Idaho Cooperative
Fish and Wildlife Research Unit

Annual Report

2005

ANNUAL REPORT

October 1, 2004 — September 30, 2005

IDAHO COOPERATIVE
FISH AND WILDLIFE RESEARCH UNIT

University of Idaho
6th and Line Streets
P.O. Box 441141
Moscow, ID 83844-1141
208-885-6336
idahocoop@uidaho.edu
http://www.cnrhome.uidaho.edu/coop/

Unit Cooperators

U.S. GEOLOGICAL SURVEY
IDAHO DEPARTMENT OF FISH AND GAME
UNIVERSITY OF IDAHO
WILDLIFE MANAGEMENT INSTITUTE
U.S. FISH AND WILDLIFE SERVICE

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Idaho Cooperative Fish and Wildlife Research Unit
A cooperative research and educational program of
U.S. GEOLOGICAL SURVEY
IDAHO DEPARTMENT OF FISH AND GAME
UNIVERSITY OF IDAHO
WILDLIFE MANAGEMENT INSTITUTE
U.S. FISH AND WILDLIFE SERVICE

The Cooperative Fish and Wildlife Research Units Program has been in existence for over 70 years. It began with the U.S. Fish and Wildlife Service in response to a recognized need for trained biologists and scientific information in the field of fish and wildlife management. The resulting unique partnership, which developed among federal and state resource agencies, the Land Grant University, and private entities, has evolved into a nationwide program. This key program operated as part of the U.S. Fish and Wildlife Service until November 1993, when the entire program was moved into the National Biological Survey established by a Secretarial Order under the FY 1994 Interior Appropriations Act. More recently, in October 1996, the Units Program was moved into the U.S. Geological Survey, where it now resides in the Biological Resources Division.

Beginning in 1984, wildlife and fishery units were combined into cooperative fish and wildlife research units. There are 41 cooperative research units.

Unit History
The Idaho Cooperative Wildlife Research Unit was established at the University of Idaho September 20, 1947 and the Idaho Cooperative Fishery Research Unit was established in 1963. The two units were combined into the Idaho Cooperative Fish and Wildlife Research Unit in 1985. The unit is housed in the Department of Fish and Wildlife Resources in the College of Natural Resources at the University of Idaho. The unit is staffed, supported, and coordinated by the United States Geological Survey-Biological Resources Division, the Idaho Department of Fish and Game, the University of Idaho, the Wildlife Management Institute, and the U.S. Fish and Wildlife Service.

Program Direction
The unit works toward conducting research on fish and wildlife problems of state, regional, and national interest, training graduate students for careers in the fish and wildlife professions, and providing technical assistance to state and federal managers and researchers.

The unit emphasizes research to help find solutions to problems affecting anadromous fish passage in the Snake River basin, develop and evaluate methods to enhance fish health of hatchery reared fish, evaluate methods of establishing new animal populations or augment existing populations, improve estimators of animal abundance, evaluate effectiveness of existing reserve and management areas, develop methods to assess the input of introduced aquatic species, study the basic biology of aquatic and terrestrial animals, evaluate effectiveness of efforts to recover populations of endangered species, and evaluate factors that regulate carrying capacity in fresh water and terrestrial habitats.

Unit Research, Expertise, and Interests

Unit personnel maintain close working and professional relationships with the University of Idaho faculty, Idaho Department of Fish and Game and U.S. Fish and Wildlife Service personnel. Research studies are conducted primarily within Idaho, though some work is done in Montana, Washington, California, Colorado, North Carolina, Oregon, Alberta, Federated States of Micronesia, Hawaii, Costa Rica, and Eastern Europe.

Unit research is supported by state contributions and by contracts from the U.S.G.S.-Biological Resources Division, U.S. Fish and Wildlife Service, U.S. Army Corps of Engineers, U.S. Forest Service, Bonneville Power Administration, Northwest Power Planning Council, and other federal, state, and private agencies. In addition to research activities, unit personnel teach graduate-level courses, serve as advisers for graduate students, and participate in a variety of professional activities.

J. Michael Scott, Ph.D. – Unit Leader and Professor of Wildlife Resources. Recent research activities include studies on: reserve identification, selection, and design in North America; the use of translocation as a tool for establishing or augmenting animal populations; predicting species occurrences; recovery of endangered species; and development of tools to facilitate the transfer of information at the science policy interface. Areas of interest include animal · ecology and conservation biology. Specialty course: WLF 515 – Advanced Topics in Conservation Biology.

