Alaska Cooperative Fish and Wildlife Research Unit

Annual Report, 2003

Contents

Unit Roster

Federal Scientists

- Brad Griffith: Assistant Leader-Wildlife
- F. Joseph Margraf: Leader
- A. David McGuire: Assistant Leader-Ecology
- Abby N. Powell: Assistant Leader-Wildlife
- Mark S. Wipfli: Assistant Leader-Fisheries

University Staff

- Michelle M. Das-Administrative Secretary
- Karen R. Enochs-Administrative Assistant
- Kathleen R. Pearse-Administrative Assistant
- Theresa L. Tanner-Student Assistant

Unit Students

Current

- Corey Adler, MS Wildlife (Powell)
- Stacia Backensto, PhD Biology (Powell)
- Michael Balshi, PhD Biology (McGuire)
- Mia Baylor, MS Fisheries (Margraf)
- Colin Beier, PhD Biology (McGuire)
- Peter Cleary, MS Fisheries (Margraf)
- Catharine Copass Thompson, PhD Biology (McGuire)
- Anthony Eskelin, MS Fisheries (Margraf)
- Christie Hendrich, PhD Fisheries (Margraf)
- Deena Jallen, MS Fisheries (Margraf)
- Rachel Jones, MS Wildlife (Griffith)
- Michael Knoche, MS Wildlife (Powell)
- Andra Love, PhD Fisheries (Margraf)
- Rebecca McGuire, PhD Biology (Powell)
- Julie Meka, MS Fisheries (Margraf)
- Julie Morse, MS Wildlife (Powell)
- Isla Myers-Smith, MS Biology (McGuire)
- Jenny Neyme Polloczek, MS Fisheries (Margraf)
- John O'Brien, MS Fisheries (Margraf)
- Lincoln Parrett, MS Biology (Griffith)
- Laura Phillips, MS Wildlife (Powell)
- Audrey Taylor, PhD Biology (Powell)
- Miranda Terwilliger, MS Biology (Griffith)
- Jason Valliere, MS Fisheries (Margraf)
- Bradley Wendling, MS Wildlife (Griffith)
- Heather Wilson, PhD Biology (Powell)
- Daniel Young, MS Fisheries (Margraf)

Introduction

This is the Annual Report for the Alaska Cooperative Fish and Wildlife Research Unit, highlighting activities for calendar year 2003. The Unit engages in research on living natural resources for a variety of State and Federal agencies. As an unbiased research organization, the Unit provides information requested and funded by these agencies. When studies are completed, the agencies use the information to assist in their natural resource management efforts. Most of the research is conducted by graduate students, many of whom go on to work for the agencies upon graduation.

The Alaska Unit was established in 1950, providing over half a century of research dedicated to helping conserve and enhance the living natural resources of the State and the Arctic Region. The Unit is part of a larger and even older program, the U.S. Department of the Interior's Cooperative Research Unit Program. Established in 1935, Cooperative Research Units were created to fill the vacuum of wildlife management information and the shortage of trained wildlife biologists. In 1960, the Unit Program was formally sanctioned by Congress with the enactment of the Cooperative Units Act. Each unit is a partnership among the Biological Research Division of the U.S. Geological Survey, a State fish and game agency, a host university, and the Wildlife Management Institute. Staffed by Federal personnel, Cooperative Research Units conduct research on renewable natural resource questions; participate in the education of graduate students destined to become natural resource managers and scientists; provide technical assistance and consultation to parties who have legitimate interests in natural resource issues; and provide continuing education for natural resource professionals. Presently, there are Cooperative Research Units in 37 states, conducting research on virtually every type of North American ecological community. The Program is staffed by more than 110 PhD scientists who advise as many as 600 graduate student researchers per year.

Statement of Direction

The research program of the Unit will be aimed at understanding the ecology of Alaska’s fish and wildlife; evaluating impacts of land use and development on these resources; and relating effects of social and economic needs to production and harvest of natural populations.

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

Unit Cost-Benefit Statements

In-Kind Support

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

Benefits

Students Graduated: 3
Presentations: 24
Scientific and Technical Publications: 21

Graduate Committee Assignments

- Corey Adler - MS Wildlife (Griffith)
- Richard Barnhardt – PhD Fisheries (Margraf)
- Thomas Braile - PhD Biology (Powell)
- Matthew Carlson - MS Wildlife (McGuire)
- Karen Clyde-Lien – MS (Griffith)
- Paul Duffy - PhD Interdisciplinary (McGuire)
- Greg Finstad - PhD Interdisciplinary (Griffith)
- Nancy Fresco – PhD Biology (McGuire)
- F. Michael Holliman - PhD Fisheries (Margraf)
- Andrew Johnson – MS Zoology (Powell)
- Jill Johnstone – PhD Biology (McGuire)
- Scott MacLean – MS Fisheries (Margraf)
- Anthony Overton - PhD Fisheries (Margraf)
- Kevin Petrone – PhD Biology (McGuire)
- Brian Riordan - MS Natural Resource Management (McGuire)
- Joshua Schmidt - MS Wildlife (Powell)
- Kristine Sowl – MS Wildlife (Powell)
- Tumi Traustason – PhD Biology (McGuire)
- Jason Vogel - PhD Interdisciplinary (McGuire)
- Johann Walker - MS Wildlife (Powell)
- James Walton – MS Biology (McGuire)
- Heidi Weigart – PhD Fisheries (Margraf)
- Lijie Zhu - PhD Interdisciplinary (McGuire)

Courses Taught

- Contemporary Issues in Fisheries Science (Margraf - 1 credit hour. Spring 2003).
- Readings in Conservation Biology (Powell - 2 credit hours. Spring 2003.)
- Scale in Ecology and Management (Griffith - 3 credit hours. Spring 2003.)

University Committees and Workgroups

- Chair, Faculty Search Committee (Margraf)
- Member, Faculty Search Committee, Landscape Ecologist (Powell)
- Member UAF/IAB Management and Budget Committee (Margraf)
- Member UAF/IAB Space Utilization Committee (Margraf)
- Member, Committee on Unit Criteria for Promotion and Tenure in the Department of Biology and Wildlife (McGuire)
- Member, Executive Committee for Bonanza Long-Term Ecological Research Program (McGuire)
- Parade Marshal for 2003 Commencement Ceremony for UAF/SFOS degree candidates (Margraf)
- Seminar Coordinator, Life Sciences Seminar Series of the Institute of Arctic Biology and the Department of Biology and Wildlife, University of Alaska Fairbanks (Griffith)
- Chair, Graduate Comprehensive Exam Committee (Griffith)
- Faculty/Assistant Unit Leader Search Committee (Powell)
- Member, Executive Committee for the Regional Resilience and Adaptation Interdisciplinary Graduate Program, University of Alaska Fairbanks. (McGuire)
- Member, Leadership Committee for Bonanza Creek Long-Term Ecological Research Program (McGuire)
- Member, Research Advisory Committee (Griffith)

Editorships

- Auk (Powell)
- Ecological Applications (McGuire)
- Fisheries Management and Ecology (Margraf)

Invited Seminars

The Cooperative Fish and Wildlife Research Unit program in the Institute of Arctic Biology at the University of Alaska Fairbanks. Given at USFWS, Region 7 Annual Directorate Meeting, Chena Hot Springs Resort, Alaska on 2003/01/29. (Griffith)

Non-Society Memberships

- Member, Committee to draft the Implementation Plan for the North American Carbthe 45 0 05 0 0 -45 264 CP), a rnit progaogyvaskasuppicaeartmrough sef A Q q 0.24 (

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Outreach and Information Transfer

- Briefing to Arctic National Wildlife Refuge staff on research priorities for

understanding long-term terrestrial carbon: Mechanisms, modern tools, and modeling of soil systems. XVI INQUA Congress, Reno, NV.

