ecological Society of America, Tucson, AZ.

Chapin, F. S., J. Beringer, W. Eugster, A. Lloyd, A. Lynch, J. McFadden, A. D. McGuire, and M. Sturm. August 2002. Vegetation feedbacks to climate warming in Alaskan arctic and boreal ecosystems. Annual Meeting, Ecological Society of America, Tucson, AZ.

Copass, C. D., J. Beringer, F. S. Chapin III, A. D. McGuire, and D. A. Walker. August 2002. Relationship of structural complexity to land surface exchange along a gradient from arctic tundra to forest. Annual Meeting, Ecological Society of America, Tucson, AZ.

Joyce, L. A., D. P. Coulson, A. D. McGuire, R. Birdsey, and B. Smith. August 2002. Harvesting disturbances on forestland from 1600 to present. Annual Meeting, Ecological Society of America, Tucson, AZ.

Knudsen, E. E., E. W. Symmes, and F. J. Margraf. August 2002. Searching for a life history approach to Pacific salmon population modeling. Annual Meeting, American Fisheries Society, Baltimore, MD.

McGuire, A. D. and the IGBP High Latitude Transect Working Group. August 2002. Environmental variation, vegetation distribution, and carbon dynamics in high latitudes.

International Boreal Forest Research Association XI International Conference, Boreal Forests and the Environment: Local, Regional, and Global Scales, Krasnoyarsk, Russia. Invited.

Overton, A. S., F. J. Margraf, and E. B. May. August 2002. Ontogenic and spatial patterns in diet and growth of striped bass in Chesapeake Bay. Annual Meeting, American Fisheries Society, Baltimore, MD.

Shvidenko, A. Z., Ch. Schmullius, M. Apps, K. Bergen, J. Cihlar, D. F. Effremov, R. A. Houghton, A. D. McGuire, S. Nilsson, F. I. Pleshikov, V. A. Rozhkov, E. A. Vaganov, W. Steffen, and D.-E. Schultze. August 2002. On an integrated project on estimating the role of northern Eurasia forests in global biogeochemical cycles. International Boreal Forest Research Association XI International Conference, Boreal Forests and the Environment: Local, Regional, and Global Scales, Krasnoyarsk, Russia. Invited.

Zhuang, Q., J. S. Clein, A. D. McGuire, R. J. Dargaville, V. E. Romanovsky, J. Harden, D. W. Kicklighter, J. M. Melillo, J. E. Hobbie, and E. B. Rastetter. August 2002. Modeling the effects of soil thermal on the seasonality of carbon fluxes across northern temperate and high latitude regions. Annual Meeting, Ecological Society of America, Tucson, AZ.

McGuire, A. D. September 2002. Carbon cycling in extratropical ecosystems of the Northern Hemisphere during the 20th century: A modeling analysis of soil thermal dynamics. IGBP/GCTE-LCUC Transect Meeting, Guangzhou, China. Invited.

Meka, J. M., F. J. Margraf, N. B. Hughes, and J. L. Nielsen. October 2002. Effects of catch-and-release fishing on hooking injury and physiology of wild rainbow trout in the Alagnak River, Alaska. Annual Meeting, Alaska Chapter, American Fisheries Society, Girdwood, AK.

Powell, A. N. October 2002. Are southern California's fragmented salt marshes capable of sustaining populations of Belding's Savannah sparrows? Invited Speaker, Animals of Tidal Marshes Symposium, Patuxent, MD.

Young, D. B., C. A. Woody, and F. J. Margraf. October 2002. Sockeye salmon spawning distribution in Lake Clark, Alaska. Annual Meeting, Alaska Chapter, American Fisheries Society, Girdwood, AK.

McGuire, R. L., L. Phillips, R. Suydam, and A. N. Powell. November 2002. Breeding biology and habitat use by king eider at Teshekpuk Lake and Kuparuk oil fields on the North Slope of Alaska. Poster, North American Sea Duck Conference, Victoria, BC.

Meka, J. M., F. J. Margraf, N. F. Hughes, and J. L. Nielsen. November 2002. Effects of catch-and-release fishing on hooking injury and physiology of wild rainbow trout in the Alagnak River, Alaska. Annual Meeting, Alaska Chapter, American Fisheries Society, Girdwood, AK.

Phillips, L. M., A. N. Powell, and E. J Taylor. November 2002. Importance of the Alaskan Beaufort Sea to king eiders during fall migration. Poster, North American Sea Duck Conference, Victoria, BC.

Schmidt, J. H., E. Rexstad, E. J. Taylor, and A. N. Powell. November 2002. Duckling survival rate and nest attendance patterns in common goldeneyes in interior Alaska: Preliminary results. Poster, North American Sea Duck Conference, Victoria, BC.

Wilson, H. M., T. L. Moran, P. L. Flint, and A. N. Powell. November 2002. Breeding biology of common eiders on the Yukon-Kuskokwim Delta, Alaska. Poster, North American Sea Duck Conference, Victoria, BC.

Scientific Publications

Amthor, J. S., J. M. Chen, J. S. Clein, S. E. Frolking, M. L. Goulden, R. F. Grant, J. S. Kimball, A. W. King, A. D. McGuire, N. T. Nikolov, C. S. Potter, S. Wang, and S. C. Wofsy. 2001. Boreal forest CO2 exchange and evapotranspiration predicted by nine ecosystem process models: Intermodel comparisons and relationships to field measurements. Journal of Geophysical Research - Atmospheres 106:33, 623-33, 648.

Blanc, T. J. and F. J. Margraf. 2002. Effects of nutrient enrichment on channel catfish growth and consumption in Mt. Storm Lake, West Virginia. Lakes & Reservoirs: Research & Management 7:109-123.

Cameron, R. D., W. T. Smith, R. G. White, and B. Griffith. 2002. The Central Arctic caribou herd. Pages 38-45 in D. C. Douglas, P. E. Reynolds, and E. B. Rhode, editors. Arctic Refuge Coastal Plain Terrestrial Wildlife Research Summaries. U.S. Geological Survey, Biological Resources Division, Biological Science Report USGS/BRD BSR-2002-0001.

Clein, J. S., A. D. McGuire, X. Zhuang, D. W. Kicklighter, J. M. Melillo, S. C. Wofsy, P. G. Jarvis, and J. M. Massheder. 2002. Historical and projected carbon balances of mature black spruce ecosystems across North America: The role of carbon-nitrogen interactions. Plant and Soil 242:15-32.

Danks, F. S. and D. R. Klein. 2002. Using GIS to predict potential wildlife habitat: A case study of muskoxen in northern Alaska. International Journal of Remote Sensing 23(21):4611-4632.

Dargaville, R., A. D. McGuire, and P. Rayner. 2002. Estimates of large-scale fluxes in high latitudes from terrestrial biosphere models and an inversion of atmospheric CO2 measurements. Climatic Change 55:273-285.

Eckmayer, W. J. and F.J. Margraf. 2001. Aging early age-0 white bass (*Morone chrysops*) by daily otolith increment analysis. Journal of Freshwater Ecology. 16:653-654.

Fleming, M. A. and J. A. Cook. 2002. Phylogeography of endemic ermine (*Mustela erminea*) in southeast Alaska. Molecular Ecology:795-808.