James L. Congleton, Ph.D. – Assistant Unit Leader and Professor of Fishery Resources. Recent research activities include studies on the energetics of migration through the Snake-Columbia River hydropower system for Chinook salmon smolts and consequences for survival. Specialty courses include: FISH 511 – Fish Physiology, FISH 514 – Fish Population Ecology, Guest lecture in FISH 424, Fish Health, "Effects of physiological stress on fish health and performance," Guest lecture in Forestry 221, Natural Resource Ecology, "Homeostasis and general systems theory."
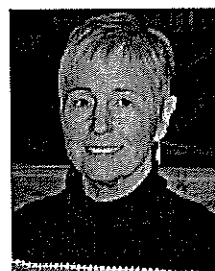
Christine M. Moffitt, Ph.D. – Assistant Unit Leader and Professor of Fishery Resources. Recent research activities include: studies of the efficacy, risks, approval and regulation of aquaculture chemicals, understanding host-parasite relationships in ecological settings; in interactions between cultured and wild fish, monitoring and control of invasive New Zealand mudsnails; temperature effects on fish physiology and health; and fisheries history. Specialty Courses: FISH 510, Advanced Fisheries Management; FISH/WLF 501, Graduate Seminar; and FISH 504, Sustainable Aquaculture.

Idaho Cooperative Fish and Wildlife Research Unit
http://www.cnr.uidaho.edu/coop/
idahocoop@uidaho.edu

J. Michael Scott, Ph.D.
Leader
(208) 885-6960
mscott@uidaho.edu

James L. Congleton, Ph.D.
Assistant Unit Leader
(208) 885-7521
jconglet@uidaho.edu

Christine M. Moffitt, Ph.D.
Assistant Unit Leader
(208) 885-7047
cmoffitt@uidaho.edu

Shauna J. Woods, Administrative Assistant
(208) 885-6336
shaunaw@uidaho.edu

Cooperators

UNIVERSITY OF IDAHO
Steven B. Daley Laursen, Dean
College of Natural Resources
Kerry P. Reese, Department Head
Fish and Wildlife Resources
P.O. Box 441141
Moscow, ID 83844-1141

IDAHO DEPARTMENT OF FISH AND GAME
Steve Huffaker, Director (208) 334-5159
Jim Unsworth, Chief, Wildlife Bureau
Virgil Moore, Chief, Fisheries Bureau
600 South Walnut
P.O. Box 25
Boise, ID 83707

U.S. GEOLOGICAL SURVEY
Pat Leahy, Director
12201 Sunrise Valley Drive, MS 303
Reston, VA 20192

COOPERATIVE RESEARCH UNITS
Byron K. Williams, Chief
Lynn Haines, Supervisor
12201 Sunrise Valley Drive, MS 303
Reston, VA 20192

WILDLIFE MANAGEMENT INSTITUTE
Steven A. Williams, President
1146 19th Street, NW, Suite 700
Washington, DC 20036

U.S. FISH AND WILDLIFE SERVICE
Dale Hall, Director
1849 C Street, NW
M/S 3238 MIB
Washington, DC 20240

University of Idaho Faculty Collaborators

David Bennett, Ph.D., Fishery Resources
Jeffrey Braatne, Ph.D., Fishery Resources/Range Management and Ecology
Oz Garton, Ph.D., Wildlife Resources
Dale Goble J.D., College of Law
Wayne Melquist, Ph.D. – Wildlife Resources
Chris Peery, Ph.D., Fishery Resources
Matt Powell, Ph.D., Fishery Resources
Janet Rachlow, Ph.D., Wildlife Resources
John Ratti, Ph.D., Wildlife Resources
Kerry Paul Reese, Ph.D., Wildlife Resources
Dennis Scarnecchia, Ph.D., Fishery Resources
Lisette P. Waits, Ph.D., Wildlife Resources
R. Gerald Wright, Ph.D., Wildlife Resources

Post-Doctoral Associates

William Kristan, Ph.D., Wildlife Resources, University of Idaho
S.M.A. Mobin, Ph.D., Fishery Resources, University of Idaho