- Maier, J. A. K., J. Ver Hoef, A. D. McGuire, H. A. Maier, L. Saperstein, and R. T. Bowyer. September 2003. Are data on fire history and landscape useful for predicting density and distribution of moose and enhancing management of populations in interior Alaska? 5th AAAS Arctic Science Conference, Fairbanks, AK.
- McGuire, A. D. and D. Zamolodchikov. April 2003. Status of modeling the location and timing of carbon sources and sinks in northern Eurasia. Northern Eurasian Earth System Partnership Initiative (NEESPI) Science Plan Workshop, Suzdal, Russia. Invited.
- McGuire, A. D. April 2003. Effects of increasing temperature and atmospheric CO2 on regional and global C storage. Terrestial Ecosystems Responses to Atmospheric and Climatic Change (TERACC) Workshop on Interactions between Increasing CO2 and Temperature in Terrestrial Ecosystems, Lake Tahoe, CA. Invited.
- McGuire, A. D. April 2003. Landscape analysis of moose distribution relative

- Zhuang, Q., J. M. Melillo, D. W. Kicklighter, R. G. Prinn, P. A. Steudler, A. D. McGuire, B. S. Felzer, and S. Hu. August 2003. Modeling methane consumption and emission between the terrestrial biosphere and the atmosphere. Ecological Society of American Annual Meeting, Savannah, GA.

Scientific Publications

- Bigelow, N. H., L. B. Brubaker, M. E. Edwards, S. P. Harrison, I. C. Prentice, P. M. Anderson, A. A. Andreev, P. J. Bartlein, T. R. Christensen, W. Cramer, J. O. Kaplan, A. V. Lozhkin, N. V. Matveyeva, D. F. Murray, A. D. McGuire et al. 2003. Climate change and arctic ecosystems: 1. Vegetation changes north of 55°N between the last glacial maximum, mid-Holocene, and present. Journal of Geophysical Research 108 (D19), 8170, doi:10.1029/2002JD002558, 2003.
- Bowyer, R. T., G. M. Blundell, M. Ben-David, S. C. Jewett, T. A. Dean, and L. K. Duffy. 2003. Effects of the Exxon Valdez oil spill on river otters: Injury and recovery of a sentinel species. Wildlife Monographs No. 153, 67(3), 53 pp.
- Chapin, F. S. III, T. S. Rupp, A. M Starfield, L. DeWilde, E. S. Zavaleta, N. Fresco, J. Henkelman, and A. D. McGuire. 2003. Planning for resilience: Modeling change in human-fire interactions in the Alaskan boreal forest. Frontiers in Ecology and the Environment 1(5):255-261.
- Griffin, J. C. and F. J. Margraf. 2003. The diet of Chesapeake Bay striped bass in the late 1950s. Fisheries Management and Ecology 10:323-328.
- Hartman, K. J. and F. J. Margraf. 2003. US Atlantic coast striped bass: Issues with a recovered population. Fisheries Management and Ecology 10:309-312.
- Holliman, F. J. and J. B. Reynolds. 2003. A predictive risk model for electroshock-induced mortality of the endangered Cape Fear shiner. North American Journal of Fisheries Management 23:905-912.
- Holliman, F. J., J. B. Reynolds, and T. J. Kwak. 2003. Electroshock-induced injury and mortality in the spotfin chub, a threatened minnow. North American Journal of Fisheries Management 23:962-966.
- Kaplan, J. O., N. H. Bigelow, I. C. Prentice, S. P. Harrison, P. J. Bartlein, T. R. Christensen, W. Cramer, N. V. Matveyeva, A. D. McGuire et al. 2003. Climate change and arctic ecoystems: 2. Modeling, paleodata-model comparisons, and future projections. Journal of Geophysical Research 108 (D19), 8171, doi:10.1029/2002JD002559, 2003.
- Knudsen, E. E., E. W. Symmes, and F. J. Margraf. 2003. Searching for a Life History Approach to Salmon Escapement Management. Pages 261-276 in J. G. Stockner, editor. Nutrients in Salmonid Ecosystems: Sustaining Production and Biodiversity. American Fisheries Society Symposium 34, Bethesda, MD. 285 pages.
- LaPerriere, J. D. 2003. Limnology of Harding Lake, Alaska: A deep, subarctic lake. Lake and Reservoir Management 19(2):93-107.
- LaPerriere, J. D., J. R. Jones, and D. K. Swanson. 2003. Comparative limnology of lakes in Gates of the Arctic National Park and Preserve, Alaska. Lake and Reservoir Management 19(2):108-121.

- LaPerriere, J. D., T. D. Simpson, and J. R. Jones. 2003. Comparative limnology of some lakes in interior Alaska. Lake and Reservoir Management 19(2):122-132.
- Lloyd, A. H. Lynch, B. J. Peterson, R. A. Peilkel Sr., J. P. Schimel, M. C. Serreze, and G. R. Shaver. 2003. PACTS (Pan Arctic Cycles, Transitions, and Sustainability): A Science Plan. NSF, Land Atmosphere Ice International Science Management Office, UAF, Fairbanks, AK, January 2003. 53 pp.
- McGuire, A. D., M. Sturm, and F. S. Chapin III. 2003. Arctic Transitions in the Land-Atmosphere System (ATLAS): Background, objectives, results, and future directions. Journal of Geophysical Research - Atmospheres 108(D2), 8166, doi:10.1029/2002JD002367.
- Overland, J., J. Calder, F. Fetterer, A. D. McGuire, J. Morison, J. Richter-Menge, N. Soreide, and J. Walsh. 2003. SEARCH Workshop on Large-Scale Atmosphere/Cryosphere Observations. Bulletin of the American Meteorological Society 84:1077-1081.
- Overton, A. S., F. J. Margraf, C. A. Weedon, L. H. Pieper, and E. B. May. 2003. The prevalence of mycobacterial infections in striped bass in Chesapeake Bay. Fisheries Management and Ecology 10:301-308.
- Maureen P. Small, K. D. Stone, and J. A. Cook. 2003. American marten (*Martes americana*) in the Pacific Northwest: Population differentiation across a landscape fragmented in time and space. Molecular Ecology 12:89-103.
- Sturm, M., F. S. Chapin III, M. E. Edwards, B. Griffith, H. P. Huntington, G. P. Kofinas, A. H. Tian, H., J. M. Melillo, D. W. Kicklighter, S. Pan, J. Liu, A. D. McGuire, and B. Moore III. 2003. Regional carbon dynamics in monsoon Asia and its implications for the global carbon cycle. Global and Planetary Change 37:201-217.
- Zhuang, Q., A. D. McGuire, J. M. Melillo, J. S. Clein, R. J. Dargaville, D. W.719 Tm /F2.0 1