Geiger, H. J. and X. Zhang. 2002. A simple procedure to evaluate salmon escapement trends that emphasizes biological meaning over statistical significance. Alaska Fishery Research Bulletin 9(2):128-134.

Golet, G. H., P. E. Seiser, A. D. McGuire, D. D. Roby, J. B. Fischer, K. J. Kuletz, D. B. Irons, T. A. Dean, S. C. Jewett, and S. H. Newman. 2002. Long-term direct and indirect effects of the Exxon Valdez oil spill on pigeon guillemots in Prince William Sound, Alaska. Marine Ecology Progress Series 241:287-304.

Griffith, B., D. C. Douglas, N. E. Walsh, D. D. Young, T. R. McCabe, D. E. Russell, R. G. White, R. D. Cameron, and K. R. Whitten. 2002. The Porcupine caribou herd. Pages 8-37 in D. C. Douglas, P. E. Reynolds, and E. B. Rhode, editors. Arctic Refuge Coastal Plain Terrestrial Wildlife Research Summaries. U.S. Geological Survey, Biological Resources Division, Biological Science Report USGS/BRD BSR-2002-0001.

Holliman, F. M. and J. B. Reynolds. 2002. Electroshock-induced injury in juvenile white sturgeon. North American Journal of Fisheries Management 22:494-499.

Johnstone, J., D. Russell, and B. Griffith. 2002. Variations in plant forage quality in the range of the Porcupine caribou herd. Rangifer 22(1):65-74.

Margraf, F. J. and C. T. Knight. 2002. Evaluation of fish sampling using rotenone in a navigation lock. Fisheries Research. 55:297-305.

McGuire, A. D. 2002. Ecosystem element cycling. Pages 614-618 in A. H. El Shaarawi and W. W. Piegorsh, editors. Encyclopedia of Environmetrics, Volume 2. John Wiley and Sons, Chichester.

McGuire, A. D., M. Apps, J. Beringer, J. Clein, H. Epstein, D. W. Kicklighter, C. Wirth, J. Bhatti, F. S. Chapin III, B. de Groot, D. Efremov, W. Eugster, M. Fukuda, T. Gower, L. Hinzman, B. Huntley, G. J. Jia, E. Kasischke, J. Melillo, V. Romanovsky, A. Shvidenko, E. Vaganov, and D. Walker. 2002. Environmental variation, vegetation distribution, carbon dynamics, and water/energy exchange in high latitudes. Journal of Vegetation Science 13:301-314.

Pan, Y., A. D. McGuire, J. M. Melillo, D. W. Kicklighter, S. Sitch, and I. C. Prentice. 2002. A biogeochemistry-based successional model and its application along a moisture gradient in the continental United States. Journal of Vegetation Science 13:369-380.

Perez-Garcia, J., L. A. Joyce, and A. D. McGuire. 2002. Integrated ecological economic assessments at the global scale: Lessons learned and temporal uncertainties. Forest Ecology and Management 162:105-115.

Perez-Garcia, J., L. A. Joyce, A. D. McGuire, and X. Xiao. 2002. Impacts of emission controls on the global forest sector. Climatic Change 54:439-461.

Potter, C., S. Wang, N. T. Nikolov, A. D. McGuire, J. Liu, A. W. King, J. S. Kimball, R. F. Grant, S. E. Frolking, J. S. Clein, J. M. Chen, and J. S. Amthor. 2001. Comparison of boreal ecosystem model sensitivity to variability in climate and forest site parameters. Journal of Geophysical Research - Atmospheres 106:33, 671-33, 688.

Powell, A. N. 2002. Book Review. Prairie Birds: Fragile Splendor in the Great Plains, by Paul A. Johnsgard. Condor 104:224-225.

Powell, A. N., C. L. Fritz, B. L. Peterson, and J. M. Terp. 2002. Status of breeding and wintering snowy plovers in San Diego County, California, 1994-1999. Journal of Field Ornithology 73(2):156-165.

Prentice, I. C., G. D. Farquhar, M. J. R. Fasham, M. L. Goulden, M. Heimann, V. J. Jaramillo, H. S. Kheshgi, C. LeQuere, R. J. Scholes, D. W. R. Wallace, and contributing authors (including A. D. McGuire). 2001. The carbon cycle and atmospheric carbon dioxide. Pages 183-237 in J. T. Houghton et al., editors. Climate Change 2001: Contribution of Working Group I to the Third Assessment Report of the Intergovernmental Panel on Climate Change. Cambridge University Press, Cambridge, UK and New York, NY, USA.

Silapaswan, C. D., D. Verbyla, and A. D. McGuire. 2001. Land cover change on the Seward Peninsula: The use of remote sensing to evaluate potential influences of climate change on historical vegetation dynamics. Canadian Journal of Remote Sensing 5:542-554.

Stone, K. D. and J. A. Cook. 2002. Molecular evolution of Holarctic martens (genus *Martes*, Mammalia: Carnivora: Mustelidae). Molecular Phylogenetics and Evolution 24:169-179.

Walsh, J. E., J. Curry, M. Fahnestock, M. C. Kennicutt II, A. D. McGuire, W. B. Rossow, M. Steele, C. J. Vorosmarty, and R. Wharton. 2001. Enhancing NASA's Contribution to Polar Science: A Review of Polar Geophysical Data Sets. National Academy Press, Washington, DC. 124 pp.

Young, D. D., T. R. McCabe, R. Ambrose, G. W. Garner, G. W. Weiler, H. V. Reynolds, M. S. Udevitz, D. J. Reed, and B. Griffith. 2002. Predators. Pages 51-53 in D. C. Douglas, P. E. Reynolds, and E. B. Rhode, editors. Arctic Refuge Coastal Plain Terrestrial Wildlife

Research Summaries. U.S. Geological Survey, Biological Resources Division, Biological Science Report USGS/BRD BSR-2002-0001.

Zhuang, Q., V. E. Romanovsky, and A. D. McGuire. 2001. Incorporation of a permafrost model into a large-scale ecosystem model: Evaluation of temporal and spatial scaling

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

Growth, Foraging Behavior and Distribution of Age-0 Arctic Grayling in an Alaskan Stream

Student Investigator: Cheryl A. Dion, MS Fisheries
Advisors: Nicholas F. Hughes and James B. Reynolds
Funding Agency: Sport Fish, ADFG (RSA)

Note: Cheryl Dion graduated from UAF in December 2002. Her thesis abstract follows:

Abstract—I evaluated the ability of three models to relate habitat characteristics to habitat quality for age-0 Arctic grayling *Thymallus arcticus* in an Alaskan stream. A temperature-based growth model made accurate predictions, showing it can reliably assess thermal habitat quality. Deviations between predicted and observed growth were useful because they identified the timing of possible critical periods, when competition for food or space may cause density-dependent mortality and emigration. A foraging model consistently overestimated the mean prey size of fish, showing that such models need further work before they can accurately assess food availability from invertebrate drift. A habitat selection model accurately predicted small fish would occupy the stream margins and the ontogenetic shift into faster, deeper water, but its detailed predictions for larger fish were not very precise. These models were useful tools for assessing habitat quality and gave insight into possible interactions between habitat characteristics and population dynamics.