Graduate Students on Unit-Assisted Projects

Student	Discipline	Adviser
Kara Anlauf	M.S. Fishery Resources	C.M. Moffitt
Emmi Blades	M.S. Environmental Science	J.M. Scott
Peter Bloom	Ph.D. Wildlife Resources	J.M. Scott
Rolita Louise Bruce	M.S. Fishery Resources	C.M. Moffitt
John Cassinelli	M.S. Fishery Resources	C.M. Moffitt
Lubia Cajas Cano	M.S. Environmental Science	C.M. Moffitt
Michael Colvin	M.S. Fishery Resources	C.M. Moffitt
Jason Dungan	M.S. Wildlife Resources	R.G. Wright
Derek Fryer	M.S. Fishery Resources	J.L. Congleton
Christopher James	M.S. Fishery Resources	C.M. Moffitt
Stephen Mosher	M.S. Wildlife Resources	J.M. Scott
Anna Pidgorna	Ph.D. Environmental Science	J.M. Scott
Amy Pinson	M.S. Fishery Resources	J.L. Congleton/C.A. Peery
David Rupp	M.S. Environmental Science	J.M. Scott
Jan Schipper	Ph.D. IGERT/Fish and Wildlife	J. M. Scott
David Stanish	M.S. Environmental Science	J. M. Scott/Dale Goble
Leona Svancara	Ph.D. Wildlife Res/Geography	J. M. Scott
Jeffrey Yanke	M.S. Fishery Resources	C. M. Moffitt
Don Zaroban	Ph.D. Fishery Resources	J. M. Scott/G.W. LaBar

Students on Unit Associated Projects

Student	Discipline	Adviser
Chris Anderson	M.S. Fishery Resources	C.A. Peery
Jen Adams	Ph.D. Wildlife Resources	L.P. Waits
Jocelyn Aycrigg	Ph.D. Wildlife Resources	E.O. Garton
Regan Berkley	M.S. Wildlife Resources	J.L. Rachlow
Nathan Burkepile	Ph.D. Wildlife Resources	K.P. Reese
Anne-Marie Casey	M.S. Environmental Science	J.H. Braatne
Dustene Cummings	M.S. Fishery Resources	C.A. Peery
Mark Dolous	Undergraduate internship	C.A. Peery
Rita Dixon	Ph.D. Wildlife Resources	E.O. Garton
Alisse Garner	M.S. Wildlife Resources	J.L. Rachlow
David Griffith	M.S. Fishery Resources	C.A. Peery
Chanoane Hartt	M.S. Environmental Science	J.H. Braatne
Darlene Kilpatrick	M.S. Wildlife Resources	K. P. Reese
Ryan Kreiner	M.S. Fishery Resources	D.L. Scarnecchia
Jesse Lewis	M.S. Wildlife Resources	J.L. Rachlow
Ryan Mann	M.S. Fishery Resources	C.A. Peery
Ashley Martens	M.S. Wildlife Resources	K.P. Reese
Jonathan Muir	M.S. Wildlife Resources	J.L. Rachlow
Amy Pinson	M.S. Fishery Resources	C.A. Peery
Scott Putman	M.S. Fishery Resources	D.L. Scarnecchia
Kim Sager	M.S. Wildlife Resources	R.G. Wright
Daniel Schill	Ph.D. Fishery Resources	G.W. LaBar
Jay Shepherd	Ph.D. Wildlife Resources	K.P. Reese
Timothy Smyser	M.S. Wildlife Resources	E.O. Garton
Katherine Strickler	Ph.D. Wildlife Resources	L.K. Lohman
John Stevenson	M.S. Wildlife Resources	K.P. Reese
Kajsa Stromberg	M.S. Fishery Resources	J. H. Braatne
Brad Stumph	M.S. Wildlife Resources	R.G. Wright
Marcus Swan	M.S. Wildlife Resources	R.G. Wright
Nancy Wright	M.S. Environmental Science	C.A. Peery

Research Associates-Staff

Charles Boggs	Katherine Strickler
Michael Colvin	Boling Sun
Lisa Garrett	Jim Witham
Jennifer Jensen	Gina Wilson
David Roon	

James L. Congleton, Ph.D.
* Evaluation of physiological condition of migrating and transported juvenile salmon and effects on survival

Christine M. Moffitt, Ph.D.
* Assessment of distribution of New Zealand mudsnails in Silver Creek, Idaho
* Strategies that can reduce the risk of New Zealand mudsnail infestation at fish propagation facilities during fish transfer operations
* Exploring feasibility of proposed control strategies for New Zealand mud snails at fish hatcheries
* Effects of water temperature on growth of physiology of redband trout
* Infrastructure to complete FDA registration of erythromycin
* Environmental and social costs of large-scale production of beef and fish for human consumption
* Effects of water temperature and pit-tags on the survival, growth, physiology, and health status of sub-yearling fall chinook salmon
* Spatially based monitoring and modeling of resistant microorganisms at freshwater aquaculture facilities