Theses and Dissertations: Theses and Dissertations of Unit Graduate Students

- Cleary, P. M. 2003. Effects of fish wheels on fall chum salmon (*Oncorhynchus keta*): Non-esterified fatty acids and plasma indices of stress. MS thesis, University of Alaska Fairbanks. 46 pp.
- Meka, J. M. 2003. Evaluating the hooking injury and immediate physiological response of wild rainbow trout to capture by catch-and-release angling. MS thesis, University of Alaska Fairbanks. 83 pp.

Theses and Dissertations: Theses and Dissertations of Affiliated Graduate Students

Holliman, F. M. 2003. Assessment and prediction of electroshock-induced injury in North American fishes. PhD thesis, University of Alaska Fairbanks. 118 pp.

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

biologists. To test the null hypothesis of no effect of electrical waveform (W), voltage gradient (E), and fish size (S) on injury rate, I conducted controlled electroshock experiments on chinook salmon *Oncorhynchus tshawytscha*, rainbow trout *O. mykiss,* channel catfish *Ictalurus punctatus,* largemouth bass *Micropterus salmoides,* bluegill *Lepomis macrochirus,* and hybrid striped bass *Morone saxatilis* x *M. chrysops.* Data collected included electrical stimulus, fish behavioral response (R), length (L), and weight (W), and injury status (present/absent). Vertebral injury was determined using radiography, and hemorrhage by bilateral filleting. My model selection criteria, which was based on Akaike's Information Criterion (AIC), indicated that risks for both types of injury in chinook salmon and channel catfish were best represented by the (W, E, S) model, the (W, S) model for both types of injury in rainbow trout, the (W, E) model for hemorrhage and the (W, E, S) model for vertebral injury in largemouth bass, the (W) model for both injury types in hybrid striped bass, and, that risk for injury in bluegill injury was best described by the null model (no effect of W, E, S). A mechanistic model relating electrical stimulus, the force of contraction, and the resistance to contraction to electroshock-induced injury, using (R) as a surrogate for electrical stimulus, (L) as a surrogate for force of contraction, and vertebral count (V) as a surrogate of resistance to contraction, was explored. Application of the mechanistic model (R, L, V) to the pooled data set demonstrated a strong predictive relationship. This model offers guidance for the reduction and prevention of electroshock-induced injury for all species in all situations.

Evaluating the Hooking Injury and Immediate Physiological Response of Wild Rainbow Trout to Capture by Catch-and-Release Angling

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

Note: Julie Meka graduated from UAF in August 2003. Her thesis abstract follows:

Abstract—Rainbow trout from the Alagnak River watershed, Alaska, were captured by angling to determine the types of terminal gear contributing to hooking injury and the physiological response to angling based on concerns over high incidences of hooking injuries and the physiological impact of multiple recaptures on individual fish. Landing and hook removal times were recorded for a portion of fish captured, and plasma cortisol, glucose, ions (sodium, chloride, potassium), and lactate were evaluated in fish following capture to document physiological changes in relation to capture duration. The majority of new injuries resulted when fish were captured using barbed J hooks, and barbed J hooks took longer to remove than barbless hooks. Fish were hooked internally more frequently when captured with J hooks compared to circle hooks, but similar overall hooking injury rates were observed for both hook types. Novice

anglers injured proportionally more fish than experienced anglers, and experienced anglers took longer to land fish than novice anglers. Plasma cortisol and lactate increased significantly with increasing landing and handling times. Fish captured at cooler water temperatures had significantly lower cortisol and lactate concentrations than fish caught at warmer temperatures indicating that water temperature influenced the magnitude of the physiological response.

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: USFWS (RWO 92)
In-Kind Support: UAF laboratory supplies, equipment, and salary

Chum salmon are a vital resource for both commercial and subsistence fisherman as well as to wildlife along the U.S. and Canadian portions of the Yukon. The U.S./Canada border populations of chum salmon are genetically quite similar, which has confounded efforts to manage and allocate chum salmon by country of origin. Also, implicit in effective resource management is conservation of the resource. Mixed stock allocations for Yukon River chum salmon have not been sufficiently accurate with previously used genetic markers. The object of this study is to test genetic methods with which a baseline of U.S. and Canadian stocks of chum salmon might be developed for use in determining the relative contributions of stocks 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.

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 including 18 previously unidentified. Approximately two-thirds of tagged fish spawned in glacially turbid waters. Seventy-five percent of the identified spawning areas are adjacent to private land, yet only 50% of radio-tagged fish spawned in areas adjacent to private land. Sockeye salmon spawning habitats in the Lake Clark watershed have historically been grossly underestimated due to the glacial system's high turbidity. Most (75%) of the spawning habitats identified were adjacent to private land. It is critical that managers take proactive measures to ensure responsible development and prevent degradation to critical spawning habitats.

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

Student Investigators: 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

to forecast future returns, estimate freshwater rearing capacity and assess the overall health of juvenile salmon populations. Stratified mark-recapture experiments 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 and analyze the factors affecting the variability of abundance estimates. 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. Results show moderate to high variability in abundance estimates when using trap efficiency to estimate smolt emigration. Release time of day had a greater effect on capture probability than release distance. Recapture rates from night releases were 30% higher than daytime releases. Underwater video showed appreciable amounts of daytime migration and trap avoidance with schools of smolt actively avoiding the trap entrance. Researchers performing smolt enumeration studies using trap efficiency to estimate abundance should be cautious of the many factors that can affect trap efficiency and the potentially high variability in abundance estimates.

Movements, Vertical Distribution, and Temperature Selectivity of Lake Trout in Lower Ugashik Lake

Student Investigator: Jason Valliere, MS Fisheries
Advisor: F. Joseph Margraf
Funding Agency: USFWS (RWO 102, RWO 111)
In-Kind Support:

locate the 26 tagged individuals. Movements were documented from June through October. Depth of water at observation location ranged from 1 to 130 m with an average of 32 m. Some individuals moved much more than others. Home ranges for the 2003 season ranged from < 1km^2 to the entire lake, approximately 150 km^2. Seventy-three to eighty-six percent of all fish were located on each grid search. Information on lake trout behavior under undisturbed conditions will provide an interesting comparison to information collected on lake trout under disturbed conditions where most published information on lake trout has come from. Information collected on this system should prove very useful in effectively managing a lake trout fishery in the Ugashik system and similar systems when pressure increases on these fisheries.