A Protocol for Assessing the Impacts of Urbanization on Coho Salmon with Application to Chester Creek, Anchorage, Alaska

Student Investigator: Matthew S. Whitman, MS Fisheries
Advisor: Nicholas F. Hughes
Funding Source: Water Resources Division, USGS

Note: Matthew Whitman graduated from UAF in August 2002. His thesis abstract follows:

Abstract—Coho salmon (*Oncorhynchus kisutch*) abundance has declined in many urban streams. The causes of these declines can be hard to identify because urban impacts on stream ecology are complex and can vary between watersheds. This makes it difficult to develop appropriate and effective strategies for stream rehabilitation or mitigation aimtaliif3a /F3 1 Tf -7.9f -2

characteristics from one non-urban and two urban study reaches to “healthy” standard guidelines. This application of the protocol showed that the most significant adverse effects of urbanization on coho salmon habitat in urbanized reaches were increased flood intensity, barriers to adult and juvenile migration, reduced physical habitat complexity, siltation of spawning gravels, stressful water quality conditions, and stocking of potential predators and competitors. These results provide useful information for prioritizing rehabilitation and mitigation efforts in Chester Creek.

The Limnology of Lake Clark, Alaska

Student Investigator: Alexander X. Wilkens, MS Biology
Advisor: Nicholas F. Hughes
Funding Agency: NPS (RWO 84)

Note: Alex Wilkens graduated from UAF in December 2002. His thesis abstract follows:

Abstract—This study gathered baseline limnological data to investigate the thermal structure, water quality, phytoplankton, and zooplankton of Lake Clark, Alaska. Results indicate Lake Clark is oligotrophic and mixes biannually, but stratification is weak and thermoclines are deep. Longitudinal gradients were seen in measurements of temperature, suspended solids, turbidity, light penetration, algal biomass, and zooplankton density. Wind and tributary inputs determine the thermal regime. Glacially influenced tributaries drive turbidity and light gradients by introducing suspended solids to the inlet end of the lake. Suspended solids likely create the algal biomass gradient by limiting the light available for photosynthesis in the inlet basin. Algal biomass and turbidity gradients may interact to create an area of high productivity and low predation risk, causing high zooplankton concentrations in the central basin. Oxygen supersaturation was discovered in the hypolimnion but remains unexplained. Because tributaries are glacially influenced, Lake Clark could be sensitive to global warming.

Ongoing Aquatic Studies

Applications of new DNA methodologies to identify stocks of Alaskan chum salmon

Student Investigator: Blair G. Flannery, MS Fisheries
Advisor: Anthony J. Gharrett
Funding Agency:

in a mixed fishery. Major chum salmon populations of the Yukon were sampled. The molecular technique - amplified fragment length polymorphism (AFLP) - was applied in an attempt to find markers that characterize the populations. The AFLP data separate the populations into the following regional groups: Lower, Middle, Border, and Upper Yukon. These groupings correspond with the run-timing and geographic location of the populations and are concordant with the results of previous studies that used allozymes, mtDNA-RFLPs, and microsatellites. The results indicate that the patterns of genetic structure mirror the life history patterns and geographic relationships of the fish in this region of the Yukon River. However, unlike the previous studies, the AFLP data were successful at providing acceptable mixed stock analysis estimates for the border group broken into country of origin. Article III of the Pacific Salmon Treaty of 1985 mandates that the salmon resources are to be conserved and fairly allocated between the two countries. AFLP data can be used to identify chum salmon stocks by country of origin, which would simplify allocation and management. Managing by political boundaries comes at a price as estimates are less accurate and precise. The baseline could be used to determine the relative contributions to fisheries, composition of pulses of chum salmon entering the Yukon River, run reconstruction, run timing and migratory patterns.

A Risk Model for Predicting Electrofishing Injury in Freshwater Fishes

Student Investigator: Farland (Mike) Holliman, PhD Fisheries
Advisor: James B. Reynolds
Funding Agency:

Stress Effects in Fall Chum Salmon from Mark-Recapture: Plasma Stress Indicators and Non-esterified Fatty Acid Analysis

Student Investigator: Peter M. Cleary, MS Fisheries
Advisor: F. Joseph Margraf
Funding Agency: None
In-Kind Support: Fully supported by Commercial Fisheries Division, ADFG

Five species of Pacific salmon return to the Yukon River and its tributaries and are used in subsistence, personal use, commercial, and sport fisheries. Since 1981, fish wheels have been commonly used as a method of estimating run strength and timing of salmon migrations in the Yukon River drainage. Because of the limited energy resources in migrating chum salmon, fish wheel capture and stress from tagging have the potential to change the physiological condition of these fish, which may lead to reduced fitness through a reduction in energy reserves. Blood plasma samples were collected from tagged and untagged adult chum salmon in August and September 2000 and 2001. Fish were captured for tagging and blood plasma sampling from a fish wheel on the lower Kantishna River. Both tagged and untagged chum salmon were captured 114 km upstream at fish wheels on the lower Toklat River (a Kantishna River tributary) and blood plasma sampled. In 2000, plasma samples were analyzed for the stress indicators cortisol, glucose, lactate, and chloride. Plasma samples collected in 2001 were analyzed for non-esterified fatty acids. Tagged chum salmon captured at the Toklat River recovery wheels had lower cortisol values then untagged. The other indicators—glucose, lactate, and chloride—did not indicate a difference between tagged and untagged chum salmon. Tagged chum salmon captured at the Toklat River recovery wheels had reduced levels of non-esterified fatty acids, suggesting that there is a metabolic cost associated with fish wheel capture and tagging.

Effects of Catch-and-Release Fishing on the Physiology and Hooking Injury of Alagnak River Rainbow Trout, Katmai National Park

Student Investigator: Julie M. Meka, MS Fisheries
Advisors: F. Joseph Margraf, Nicholas Hughes, and Jennifer Nielsen (USGS)
Funding Agency: None
In-Kind Support: Fully supported by Alaska Science Center, USGS. Logistic support for field crew and remote camp furnished by Katmai National Park and Preserve, NPS.

Rapidly increasing angler use of the Alagnak River rainbow trout fishery led to concerns about the health of the population and resulted in recent regulatory changes to catch-and-release fishing only. Alagnak River rainbow trout are subjected to stresses including handling, exhaustion, and repeated air exposure during capture and a high probability of hook injury with heavy catch-and-release fishing pressure. The effects of high incidences of catch-and-release captures on chronic and acute stress, growth, and productivity of the population remain unknown. Numerous cases of angler dissatisfaction due to trout deformities or mutilations purportedly resulting from repeated hooking by anglers have been reported. The goal of this study is to assess acute and chronic stress, incidence of hooking injury, and changes to seasonal growth patterns associated with a catch-and-release fishery,

and relate those factors to the overall health of the population. Larger (at least 10 inches) fish were sampled for blood chemistry in summer 2000-2002. The fish were caught by hook and line using different types of terminal gear. In 2000 and 2001, there were significant changes over time in cortisol and glucose levels, and there was a significant relationship between both cortisol and glucose to body size. The amount of time required to land fish was significantly related to fish size, indicating the time it takes to land fish (as determined by body size) will ultimately influence the elevation of plasma cortisol and glucose levels. Nearly a third of all fish captured during 2000-2002 had at least one past hooking injury; over half were given at least one new hooking injury. Degree of injury, as indicated by the number of scars, was higher in fish caught with barbed hooks as compared with barbless hooks regardless of the fishing method. The amount of time to land fish was longer for experienced anglers, and the amount of time to remove the hook from fish was longer for novice anglers. The results of this study will have direct application for management decisions regarding catch-and-release fishing throughout cold-water regions, and will provide specific recommendations for management tools to restore the naturally occurring rainbow trout population in the Alagnak Wild River to a more pristine state.

Sockeye Salmon Spawning Distribution in Lake Clark, Alaska

Student Investigator: Daniel B. Young, MS Fisheries
Advisors: F. Joseph Margraf and Carol A. Woody (USGS)
Funding Agency: None
In-Kind Support: Fully supported by Alaska Science Center, USGS. Logistic support furnished by Lake Clark National Park and Preserve, NPS.

Recent declines in the annual sockeye salmon returns to the Kvichak River highlighted a lack of information regarding spawning habitats of sockeye salmon in the glacially influenced Lake Clark watershed. Lake Clark provides important spawning and rearing habitat for the commercially valuable Bristol Bay sockeye salmon. Increased development along the shoreline of Lake Clark could inadvertently harm spawning areas. Understanding where and when salmon spawn will provide managers with information to protect critical spawning habitats to maintain productive salmon returns. Migrating adult sockeye salmon were captured at the outlet of Lake Clark with a nylon beach seine and radio tagged throughout the run. Tagged fish were located every 5 to 10 days by boat or small aircraft and 24 hours/day at fixed radio-telemetry stations. A fish was considered to be at its spawning location if it was relocated 400 m from its previous location at least twice within 3 weeks, no further migration occurred, and spawned-out or spawning sockeye salmon were observed in that area. A beach seine was used to verify spawning in turbid habitats. Of 332 radio-tagged sockeye salmon, 282 were tracked to spawning grounds; 35 spawning areas were identified inc.csnrif islet of Le trNtandol Ader

Historical Salmon Production in Lake Clark National Park and Preserve (LCNPP)

Student Investigator: Assistance from several GPMSL graduate students
Advisor: Bruce Finney
Funding Agency: Alaska Science Center, USGS (RWO 110)
In-Kind Support: Housing and logistical support during field season

Alaska Natives of the Lake Clark region have relied on annual sockeye salmon returns for their subsistence since prehistoric times, as do many contemporary users. Recent dramatic declines in sockeye salmon returns negatively impacted subsistence and commercial fishers. Little is understood regarding causal factors or salmon production trends. Data on current and historic salmon production trends are currently lacking for this 6000 mi^2 watershed. Production information is critical to managers in terms of evaluating and justifying future subsistence management decisions. Subsistence management is a high priority for LCNPP personnel, and evaluation of historic and contemporary salmon population trends is imperative for the decision-making process. Therefore, the purpose of this project is to provide technical assistance to LCNPP personnel by providing a measure of historic salmon production trends within the Park. A salmon productivity database is also scientifically valuable, as it will allow researchers to evaluate production trends relative to natural climate fluctuations, the advent of commercial fisheries, and recent escapement estimates. Our objectives are to reconstruct from sediment core analysis long-term records of sockeye salmon abundance and lake primary productivity. From such data, we will examine relationships between salmon abundance and climate, assess escapement trends and goals for these systems based on long-term data, determine whether relationships exist between salmon productivity trends and commercial harvest, and determine relationships between lake productivity and salmon abundance. This information will help assess the importance of salmon carcass-derived nutrients in controlling salmon production and determine watershed-scale environmental response within LCNPP to regional climate change, such as during the Little Ice Age, Medieval Warm Period, and Hypsithermal. We will collect and analyze cores from several sites within LCNPP. Analyses include core dating, and downcore measurements of $\delta^{15}N$, organic carbon, nitrogen, biogenic silica (diatom abundance), and $\delta^{13}C$. This data will be used to reconstruct records of temporal changes in salmon escapement ($\delta^{15}N$) and lake primary productivity (organic carbon, nitrogen, biogenic silica, and $\delta^{13}C$). Further, geomorphic studies will help determine the timing of deglaciation (proxy for opening of salmon habitat), the timing of lake level changes, and the timing of tributary stream drainage reversals in the Lake Clark valley. Cores have been obtained from the following sockeye salmon lakes: Lake Clark, Kijik Lake, Lower Twin Lake, and Telaquana Lake. Control lakes Upper and Lower Tazimina Lake were also cored. Gravity cores and longer hammer cores (~1.5 m) were obtained from all lakes. Routine sedimentological analyses have been completed, and dating and stable isotope analyses are underway. The Lake Clark Park lakes span diverse lake types (glacial and clearwater) and drain into several different river systems (e.g., Kvichak, Stony Rivers). Knowledge of how these different lakes respond to factors such as commercial fishing and climatic change is important for proper management.

Precision of One-Site Mark-Recapture Experiments to Estimate Salmon Smolt Abundance in Small Streams

Student Investigator: Tony Eskelin, MS Fisheries
Advisor: F. Joseph Margraf
Funding Agency: Sport Fish Division, ADFG
In-Kind Support: Additional support by Homer and Soldotna ADFG Field Offices, and Peggy and Larry Leonard

Sound management of salmon stocks, including management objectives that optimize sustainable yield, often require smolt abundance estimates to assess freshwater production and marine survival. Stratified mark-recapture estimates are commonly used to estimate abundance, but few studies to date have verified the accuracy of using "trap efficiency" as an index of abundance for salmon smolt. The objective of this study was to assess the precision of one-site mark-recapture experiments to estimate smolt abundance in small streams. Coho salmon smolt were batch marked with partial fin clips and released upstream of a rotary smolt trap in Deep Creek, Alaska, with a portion to be recaptured in the same trap on their downstream migration to the ocean. Four treatment groups and one control group were used to investigate the variability of distance upstream of a trap upon release, the time of day of release, and the accuracy of smolt abundance estimates using trap efficiency as an index. Preliminary results show moderate to high variability in abundance estimates when using trap efficiency to estimate smolt emigration. Recapture rates were highest during night, lower during the day; smolt emigration was more pronounced at night. Researchers performing smolt enumeration studies using trap efficiency to estimate abundance should be cautious of the potentially high variability in abundance estimates.

Spawning Habitats, Seasonal Movements, and Population Characteristics of Lake Trout in the Ugashik Lakes

Student Investigator: Jason Valliere, MS Fisheries
Advisor: F. Joseph Margraf
Funding Agency: USFWS (RWO 102, RWO 111)
In-Kind Support: USFWS training, housing and field camp supplies during field season

The ecology of lake trout in the Ugashik Lakes system is unknown. Due to the lack of research conducted within the Ugashik Lakes and the scarcity of lakes sharing the characteristics of the Ugashik Lakes system, there is very little insight into this ecosystem.