Study of Dolly Varden and Arctic Char Populations in the Ugashik Narrows

Student Investigator: Mia Baylor, MS Fisheries
Advisor: F. Joseph Margraf
Funding Agency: USFWS (RWO 111)
In-Kind Support: Technical assistance and equipment provided by USFWS

The Ugashik Narrows is a high traffic fly-in fishing area on the Alaskan Peninsula. As more people use this area for sport fishing it becomes increasingly more important to know about the fish that are resident or use this area in migrations. Dolly Varden and Arctic char both use the Ugashik Narrows during the summer months. For management purposes it is important to know about the movement patterns, population size and distribution in the Ugashik Narrows by both of these species. The objectives of this study are to (1) document the size distribution and proportion of Dolly Varden and Arctic char in the Ugashik Narrows in June, July and August; (2) document the movement of fish captured in the Ugashik Narrows throughout June, July and August throughout the Lakes and Outlet; and (3) estimate the abundance of Dolly Varden and Arctic char in the Ugashik Narrows in June, July and August. During June, July and August, Dolly Varden and Arctic char were captured using seine nets and hook and line. Lengths and weights and species of fish were noted, and the fish were tagged using soft visual implant and floy tags. Thirteen Dolly Varden were implanted with radio tags and tracked throughout the Ugashik Narrows. Preliminary results show that the Dolly Varden and Arctic char appear to move throughout the Ugashik System as they follow patterns of the sockeye salmon migration. The population size remains unknown as so many fish are moving in and out of the Ugashik Narrows. Because the population size and movement patterns of the

Fish Community Structure of Resident Salmonid Species in Upper and Lower Ugashik Lakes of the Alaska Peninsula

Student Investigator: Miranda Plumb, MS Fisheries
Advisor: F. Joseph Margraf
Funding Agency: USFWS (RWO 111)
In-Kind Support: Boat, technical assistance and equipment provided by USFWS

The resident salmonids of the Ugashik lakes system on the Alaska Peninsula have never been thoroughly studied. Basic biological information is needed to accurately document the current status of resident fish populations. Ugashik lakes are classified as warm thereimictic, meaning that they typically lack thermal habitat structure. Normally, in deep lakes salmonid species are distributed according to the temperature structure of the lake, but due to the lack of thermocline in the Ugashik Lakes the salmonid species distribution could be influenced by other variables such as depth, physical habitat features, or food availability. The object of this study is to determine if salmonid species (Arctic char, lake trout, round whitefish, pygmy whitefish, Arctic grayling, Dolly Varden) are distributed according to depth or physical habitat structure in the Ugashik Lakes, and to get a better understanding of habitat use of the different resident salmonid species. The Ugashik lakes were divided into four areas or zones, each with three different depth strata. Random sample sites were chosen within each zone and depth strata and a gill net was set at each site. Depth, water temperature at depth, habitat characteristics, and other environmental factors were recorded. Dominant substrate was recorded in the near shore strata when possible and will be recorded with the use of an underwater camera for other strata in the 2004 field season. Analysis of 2003 data is currently underway. It is expected that the distribution of resident species will be related to depth, habitat structure, and food availability. Collection of data on the whitefish and char in the Ugashik drainage will help managers to make informed decisions with regard to its fisheries resources.

Developing a Method for Quantification of Chinook Salmon Spawning Habitat in the Yukon-Kuskokwim River Delta Using Stocks and Habitat in the Tuluksak River

Student Investigator: Deena Jallen, MS Fisheries
Advisor: F. Joseph Margraf
Funding Agency: USFWS (RWO 112)
In-Kind Support: Technical assistance and equipment provided by USFWS

Most salmon stocks are currently managed using spawner-recruit models. This project will examine how many salmon can be successfully supported in a stream with an SEG (Sustainable Escapement Goal) approach. Calculating habitat usage quickly and efficiently using large-scale observations would be of great use. A method is needed in rural Alaska that does not require years of data and minute detailing of stream systems. The objectives of this study are a description of spawning habitat in the Tuluksak, river classification using

Rosgen, and modeling predicted pawning habitats in the Tuluksak and other Kuskokwim drainage rivers. Habitat surveys were conducted along a section of the Tuluksak River in two summers (2002 and 2003). Map and aerial photo data from the Tuluksak and other rivers were analyzed using GIS resources. Results include habitat measurements and fish observations from three float trips. Chinook salmon were observed as far upstream as the NYAC mine, and few chinook were observed in the lower section of the river where chum salmon spawning was prevalent. Determining escapement goals and survival bottlenecks are much-desired goals of managers. Studies of habitat usage may reveal theoretically optimum fish numbers a system should sustain.

Understanding the Link between River Features and Habitat for Spawning Chum Salmon in Southwestern Alaska

Student Investigator: John O'Brien, MS Fisheries
Advisor: F. Joseph Margraf
Funding Agency: USFWS (RWO 112)
In-Kind Support: Technical assistance and equipment from USFWS

Chum salmon are reported to favor riverine spawning sites have either an influx or outflow of water from and the hyporheic zone. Landscape topography and channel morphology constitute hydraulic controls that create these preferred spawning conditions. This study was conducted in 2002 to 2004 on the Tuluksak River in Southwestern Alaska. Large-scale river features were mapped remotely by aerial surveys and synthetic aperture radar interferometry (INSAR). These large-scale features included sinuosity, permafrost distribution and continuity, ice-cover continuity in the winter (as an indicator of upwelling) and abrupt changes in stream gradient or surface terrain elevation. Small-scale river features that required on-site sampling were bed particle size, redd location and distribution, hyporheic sampling with mini-piezometers, and phyisco-chemical habitat measures. In July 2003, 28 chum salmon spawning sites were identified by observation from a raft; 79% of the total number of spawning sites were in one 10 mile stretch of river. In this river section the sinuosity was 2.07. The mean gradient in these heavily used areas was 0.22%. This study represents progress toward developing habitat-based escapement goals in remote rivers in western Alaska.

Environmental Processes Affecting Population Dynamics and Life History Traits of Arctic Grayling in Western and Interior Alaska

Student Investigator: Jenny Neyme eatures and Habitat for

length class. We seek to understand the biological and environmental mechanisms that are responsible for this apparent difference. Habitat quality based on traditional IFIM is compared with a new method combining IFIM with a drift based foraging model. Traditional IFIM approaches were appropriate for some pools; however, a lack of weighting in the application of preference curves to calculate weighted usable area resulted in unsatisfactory results on several pools. Diet samples indicated a strongly opportunistic foraging strategy that questions the applicability of a drift-based foraging model for this species. Overall, we find that traditional IFIM is inadequate and that a new method for habitat assessment is required.