Individuals traveled as far as 8 miles in as little as 3 days with depth of water ranging from 33 to 185 feet with an average depth at point of observation being 83 feet. During the 2003 summer/fall season movements will be documented from June through September. Baseline information such as seasonal habitat use, seasonal movements, length composition, mean length of the population, weight composition, mean weight of the population, length-to-weight relationship, and forage base should prove to be very useful in effectively managing a lake trout fishery to protect critical habitat and in designing future research study plans.

Study of Dolly Varden and Arctic Char Population in the Ugashik Narrows during June, July and August

Student Investigator: Mia Baylor, MS Fisheries
Advisor: F. Joseph Margraf
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Quantification of Chinook Salmon Spawning Habitat on the Tuluksak River

Student Investigator: Deena Jallen, MS Fisheries
Advisor: F. Joseph Margraf
Funding Agency: USFWS (RWO 112)
In-Kind Support: Kenai Fisheries Resource Office and Bethel Office, Yukon Delta National Wildlife Refuge, USFWS, and the village of Tuluksak for transportation and logistical support

Most salmon stocks are currently managed using stock-recruitment models. These models require long-term (at least 25 years) data sets of adult fish returns to a system to be useful in establishing fishery escapement goals. In this study we will explore the use of habitat-based models for establishing escapement. This project will examine how much spawning habitat is available, and how many salmon can be successfully supported. Quantifying biological carrying capacity and identifying survival bottlenecks are important factors in determining salmon escapement goals. Developing a methodology whereby salmon habitat can be measured quickly and efficiently using large-scale observations would be of great use. The object of this study was to delineate and quantify chinook salmon spawning areas. Of particular interest are when and where chinooks spawn, seasonal and density-based habitat usage, and overlap of spawning habitat with other salmon species in the river. In 2002, habitat surveys were conducted along the length of the Tuluksak River where salmon were expected to spawn. Chinook salmon appear to spawn in upstream areas of the river, and few chinook salmon were observed in the lower section of the river where chum salmon spawning was prevalent. Plans for summer 2003 include aerial surveys and tagging of chinooks as they pass through the weir. Determining escapement goals from large-scale observations is a much-desired goal of fisheries managers. Studies of habitat usage may reveal the theoretical minimum and maximum numbers a system can sustain.

A Method to Assess Spawning Habitat of Chum Salmon for Use in Biological Escapement Estimates

Student Investigator: John O'Brien, MS Fisheries
Advisor: F. Joseph Margraf
Funding Agency: USFWS (RWO 112)
In-Kind Support: Kenai Fisheries Resource Office and Bethel Office, Yukon Delta National Wildlife Refuge, USFWS, and the village of Tuluksak for transportation and logistical support

Salmon stocks are on the decline in the Kuskokwim River area. Chum salmon are one of several species of Pacific salmon important to commercial and subsistence fishers of the lower Kuskokwim River basin in Western Alaska. Stream habitat data, critical to the management of the fishery, are limited. Through the examination of the relationship between spawning habitat and its use by chum salmon, we plan to develop rapid assessment criteria useful for estimating biological escapement goals on a basin- and region-wide scale. Selected habitat features of the Tuluksak River, an important spawning tributary of the Kuskokwim, were surveyed, and spawning of chum salmon was observed in summer 2002. Chum salmon

were located spawning in the mid-reaches of the Tuluksak River in areas of stream bottom adjacent to woody in-stream and riparian cover. Conventional wisdom indicates that they select spawning sites over porous gravel in upwelling zones. If a hydrologic regime can be identified through the analysis of aerial photos, managers will have a powerful new tool in assessing the quantity and quality of habitat available to spawning chum salmon.

Environmental and Evolutionary Differences in Population Dynamics and Life History Traits of Western and Interior Arctic Grayling

Student Investigator: Jenny Neyme, MS Fisheries
Advisors: F. Joseph Margraf and Nicholas Hughes
Funding Agency: Sport Fish Division, ADFG
In-Kind Support: ADFG vehicle, technical assistance, and equipment use during field season

Little is known about the carrying capacity of Arctic grayling in the upper Chatanika and

Paleolimnology and Historical Salmon Production of Glacial and Salmon Lakes, Seward Peninsula, Alaska

Student Investigator: To be determined
Advisor: Dr. Bruce Finney
Funding Agency: BLM (RWO 126)
In-Kind Support: Assistance during field season

Very little is known about the aquatic ecosystems and prehistoric sockeye salmon production of Glacial and Salmon Lakes on the Seward Peninsula, Alaska. The lakes are among the northernmost sockeye systems in the world. Sockeye returns to these lakes, which are important for local subsistance use, is currently very low relative to historic information. Obtaining a better understanding of these lakes is important from both ecologic and economic viewpoints. The work described here will provide baseline information and a long-term perspective on these lake ecosystems. The main objectives of this study are to reconstruct records over the past several thousand years of sockeye abundance and lake paleoproductivity. Long-term trends in sockeye abundance will help place the recent low levels in terms of a longer perspective and determine how abundance trends compare with those determined for other Alaskan systems. In addition, results will help determine the roles of lake primary productivity and carcass-derived nutrients in influencing sockeye production. Several sediment cores were obtained from these lakes with the assistance of the BLM. We will conduct routine sedimentological analysis on these cores, and develop chronologies (ages) using methods such as volcanic ash stratigraphy and radiocarbon and ^{210}Pb analyses. Downcore analyses of organic carbon, nitrogen, biogenic silica,

3) higher predicted intake by migratory moose than resident moose was consistent with their higher 10-month-old calf weights.

Ongoing Wildlife Studies

Demography of Seabirds Frequently Caught in Alaska Fisheries

Student Investigator: Undergraduate students performed the laboratory duties of this project
Advisor: Daniel D. Gibson and Kevin Winker
Funding Agency: USFWS (RWO 114)
In-Kind Support: UA Museum archival and maintenance of specimens, and Principal Investigators' salaries

Fulmars, shearwaters, and albatrosses comprise almost 90% of all seabirds caught in the Alaska fisheries. Little is known about the sex or age structure of these by-caught seabirds, but such information is important to modeling and determining population effects. Results could influence management measures to reduce by-catch. The objectives of the study were to identify species of retained carcasses and to gather a variety of demographic and ecological data. To date, only two batches of specimens have been received from the Fisheries Observer Program. All of these specimens have been processed and preserved. Totals of 59 northern fulmars and 9 Laysan albatrosses have been received and processed. To date, sample sizes are insufficient to generate any management recommendations.

Breeding Ecology of White-winged Scoters on the Yukon Flats National Wildlife Refuge, Alaska

Student Investigator: David E. Safine, MS Wildlife
Advisor: Mark S. Lindberg
Funding Agencies: Yukon Flats National Wildlife Refuge, USFWS (RWO 117), Department of Biology and Wildlife and Institute of Arctic Biology (UAF), and Sea Duck Joint Venture (USFWS)
In-Kind Support: USFWS aircraft and equipment support

The causes of long-term and widespread decline of white-winged scoters are unknown. The breeding biology of white-winged scoters has not been described in their primary breeding range, the boreal forest of Alaska and Canada. Our objectives are to determine the relationship between reproductive performance of white-winged scoters and the observed population decline, and to estimate nesting success, duckling survival, and nest site selection of white-winged scoters breeding on the Yukon Flats National Wildlife Refuge. We will tag and monitor fate of breeding females and their ducklings. We will quantify nest site characteristics. We observed low nesting success and hen survival for a small sample of females monitored during pilot work in 2002. Nest sites were often much farther from water and in denser canopy cover than has been observed for other waterfowl species. Future development projects may pose a threat to the breeding habitat of white-winged scoters. Information about habitat needs and breeding biology of these scoters may help minimize the effects of future development on this species.

Survival and Reproduction of Pacific Common Eiders on the Yukon-Kuskokwim Delta, Alaska.

Student Investigator: Heather Wilson, PhD Biology
Advisor: Abby N. Powell
Funding Agencies: Yukon Delta National Wildlife Refuge, USFWS, and Alaska Science Center, USGS (RWO 118)
In-Kind Support: Field camp logistics, food, and transportation at both study sites have been provided by the Yukon Delta National Wildlife Refuge; additional personnel and field logistics have been provided by the USGS Alaska Science Center

Little is known about the survival and life history of Pacific common eiders nesting on the Yukon-Kuskokwim Delta (YKD) in western Alaska. Common eiders are in decline across their circumpolar range and over the past 40 years, the numbers of Pacific common eiders nesting on the YKD in western Alaska have dropped by more than 90%. Basic data on rates of survival and productivity for this population are currently unknown; however, accurate estimates could be used to develop simple population models, useful in identifying causes of population declines and defining potential management actions. The objective of this study is to integrate recent and historic data collected on the YKD in order to estimate adult female annual survival and productivity and develop a simple population model for common eiders on the YKD. Methods will include conducting three years of nest monitoring and mark-recapture of adult female common eiders at the two highest-density breeding areas on theYKD: Kigigak Island and Tutakoke River. Current data will be analyzed in conjunction with historical data collected by the Yukon Delta National Wildlife Refuge and the USGS Alaska Science Center, and will be used to examine annual and geographic variation in life-history parameters between the two sites, across a 10-year period. Initial analyses indicate that nest success for common eiders on the YKD varies by geographic location; in 2002, we located 203 nests at Kigigak Island and 131 at Tutakoke River, and nest success ranged from 61 % to 53% at the two study areas. Preliminary percentages of recaptured birds were relatively high (50% and 13%) at the respective study sites, suggesting strong site fidelity and the availability of an adequate sample size for examining annual survival. If differences in overall productivity at the two study sites are consistent across years, managers may want to consider the locations as separate sub-populations, but this will depend on the results of the multi-year analyses. Development of a population model based on estimates from the YKD will serve to illustrate the relative influence of variation in survival and reproduction on overall population growth, and will hopefully aid managers in promoting recovery of the Pacific common eider to former levels.

Ecological and Physiological Factors Contributing to Reproductive Success of Glaucous-winged Gulls in Chiniak Bay, Kodiak Island, Alaska

Student Investigator: J. Brook Gamble, MS Wildlife
Advisors: C. Loren Buck and Edward C. Murphy
Funding Agency: USFWS (RWO 119)

The glaucous-winged gull is an abundant colony-nesting seabird that breeds on the offshore islands surrounding Kodiak Island. Because reproductive success of seabirds is both easily monitored and has been shown to be positively correlated with available food resources, seabirds may be useful indicators of foraging conditions just prior to and during their breeding season. Understanding the reproductive biology of the glaucous-winged gull in Kodiak will allow us to investigate its utility as an indicator of local marine conditions. The objective of this study is to determine the ecological and physiological factors that contribute to the reproductive success of the glaucous-winged gull in the nearshore of the east side of Kodiak Island. We monitored 330 nests on seven different colonies within Chiniak Bay and followed their fates on designated plots from nest initiation through hatching. Additionally, we collected diet samples from adults and chicks, drew blood samples from adults, and outfitted breeding gulls with radio transmitters. We used data collection computers to monitor local colony attendance of birds with transmitters, and telemetry triangulation to determine their foraging areas within Chiniak Bay. We will analyze plasma samples for corticosterone and lipid levels to assess physiological condition of gulls throughout the breeding season. Because glaucous-winged gull reproductive success is sensitive to food supply, and because they generally prey on small, young-of-the-year fishes whose populations are notoriously difficult to study, multi-year monitoring of this species may be another useful management tool that contributes to understanding the dynamic food web in the Kodiak Island marine ecosystem.

Limits to Recruitment in Emperor Geese: Effects of Forage Quantity and Goose Density on Gosling Growth

Student Investigator: Bryce Lake, MS Wildlife
Advisor: Mark Lindberg
Funding Agency: Yukon Delta National Wildlife Refuge, USFWS, and Alaska Science Center, USGS (RWO 121)
In-Kind Support: USFWS aircraft support, field equipment, and housing during field season

The proportion of juvenile emperor geese in the fall population has declined over the past 6 cortbecaumass of er to and fled areabe usefls toarearitment in cornerstanding the oragrs thaT* (outf continflu)T

capture geese and collect information on body mass and structural size. We will assess forage availability using aerial videography and inter- and intra-specific grazing intensity with exclosures. We will estimate large-scale spatial variation in gosling growth and relate growth to the availability of quality forage and intensity of grazing. Emperor goose populations remain at levels below management goals. This research will describe the degree to which habitat conditions may be limiting recruitment of juvenile Emperor geese.

Effects of Recreational Disturbance on the Productivity of Black Oystercatchers in Kenai Fjords National Park

Student Investigator: Julie A. Morse, MS Biology
Advisor: Dr. Abby N. Powell
Funding Agency: Biological Resources Division, USGS (RWO 122)
In-Kind Support: Logistical support during field season through Kenai Fjords National Park

Productivity of black oystercatchers in Kenai Fjords National Park is low and may be impacted by human disturbance from park visitors. Black oystercatchers depend entirely on intertidal shoreline habitats for nesting and foraging. Increasing use of these habitats by park visitors may cause nest failures or limit time spent foraging, thereby leading to decreased productivity. The object of this study is to determine what mechanisms exist, if any, whereby human disturbance decreases productivity. Productivity will be monitored for three years, 2003–2005, in areas of both high and low human activities in the park. Remote cameras will be used to determine specific causes of nest mortalities. Field work will begin in 2003. We expect to monitor the outcomes of approximately 50 nests from initiation to fledgling each year. Given that the productivity of black oystercatchers is already low, further decreases may have significant impacts on the population size. The results of this project will provide crucial information that managers need in order to adequately protect oystercatchers in areas of human activity.

Using Stable Isotope Analyses to Determine Winter Molt Areas used by Western North American King Eiders in the Bering Sea

Student Investigator: Michael Knoche, MS Wildlife
Advisor: Abby Powell
Funding Agency: Coastal Marine Institute

Bering Sea and how they are distributed (e.g., grouped like spectacled eiders or sexually segregated like some Steller's eiders). Feather and tissue samples from king eiders harvested by both subsistence hunters and investigators in Barrow, Alaska, will be analyzed for ratios of stable isotopes (δ13C and δ15N). I will also use feather samples from king eiders implanted with satellite transmitters. Ratios determined for king eider feather and tissue samples will be compared with ratios of invertebrate samples from various locations in the

Foraging Ecology of Ravens on Alaska's Coastal Plain and Its Relationship to Oil and Gas Development

Student Investigator: Stacia Backensto, PhD Biology
Advisor: Dr. Abby Powell
Funding Agencies: Minerals Management Service/Coastal Marine Institute, ConocoPhillips, North Slope Borough, and IGERT Fellowship
In-Kind Support: Vehicle and housing at Prudhoe Bay during field season: ConocoPhillips, North Slope Borough, and potentially BP Alaska.