The Eelgrass Ecosystem of Izembek Lagoon: Retrospective Analysis and Development of a Protocol for Future Monitoring

Investigator: C. Peter McRoy
Funding Agency: USFWS (RWO 124)
Additional Support: Alaska Sea Grant, ARCUS, UAF

The overall goal of this project is to gather data collected by numerous past studies of the eelgrass (*Zostera marina*) community of Izembek Lagoon into a single electronic database that will permit analysis for long-term trends in response to climate change and to develop a plan for a continuing monitoring program for the eelgrass community including the associated biota. The ecology of the eelgrass beds of Izembek Lagoon, on the north side of the far western Alaska Peninsula, was the focus of numerous studies by many UAF students and this PI that began in 1962 and ended in 1983. While many publications resulted from these efforts, the data were all collected prior to the computer revolution and they have not been gathered into a single database on electronic media that would permit their use as a baseline for further work. Furthermore, there has been no analysis of the response of these eelgrass beds to significant climate changes that were known to occur during the study period. The overall objectives are to enter all biological, chemical, and physical data into an electronic spreadsheet-form database along with related ancillary data (i.e. climate and ocean information) and to analyze the data for long-term trends in the eelgrass habitat and associated biota in relation to climate change. Data are manually transferred from notebooks to a computer spreadsheet. Ancillary climate and ocean data will be collected from existing data sources. A metadatabase describing the entire data set is also being constructed. A student, supported by Sea Grant, will participate in these activities. A field trip to Izembek Lagoon in September 2002 was made to collect samples at historical sample locations. To date several thousand data pirw2e Tm /0c1978-9831have Tj ET Q q 0.

density in the upper intertidal in 2002 compared to 1978, a possible consequence of less ice scouring in an ameliorated climate. A quantitative data set that describes the eelgrass habitat in Izembek Lagoon will be a valuable asset to the Izembek National Wildlife Refuge for evaluating changes in the lagoon biota due to natural or anthropogenic influences.

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

Student Investigator: To be determined
Advisor: 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 subsistence 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, δ^{13}C and δ^{15}N will be used to reconstruct lake paleoproductivity and past changes in sockeye abundance. This project has just begun, and results are not yet available.

Paleolimnology of Selected Lakes in the Southwest Alaska Network:

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

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

Student Investigator: Heather M. 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: Equipment use and logistical support from YDNWR and USGS

Over the past 40 years, surveys have estimated a 90% reduction in breeding pairs of Pacific common eiders (*Somateria mollissima v-nigrum*) on the Yukon-Kuskokwim Delta (YKD) in western Alaska. Presently, only sparse information exists on the ecology or demography of the YKD population and little has been done to explore factors that may be contributing to their decline. This study aims to use historical and current data to estimate demographic vital rates, assess exposure to contaminants, and examine behavioral components of colonial breeding in the western Alaska population of Pacific common eiders. Additionally, the study will result in a population model which will allow managers to project population growth rate and quantify response to changes in reproductive success and survival. 1) Estimate adult female annual survival, reproductive success, reproductive output, and contaminant exposure at two breeding areas on the YKD. 2) Describe annual and geographic variation in these life history parameters using historical and current data. 3) Use estimated demographic parameters and published duckling survival rates to develop a simple common eider population model for the YKD. We will collect at least three years of data (2002-2004) in addition to eight years of historical data. We conduct nest searching and monitoring, capturing and banding adult females, as well as continued banding of ducklings at hatch. Additionally, we collect blood samples from nesting females to examine exposure to contaminants. In 2003 we expanded contaminants sampling to include pre-nesting males and females and mid-incubation females, with the goal of examining temporal dynamics in contaminants during the breeding season. As of 2003, a total of 528 common eiders were banded on the Yukon Kuskokwim Delta; 255 birds at Tutakoke River (1994-2003), 175 at Kigigak Island (1994, 1997, 2001-2003), and 98 at Hock Slough (1994-2002). Our preliminary estimate of annual survival for adult females is 87%. In 2002, we found 203 nests at Kigigak Island and 131 at Tutakoke River and in 2003, we found 184 nests at Kigigak and 93 at Tutakoke; however, due to severe arctic fox predation, no nests at Tutakoke survived laying into incubation in 2003. Overall nest success in 2002 ranged from 40 to 60% and in 2003 nest success was approximately 1% at Tutakoke to 19% at Kigigak Island. Results from analyses of blood lead and selenium during the breeding season indicate that toxic exposure to lead is relatively low (4-11%), but occurrence of detectable selenium is high (100%). Although 50-90% of individuals displayed background levels of lead in their blood, concentrations and frequencies of lead exposure in this population do not appear to warrant immediate concern. However, selenium concentrations are elevated compared to freshwater birds and other subspecies of common eiders nesting outside of Alaska. Individual variation in selenium concentrations may be linked to body

condition. Two other species of eiders breeding on the YKD have already been listed as “Threatened” species under the Endangered Species Act. Current and future conservation and management strategies for all the eiders will depend on an understanding of each species’ population dynamics; particularly sensitivity and response to demographic and environmental change. Little is known of the population ecology of the Pacific common eiders. Quantifying rates of the two most important population parameters, survival and reproduction, and understanding factors that affect these parameters (i.e. exposure to contaminants, colony dynamics, and predation) will be the first step in describing the demography of this subspecies.

Effects of Reproductive Stage on Adrenal Responsiveness 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 reproductive period for seabirds is both energetically expensive and potentially stressful. Parents have the dual challenge of maintaining their own

Limitations to Recruitment in Emperor Geese: Landscape Heterogeneity in Forage Availability and Gosling Body Mass