Raven numbers on the North Slope are increasing in response to human development.

development on king eider migration routes and breeding productivity need to be investigated. The objectives of this study are to determine the migration routes and timing of king eiders on fall and spring migration, to obtain basic breeding parameters, and to evaluate movements of females with broods in relation to oil field roads and facilities. Twenty-one king eiders were implanted with satellite transmitters (PTTs) in June 2002, and location information was plotted using ArcView GIS. Transmitters should continue to transmit until June 2003. Forty-two king eider nests were located and monitored throughout the breeding season. Eleven breeding females were trapped on the nest and fitted with glue-on radio transmitters. Females fitted with radio transmitters were then tracked by foot. We will implant approximately 30 more king eiders with satellite transmitters in June 2003. We implanted 21 king eiders (11 females and 10 males) with PTTs in mid-June 2002. Males left the study area shortly thereafter, while females dispersed in July. Males staged 7 to 17 days and females 9 to 32 days in the Beaufort Sea prior to molt migration. Males reached molting areas in late July to early August. Molting sites included areas along the Chukotsk Peninsula, the Kamchatka Peninsula, St. Lawrence Island, and Kuskokwim Bay. Females reached molting areas in mid-August to mid-September. Molting locations were similar to those of males, but also included areas along the Alaska Peninsula and Alaskan Coastal Plain. Molting areas for king eiders implanted at Kuparuk were similar to those found for king eiders implanted at Victoria Island and Prudhoe Bay, 1997–1999. Overall nest success was about 25% at Kuparuk. Nest success was about 30% for island nests and 20% for nests on the mainland. Clutch size averaged about 4 eggs per nest. Staging and molting areas in the Beaufort Sea and along Chukotsk Peninsula, St. Lawrence Island, and Alaska Peninsula may be important sites for king eiders that breed on the North Slope of Alaska. Consideration should be given to potential impacts on king eiders if these areas are slated for development.

Duckling Survival, Habitat Use, and Nest Attendance in Common Goldeneyes in the Chena River State Recreation Area

Student Investigator: Joshua Schmidt, MS Wildlife Biology
Advisor: Eric Rexstad
Funding Agency: Migratory Bird Management Division, USFWS (RWO 125)
In-Kind Support: Migratory Bird Management Division also provided a vehicle and fuel during the field season

Little is known about the survival rates of common goldeneye ducklings, what types of habitats broods use after hatch, or the strategies that hens use to incubate the eggs until hatch. Interior Alaska is the northern limit of the breeding range for this species and it is important to compare biological processes with other breeding populations at more southern latitudes and in other regions of the world. Common goldeneyes are one of the few species of sea duck that are not currently declining in Alaska, although acquisition and analysis of data on early life stages will be necessary to predict the outcomes of future management decisions. Logging, wetland development, and overharvest by hunters could affect this species in the future due to habitat loss, reduction in nesting sites, and high bag-limits. This study will determine survival rates of common goldeneye ducklings after hatch, habitats used by broods, and nest attendance patterns of incubating hens. Radio-transmitters are attached to hens at hatch, ducklings are color-marked and banded, and they are then tracked for up to 30

days. Artificial eggs are placed in nests to record increases and decreases in temperature due to the presence or absence of the female. Survival and habitat information was recorded for 21 of 44 successful broods in 2002 and 55% of ducklings survived to be 1 month old. Hens take fewer nest breaks during the middle part of incubation than during early and late incubation. A better understanding of the factors that affect the production of this waterfowl species will provide managers with the information to make informed decisions regarding the development of potentially important habitats. The number of ducklings surviving until hunting season is also important for managers when they are setting bag limits for this species because an overharvest could result in a future decrease in the overall population.

Evaluation of Moose-Habitat Models on the Alaska Peninsula/Becharof National Wildlife Refuge

Student Investigator: Corey D. Adler, MS Wildlife
Advisor: Abby Powell
Funding Agency: Alaska Peninsula/Becharof National Wildlife Refuge, USFWS (RWO 113)
In-Kind Support: USFWS field logistics support

No quantitative data has been collected on moose-habitat relationships on the Alaska Peninsula for the past twenty years. Little is known about the current moose population, the habits they use, and the interactions between the two. Moose are an important part of subsistence and recreational 7rn and recreational Caring pngsggsj 0vpngHPCH),ecauij 0 sion. A bonsatant foel

suitability index for Dall sheep that can be used to rank the relative suitability of all 31 survey units in the Park for sheep. Seven study sites were chosen that represent a range of sheep densities. Lamb:ewe ratios and horn size of hunter-killed sheep will be estimated for these areas from aerial survey and ADFG reports. These variables constitute the dependent variables. Geographic Information Systems will be used to inventory habitat characteristics in these seven sites. Each independent variable will be ranked by expected habitat quality for sheep based on literature review and expert opinion. Ranks, and the sum of ranks, of independent variables will be compared to the ranks of dependent variables to identify those variables most closely associated with sheep density, productivity, and morphology. Historical sheep surveys have been summarized. Areas and densities of count areas have been estimated. Fecal samples have been collected from the study areas and are being lab tested for diet quality and diet composition. Results of the study will allow ranking all survey units in terms of expected habitat quality for sheep and help Wrangell-St. Elias National Park and Preserve define normal and healthy populations.

Ongoing Ecological Studies

Arctic Transitions in the Land Atmosphere System

Student Investigator : Catharine Copass, PhD Biology
Advisors: R. Terry Chapin and A. David McGuire
Funding Agency: NSF

This project employs a hierarchy of modeling approaches to produce credible scenarios for altered ecosystem, permafrost, snow, and atmospheric circulation distributions under a changing climate. These models include stand-alone permafrost, vegetation and land surface models, vegetation dynamics models, and regional and global climate system models. Dr. McGuire, who is a Co-Investigator on this project, is advising a PhD graduate student in the development of a spatially explicit model of tundra vegetation dynamics. The model of tundra vegetation dynamics, which incorporates competitive interactions for water, light, and nutrients among different plant functional types, will use the results of the satellite analyses in development and testing. The dynamic vegetation model will generate spatially explicit distributions of plant functional types and suggest possible future vegetation distributions in response to potential climate change scenarios. In addition, the dynamic vegetation model will be used to provide the land surface parameterizations for the pan-arctic domain of a global climate model. The focus over the last year has been to use the results of field investigations to parameterize the dynamic vegetation model and the land surface of the global climate model. Three simulations have been conducted over the past year with the global climate model. The dynamic vegetation model is currently being tested. The application of the dynamic vegetation model will specify the vegetation surface for a fourth simulation of the global climate model.