Student Investigator:

development, but current knowledge is not sufficient to determine the nature or extent of such impacts. Specific knowledge gaps to be investigated by this study include distribution of staging shorebirds along the North Slope, movements of birds between and among staging areas within the Barrow vicinity, and the mechanisms that determine how shorebirds distribute themselves at staging sites. This study has two objectives: (1) an intensive analysis of staging habitat characteristics and physiological factors influencing shorebird choice of staging areas (study location will be Barrow, AK), and (2) an extensive aerial survey (2005 only) to determine how staging shorebirds are distributed across selected sites on the North Slope. Objective 1: Transects located in a variety of staging habitats will be monitored regularly from July-September (2004-2006) to determine distribution, species composition, and turnover times of shorebirds staging near Barrow. Shorebirds will be mist netted at selected staging locations near Barrow for banding and collection of blood samples. Blood samples will be analyzed for fattening rate and stress hormone level. Objective 2: Aerial surveys will be conducted at sites likely to have large concentrations of staging shorebirds in August 2005. Associated ground camps located in the vicinity of each survey route will provide a species correction factor for the aerial data. A short pilot season in 2003 allowed us to test methods and locations for mist netting staging shorebirds. We collected blood samples from 25 staging birds that were subsequently analyzed by Tony Williams at Simon Fraser University for fat metabolite concentration (an indicator of relative fattening rate). These data indicated that shorebirds sampled in Barrow in 2003 were not fattening rapidly compared to western sandpipers sampled at migration stopovers in British Columbia. In addition, transects surveyed in Barrow during the mid-1970's by Pete Connors were reestablished for use in this study. Many North American shorebird species are thought to be declining, including some that breed and stage on the North Slope. Given that future energy development on the North Slope is likely, information that contributes to managers' ability to predict how this development will impact the survival and reproduction of arctic breeding and staging shorebirds is warranted. This research will aid in understanding arctic shorebird ecology, which isd sgocs haryor usaccute)nted. This research w

of this study is to determine what mechanisms exist, if any, whereby human

Breeding Biology of King Eiders at Teshekpuk Lake and the Kuparuk Oilfields

Student Investigator: Rebecca McGuire, PhD Biology
Advisor: Abby Powell
Funding Agencies: CMI; ConocoPhillips Alaska, Inc.; BLM; and NSB

Little is known about the breeding biology of king eiders (*Somateria spectabilis*) and the potential impacts of development on their breeding grounds. The western North American population of king eiders declined by more than 50% between 1979 and 1996 for unknown reasons. Additionally, NPR-A is being leased for oil and gas exploration and may potentially be developed. Within the northeast planning area of NPR-A is the highest known density of nesting king eiders on the north slope of Alaska. The primary objective of this study is to provide information on eider nest survival and how it is influenced by nest site choice in both an undisturbed and a disturbed area. Accessible areas around Teshekpuk Lake and Kuparuk were searched for pre-nesting and nesting king eider in June and July 2002 and 2003. Nests were located, monitored and habitat evaluations were done. Female king eiders were fitted with VHF transmitters and broods were followed after hatch. Nest success was not different between years and sites; however, daily nest success was higher on islands than mainland sites. Our preliminary analyses found no evidence for an effect of spatial covariates on daily nest survival. Field work will continue in 2004 and 2005. The center of distribution and area of greatest nesting density of king eiders in Alaska is being leased for development so it is important to have information on the reproductive parameters of king eider in both an undisturbed and a disturbed area.

The Common Raven ( ) on the North Slope of Alaska: Wildlife Management and the Human Dimension

Student Investigator: Stacia Backensto, PhD Biology
Advisor: Abby Powell
Funding Agencies: CMI; USFWS; MMS; UAF Regional Resilience and Adaptation Program
In-Kind Support: ConocoPhillips Alaska Inc. and NSB

Little is known about the ecology of the common raven on the North Slope of Alaska and how human development and infrastructure are affecting raven survival and productivity across the slope. Additionally, little is known about how Inupiaq communities view suggested raven control programs. Ravens are nest predators of tundra-nesting birds. The extent to which they may negatively influence these species on the North Slope is unknown. Ravens appear to be increasing their numbers across the North Slope in response to human development. The objectives of this study, for various scales of human development (oil fields, human settlements, and LRRS sites, undeveloped) are to describe the foraging movements and behaviors, assess diet and productivity of breeding birds, and document current abundance and distribution. This study will also investigate local knowledge and perceptions of raven management.

Ravens will be captured, banded and fitted with PTT transmitters, VHF transmitters, or patagial markers. Movements of ravens will be monitored through telemetry and direct observation. Diet will be determined through pellet analysis, videography, and direct observation. Interviews will be conducted in Inupiaq villages and in the oilfields. Fieldwork will be conducted in 2004 and 2005. Many tundra-nesting bird populations are declining. Factors such as development and associated increased rates of predation are suspected to be influencing these declines. Future oil development on the North Slope of Alaska is imminent and the extent to which its infrastructures and other human developments influence the ability of ravens to survive, reproduce, and impact tundra-nesting species is unknown. Local knowledge and perceptions of management can inform and enhance our understanding of these relationships.

Migration and Breeding Ecology of King Eiders ( ) on the North Slope of Alaska

Student Investigator: Laura Phillips, M.S. Biology
Advisor: Abby Powell
Funding Agencies: MMS/CMI; Institute of Arctic Biology; NSB; Sea Duck Joint Venture; Angus Gavin
In-Kind Support: Logistic support provided by ConocoPhillips Alaska, Inc.; equipment support from USFWS and AKCFWRU

Little is known about the migration routes and breeding ecology of king eiders, especially in areas of development. King eiders have declined by over 50% in eastern Alaska and western Canada. Reasons for this decline are unknown. Better information about the natural history of king eiders and population dynamics is important to help model population trends. As development continues on the Arctic Coastal Plain of Alaska, potential impacts of oil 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 and evaluate movements and survival of king eider females with broods. Thirty-three king eiders were implanted with satellite transmitters (PTTs) during summers 2002 and 2003. Location information was plotted using ArcView GIS. Twenty-three breeding females were trapped on the nest and fitted with prong-and-suture or glue-on radio transmitters during the 2002 and 2003 field seasons. Radio-transmittered females were then radio-tracked by foot and airplane. Preliminary results suggest that Harrison Bay in the Beaufort Sea may be an important staging area for king eiders breeding at Kuparuk, AK in 2002 and 2003. Molting

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
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 45 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 15 of 44 successful broods in 2002 and 31 of 46 broods in 2003 with approximately 65% of ducklings surviving to 1 month of age both years. 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.

Small Mammal Monitoring at the Landscape Scale and Synthesis of Monitoring Data in Denali National Park and Preserve

Principal Investigator: Eric Rexstad
Funding Agency: NPS

During the 5-year duration of this work order, spatially extensive and temporally intensive data collection occurred in Denali National Park and Preserve. There exists a 12-year dataset of small mammal population dynamics, the longest rigorously collected small mammal data set every gathered in Alaska. Beyond

the collection and analysis of this data set, we have synthesized through predictive modeling, a relationship between climatic factors and the dynamics of the northern red-backed vole. This model (through 2002) explained in excess of 80% of the variability in the red-backed vole time series. Our analytical research of the small mammal data set extends to the development of a conformance metric that permits combination of many datasets from a variety of sources (meteorological, avian, ungulate, microtine, vegetational) to produce measures of conformance. This metric is easily comprehended by Park Service managers for assessing the state of biological resources under their control. Beyond the management utility of this metric, it can easily be decomposed for detailed assessment by biological experts to understand sources of variability in non-conformance. Work conducted under this work order was not restricted to small mammal data. Considerable effort was devoted to analyzing air quality data in collaboration with Park Service staff. Furthermore, analytical products were generated for Park Service vegetation ecologists. These products are web-enabled, affording ecologists in a variety of locations to access raw data as well as standardized summaries via the internet. This suite of web-enabled analytical tools represents the cutting edge of ecological analytical developments; and we expect to see more such products available to future scientists and managers.