Fate of Carbon in Alaskan Landscapes

Student Investigator: Isla Myers-Smith, MS Biology
Advisor: A. David McGuire
Funding Agency: Geologic Division, USGS (RWO 97)

The purpose of this study is to model how soil drainage influences carbon dynamics in Alaskan landscapes. This study is part of a larger global change study funded by the USGS Geologic Division, which has been granted to Dr. Jennifer Harden of USGS Geologic Division in Menlo Park. Dr. Harden is conducting field work in Alaska to determine soil drainage controls on (1) decomposition rates and fuel storage, (2) fire severity, (3) permafrost degradation and recovery after fire, and (4) successional responses after fire. The understanding from these field studies will be transferred into a successional version of the terrestrial ecosystem model (TEM), which is being enhanced to consider interactions between fire severity, the soil thermal regime, and carbon dynamics. Model development is represented in three manuscripts, one of which has been published (Zhuang et al. 2001. *Journal of Geophysical Research* 106:33,649-33,670). The other two manuscripts have been accepted for publication in the *Journal of Geophysical Research* (Zhuang et al., In press) and in *Tellus* (Zhuang et al., in press). The first manuscript reports on a study that indicates that the soil thermal regime in Alaskan landscapes appears to be most sensitive to moss and snow thermal properties. The second manuscript reports on a study that uses the model to evaluate how fire influences soil thermal and ecosystem dynamics during forest stand development after fire disturbance. The third manuscript reports on a study with the coupled soil thermal-ecosystem model to evaluate the potential importance of freeze/thaw dynamics in simulating carbon dynamics of the Northern Hemisphere These developments have allowed the incorporation of interactions among fire, permafrost dynamics, and soil drainage into a framework that is being used to model carbon dynamics at large spatial scales in Alaska. We have recruited a new graduate student who is conducting field studies of carbon and methane dynamics along a drainage gradient. Information from these studies will be used to refine the modeling framework.

Biocomplexity: Feedbacks between Ecosystems and the Climate System

Student Investigator: Michael Balshi, PhD Biology
Advisor: A. David McGuire
Funding Agency: NSF through Marine Biological Laboratory

Wildfire has the potential to release substantial quantities of carbon dioxide to the atmosphere, the effects of which could have impacts for the climate system because of the ability of carbon dioxide to trap heat near the surface of the earth. Wildfire is not well represented in large-scale models of ecosystem function and structure. On this project, a PhD graduate student is developing a prognostic model that can be applied at large spatial scales to simulate the effects of wildfire on the global carbon cycle. The project is initially focusing on Alaska, which has a fire record of the timing and location of fires since 1950. After developing the model over the Alaska domain, the model will be evaluated for its ability to simulate the fire regime in Canada, which also has a good historical record of fires. After

gaining confidence in use of the model, it will be tested and evaluated in boreal Eurasia. The framework will then be extended to the temperate zone through application to the conterminous U.S. and to the tropics through evaluation in the Amazon Basin. The graduate student on this project will develop a prototype model during summer 2003. Successful development of a prognostic fire capability in global carbon cycle models will allow climate assessments to consider the response of wildfire to projected climate change and to evaluate how that response will influence global terrestrial carbon storage.

Landscape Analysis of Moose Distribution Relative to Fire History in Interior Alaska

Student Investigator: Julie Maier, Postdoctoral Researcher
Faculty: A. David McGuire
Funding Agency: USFWS (RWO 108)

The overall purpose of this study is to determine if moose distribution in interior Alaska is related to fire history and topographic features in interior Alaska. The strategy in the project is to evaluate relationships by combining existing databases on the distribution of moose (e.g. survey and telemetry data) with Geographic Information System (GIS) data on vegetation and other topographic features including the age and configuration of burns. Data on the timing and location of fire events were obtained from the Alaska Fire Service (AFS), which is an interagency consortium for fire management in interior Alaska. This database extends from 1950 to present and is operationally updated by AFS each year and has been used in studies of the fire regime in interior Alaska. Location data of moose for November surveys in interior Alaska were obtained from the Alaska Department of Fish and Game. A spatial statistics model was used to relate the moose distribution data to habitat, fire, topography and other relevant coverages in a spatial statistics model. The results of the model suggest that low elevations, areas near towns, and areas that have burned between 11 and 30 years ago have higher moose densities. While the patterns with elevation and stand age are readily understood, the pattern with distance from town may be explained because of disturbed habitats near towns and because of lower densities of predators near towns. The analyses in this study have documented patterns that provide information about possible processes controlling those patterns.

Sensitivity of ATLAS to Alternative Climate Change Scenarios and Alternative Assumptions with Climate Change Scenarios

Student Investigator: Gregg Christopher (partially supported as graduate student programmer)
Faculty: A. David McGuire
Funding Agency: USDA Forest Service (RWO 109)

The overall purpose of this study is (1) to determine the sensitivity of the ATLAS-T model, which is a national forest inventory model that provides inputs to a national forest economic model, to alternative climate scenarios, and (2) to determine the sensitivity of the ATLAS-T model to alternative ecological assumptions at a finer geographic level than previous

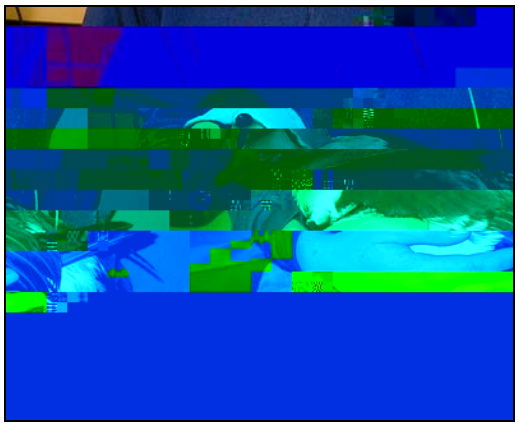
Resource Planning Act (RPA) analyses. The study is part of a USDA Forest RPA Special Study that has been granted to Dr. Linda Joyce of the USDA Forest Service Rocky Mountain Forest and Range Experiment Station. In support of these objectives, Dr. McGuire's lab has conducted simulations with the Terrestrial Ecosystem Model (TEM) to evaluate how

List of Abbreviations

ADFG	Alaska Department of Fish and Game
AKCFWRU	Alaska Cooperative Fish and Wildlife Research Unit
ANILCA	Alaska National Interest Lands Conservation Act
ARCUS	Arctic Research Consortium of the United States
BLM	Bureau of Land Management
DBW	Department of Biology and Wildlife, UAF
GIS	Geographical Information System
GPS	Global Positioning System
IAB	Institute of Arctic Biology, UAF
IMS	Institute of Marine Science, UAF
LTER	Taiga Long Term Ecological Research Program
MMS	Minerals Management Service

RSA	Reimbursable Services Agreement
RWO	Research Work Order
SFOS	School of Fisheries and Ocean Sciences, UAF
UAF	University of Alaska Fairbanks
UAM	University of Alaska Museum
UAS	University of Alaska Southeast
USDA	U.S. Department of Agriculture
	USFS U.S. Forest Service
USFWS	U.S. Fish and Wildlife Service
USGS	U.S. Geological Survey
	BRD Biological Resources Division

Corey Adler with radiocollared moose in the Alaska Peninsula/ Becharof National Wildlife Refuge.
Photo by Rick Swisher.



King eider after implantation of radio