Population Dynamics and Habitat Relationships of Large Mammals on the Upper Alaska Peninsula

Student Investigator: Corey D. Adler, MS Wildlife
Advisor: Abby Powell
Funding Agency: Alaska Peninsula/Becharof National Wildlife Refuge, USFWS (RWO 113)
In-Kind Support: Technical assistance and all equipment used during the field season provided by USFWS

No quantitative data have been collected on moose/habitat relationships on the Alaska Peninsula for the past twenty years. Little is known about the current moose population, the habitats they use, and the interactions between the two. Moose are an important part of subsistence and recreational hunting on the Alaska Peninsula. With the current decline of the Northern Alaska Peninsula Caribou Herd (NAPCH), residents of the area are seeking to have an increased use of the local moose. The objective of this study is to create a predictive model of moose use areas in relation to available habitat. The model can then be used as a baseline to predict important moose areas throughout the Peninsula and assist in game management strategies. Twenty adult cow moose were fitted with Global Positioning System (GPS)/VHF collars during October 2002. Moose movements will be tracked for two winters. Habitat characteristics were assessed in the various use areas in spring 2003 and will continue in spring 2004. A digital satellite image will be used to identify key vegetation characteristics of the use areas and then will be used to locate other similar areas throughout the refuge. Preliminary results indicate that eighteen moose are still transmitting locations. One moose is known to be dead as of May 2003, and one moose is still missing or has a non-working collar. Some vegetation data were collected in spring 2003. Winter moose use areas (high or low) will be

determined using home range analyses. Satellite images will then be used to locate similar use areas throughout the refuge. Identification of winter moose use areas on the refuge will assist in future management and research. Assessment of winter range conditions and habitat use/availability analyses will apprise resource managers of current conditions.

Assessing and Managing the Impacts of Humans along National Park Coastlines in Southcentral Alaska: Bears as an Indicator—Kenai Fjords National Park Black Bear Study

Principal Investigator: Erich H. Follmann
Funding Agency: National Park Service, RWO 96

No graduate student was assigned to the project again during 2003. The focus of efforts was to (1) complete home range size estimate for radio-collared bears monitored during 2000 and 2001; (2) prepare home range maps for each bear; (3) coordinate shipping of teeth from bears captured by Hart-Crowser personnel during 2002 to Matson's Laboratory; and (4) determine the possibility of having stable isotope analysis done at UAF on bears captured during the entire study.

- Torsten Bentzen, a DBW graduate student, estimated home range sizes using Minimum Convex Polygon and Kernal techniques. Home range maps generated for each bear monitored during 2000 and 2001 will be included in the final project report.
- Matson's Laboratory, Milltown, MT, prepared and performed an age estimation on 17 black bears captured during 2002. Ages ranged from 3 to 21.

Calving and Post-Calving Habitat Selection of the Teshekpuk Lake Caribou Herd

Student Investigator: Lincoln Parrett, MS Wildlife
Advisor: Brad Griffith
Funding Agencies: Wildlife Conservation Division, ADFG; North Slope Borough Department of Wildlife Management (NSBDWM)
In-Kind Support: Radio-tracking costs, field and office supplies, office space, and internship in Barrow (ADFG); field supplies, lodging in Barrow (NSBDWM)

The majority of the Teshekpuk Caribou Herd (TCH) annual range is currently being considered for industrial development. Habitat selection by and distribution of the TCH has not been studied beyond the calving period. The TCH comprises a significant subsistence resource for several North Slope villages. Baseline information about this herd's distribution and habitat use is necessary for the interpretation of any post-development distribution and habitat use studies, as well as for the development of any disturbance mitigation measures. This purpose of this study is to determine the geographic areas that female caribou of this herd use during the summer, and to determine what habitat features are being selected. During the course of the study, 35-50 active radio-collars were deployed. Female caribou were radio-tracked every other day in early June and every two weeks from mid-June until the rut, weather permitting, in 2002 and 2003. Fecal samples were collected following each

survey period whenever possible. A GIS will be used to analyze patterns of selection in habitat features as snow cover, terrain ruggedness, remotely sensed vegetation class, and remotely sensed green-up patterns (NDVI). In 2002, 23 calving locations were estimated, and in 2003, 20 calving locations were estimated. An additional 3 post-calving habitat use surveys were conducted in 2002, with 4 post-calving habitat use surveys conducted in 2003. Eight composite fecal samples were collected in 2002 and 6 in 2003. Concentrated calving areas were to the northeast and southeast of Teshekpuk Lake in 2002 and to northeast, southeast and west of Teshekpuk Lake in 2003. Following calving in 2002, the majority of female caribou moved to the southwest of Teshekpuk Lake before aggregating along the coast between Barrow and Harrison Bay in mid-July. By late August 2002, caribou were spread out across the central coastal plain. Following calving in 2003, female caribou moved to the southeast of Teshekpuk Lake before aggregating along the coast between Admiralty and Harrison Bays in mid-July, again achieving wide distribution by mid-August. Fecal samples from both summers were analyzed for diet composition. Lichen was the dominant plant fragment in the fecal samples during calving, with sedges and deciduous shrubs becoming prevalent as the summer progressed. An addition field season will be conducted in 2004. This herd consistently uses the area around Teshekpuk Lake intensively throughout the summer. Although the reasons for fidelity to this area are not clear at this time, their intensive use of this area needs to be taken into consideration when planning for industrial development in the Teshekpuk area. Results from analysis of habitat use patterns may help managers determine the availability of suitable alternative habitats, and inform future studies on habitat quality in the area.

Assessing Habitat Quality for Dall's Sheep in Wrangell-St. Elias National Park and Preserve, Alaska

Student Investigator: Miranda Terwilliger, MS Wildlife
Advisor: Brad Griffith
Funding Agency: National Parks Foundation, Safari Club International, and NPS
In-Kind Support: Transportation to field sites and field gear provided by NPS

A large-scale, quantitative, objective method for ranking the quality of Dall's sheep habitat is needed due to the prohibitively expensive nature of monitoring all sheep populations within Wrangell-St. Elias National Park and Preserve (WRST). Current "expert opinion" models do not correlate well with sheep population characteristics (e.g. density, productivity, horn size). Although WRST is world-renowned for its trophy sheep, biologists currently have no quantitative expectations of the relative suitability of various survey units for sheep and are thus hampered in their management decisions. The objective of this study is to estimate spatial variance in habitat suitability for Dall's sheep within Wrangell-St. Elias National Park and Preserve. Seven study sites were chosen that represent a range of sheep densities (dependent variable). Geographic Information Systems (GIS) and remote sensing were used to inventory habitat characteristics (independent variables, e.g. terrain ruggedness, greenness, %

vegetated, hunting pressure, etc.). These 7 sites will be ranked by expected habitat quality for sheep based on literature review and expert opinion for each independent variable. Ranks of independent variables will be compared to the ranks of sheep characteristics (density, productivity, and horn size) to identify the variables most closely associated with sheep performance. Historical sheep survey results have been collected, summarized and entered into a database. Count area (CA) boundaries have been formalized and digitized for consistency in future surveys. A formalized documentation of these areas has been given to all cooperating agencies clarifying the boundaries for consistency in future data collection. Areas, density indices and fecundity indices of CA's have been estimated. Average and maximum horn sized (length and basal circumference) of hunted sheep within CA's was estimated from ADFG harvest reports. Diet composition and quality was estimated from analysis of fecal pellets. The landcover map has been expanded using additional remotely sensed satellite images. Terrain ruggedness was estimated using USGS Digital Elevation Models (DEM's). Future plans for the study include ranking sheep population characteristics (horn size, density, variance in density, and lamb:ewe ratios); ranking habitat characteristics (landcover, terrain ruggedness, % park/preserve, greenness); and comparing the rank order of sheep characteristics to the rank order of habitat characteristics to identify the habitat variables most closely associated with sheep horn size, density, variance in density, and lamb:ewe ratios. Results of the study will allow estimates of expected sheep performance of all Count Areas in WRST NP/P and provide an objective basis for the determination of what constitutes normal and healthy populations in relation to habitat.

and periods and background average exposure was of 18.7 sorties/day which increased ($P < 0.001$) to 59.8 sorties/day during major flying exercises (MFE). There were significant differences in behavior (Minimum Convex Polygon home range size, total distance traveled in 2-week periods) and habitat use (2-week proportional use of landcover classes and aspect and mean slope, elevation, terrain ruggedness, and vegetation greenness) between study areas and among years and periods ($P < 0.0001$), but the sorties covariate did not add additional explanatory power ($P > 0.14$). The results of this study suggest that, under the constraints of a small number of marked sheep, a system with a long history of exposure to military overflights and a background exposure of 18.7 sorties/day, any effects of military flight sorties on sheep behavior and habitat use were not distinguishable from the natural variance in sheep behavior and habitat use that would be expected to result from variance between study areas and among years and seasons.

Assessing Temporal Changes in Habitat Selection by Caribou

Principal Investigator: Brad Griffith
Student Investigator: Rachel Jones, MS Wildlife
Funding Agency: Alaska Department of Fish and Game
In-Kind Support: Arctic National Wildlife Refuge; Vilis Nams, Department of Environmental Sciences, Nova Scotia Agricultural College

Animals may respond to landscape features differently at different temporal and spatial scales, and these differences may only be identified by examining habitat selection within animal-defined domains. A domain is a spatial region or period of time over which we may expect patterns, such as habitat selection or calving distributions, to be consistent. Objectively defining domains may allow managers to accurately time the assessment of these patterns. By working within domains, managers may minimize project costs by reducing flight time while obtaining reliable results. We hope to define the temporal and spatial domains associated with caribou calving and to estimate changes in daily habitat selection within the animal-defined calving domain. Annually from 1992-1994, approximately 70 calves were radio-collared within 48 hours of birth and relocated daily until they departed the calving grounds. Based on the movement paths of these calves, the spatial domain(s) of calving were defined by examining the correlation of the cosine of successive path turn angles. KernelHR was used to (1) estimate daily 99% fixed kernel utilization distributions using least squares cross-validation to select smoothing parameters, and (2) estimate density at each location within the temporal calving domain. In the future, we will perform a regression analysis to estimate daily selection or avoidance, using density as a response variable and habitat characteristics such as NDVI, snow cover, vegetation type, terrain ruggedness, and NDVI rate of change as explanatory variables. For 1992, 1993, and 1994 we estimated that the spatial domain was 10 km, 19 km, and 20 km, respectively. In each year daily travel rates commensurate with these domain sizes were achieved on approximately 24-26 June. Defining the temporal calving domain gives managers a time frame within which they can accurately estimate things such as habitat selection or density during calving. Estimating and identifying changes in daily habitat

selection through time may also clarify the relationship between larger scale and finer scale selection by the PCH.

Completed Ecological Studies

Arctic Transitions in the Land Atmosphere System

Student Investigator : Catharine Copass Thompson, PhD Biology
Co-Investigators: 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, advised a PhD graduate student in the development of a spatially explicit model of tundra vegetation dynamics. The student conducted field seasons at Ivotuk, Alaska and Council, Alaska to evaluate the role of plant functional types in water, energy, and carbon exchange of transitional ecosystems between tundra and boreal forest. The student has published one study on the role of plant functional types in water and energy exchange of these transitional ecosystems (Thompson et al. In press. *Journal of Vegetation Science.*). A second study, which focuses on the carbon dynamics of these transitional ecosystems (Thompson et al. In preparation. *Ecological Application.*), has used field data to parameterize a model of carbon dynamics. This model has been evaluated in the context of satellite-based estimates of biomass changes on the North Slope of Alaska over recent decades. A third study evaluates the consequences of vegetation changes on the North Slope of Alaska for regional climate.

Landscape Analysis of Moose Distribution Relative to Fire History in

Fate of Carbon in Alaskan Landscapes

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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 that have been published (Zhuang et al. 2001. *Journal of Geophysical Research* 106:33,649-33,670; Zhuang et al. 2002. *Journal of Geophysical Research* 107, 8147, doi:10.1029/2001JD001244 [printed 108(D1), 2003]; and Zhuang et al. 2003. *Tellus* 55B:751-776). The first manuscript reports on a study that indicates that the soil thermal regime in Alaskan landscapes appears to be most

Biocomplexity: Feedbacks between Ecosystems and the Climate System

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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 and Canada, which has a fire record of the timing and location of fires since the 1950s. After developing and testing the model over the Alaska and Canada domain, the model will be evaluated for its ability to simulate the fire regime 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 model will then be coupled to a large-scale

project future changes in the fire regime, which will provide scenarios to evaluate the third objective of the project.

Case Studies from the Tongass National Fo

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

CMI Coastal Marine Institute, UAF

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

MOU Memorandum of Understanding

MSL Marine Science and Limnology Program, IMS, UAF

NASA National Aeronautical Space Agency

NOAA National Oceanographic and Atmospheric Administration
NMFS National Marine Fisheries Service

NPR-A National Petroleum Reserve-Alaska

NPS National Park Service

NSB North Slope Borough

NSF National Science Foundation

NWR National Wildlife Refuge

PI	Principal Investigator
RSA	Reimbursable Services Agreement
RWO	Research Work Order
SFOS	School of Fisheries and Ocean Sciences, UAF
UAF	University of Alaska Fairbanks
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