Christopher Peery, Ph.D.
* Evaluation of adult Pacific lamprey passage success at McNary and Lower Snake River Dams
* Passage of adult steelhead in the Yakima River
* An integrated approach to restoration of Anadromous Salmonids and their habitat in the Elwha River following dam removal
* Survival and migration behavior of juvenile salmonids at Little Goose Dam
* Escapement and spawning distribution of fall Chinook salmon in the Deschutes River and Hanford Reach, Columbia River Basin, USA
* Evaluation of Pinnipeds exclusion gates on passage of adult anadromous salmonids at Bonneville Dam
* An evaluation of temporary straying of adult fall Chinook salmon on mark/recapture estimates in the Deschutes River, Columbia River Basin, USA
* Behavior of white sturgeon near hydroprojects and fishways
* Radio telemetry of adult salmon and adult lamprey throughout the watersheds of the Walla Walla District
* Test the National Marine and Estuarine Classification standards in the Columbia River Estuary
* Research and monitoring involving radio telemetry of adult steelhead kelts in the snake river

Dennis L. Scarnecchia, Ph.D.
* Identification of compatible source population for pacific lamprey recovery in the Clearwater River, Idaho.

- The effects of declines in anadromous sockeye salmon on growth of resident fish in Lake Clark National Park

J. Michael Scott, Ph.D.
- Distribution and abundance of the fishes of Idaho
- Distribution, habitat associations, discussion of potential conservation actions and feasibility of PIT-tagging the Wood River sculpin (*Cottus leiopomus*)

EVALUATION OF PHYSIOLOGICAL CONDITION OF MIGRATING AND
TRANSPORTED JUVENILE SALMON AND EFFECTS ON SURVIVAL

Principal Investigator: James L. Congleton, Ph.D.
Student Investigators: Derek Fryer
Funding Agency: U.S. Army Corps of Engineers
Completion Date: Ongoing

Objectives:

- Sample spring Chinook smolts of wild (W) and hatchery (H) origin to determine changes in energy reserves and other physiological indices during downstream migration to, and through, the Snake-Columbia River Federal Hydropower System.
- Determine the cumulative effects of exposure to fish-bypass systems at multiple dams on stress indices, energy stores, and "tissue damage" enzymes.
- Determine if significant differences exist between wild and hatchery fish Chinook salmon such that they might have different survivorship following exposure to multiple by pass systems.
- Determine if seasonal changes in stress indices, smoltification, or other indicators of physiological condition are correlated with survival rates of barge-transported wild Chinook salmon smolts.

Progress:
Overview of H fish studies.–In the five years 1998 through 2003, PIT-tagged yearling Chinook salmon *Oncorhynchus tshawytscha* reared at three hatcheries in the Snake River Basin (Dworshak, Rapid River, and McCall) were sampled prior to release, and from bypass systems at selected hydroelectric dams on the Snake and Columbia Rivers. Carcass and gut water, lipid, protein, and ash masses were determined so that the rate of use of energy reserves could be estimated as the fish migrated through, the hydropower system. Plasma triglyceride, cholesterol, and total protein concentrations and alkaline phosphatase activity were measured as indices of nutritional status.

In each year of the study, lipid, protein, and caloric reserves of hatchery-reared juvenile Chinook salmon decreased (on a length-controlled basis) as the fish migrated downstream to Lower Granite Dam on the Snake River. Lipid, protein, and caloric reserves continued to decline as the fish migrated an additional 461 km downstream to Bonneville Dam on the Columbia River. Lipid and protein masses were negative correlated with travel time to the dams. The lipid reserves of fish sampled at Bonneville Dam were depleted (<1% body weight) in all years. Protein reserves were reduced to a greater extent in 2001, an exceptionally low-flow year, than in the other years of the study.

Plasma triglyceride, cholesterol, and total protein concentrations and alkaline phosphatase activities decreased significantly as the fish migrated downstream, indicating that the energetic deficit in migrating fish was in part due to a low rate of food intake.

White-muscle activities of citrate synthase (an indicator of aerobic capacity) also declined significantly as the fish migrated from Lower Granite Dam to Bonneville Dam. These results

suggest that an energetic deficit-induced breakdown of body proteins lowers the activities of key metabolic enzymes. Lowered enzyme activities may reduce the performance capabilities of migrating fish for swimming, osmoregulation, and other vital functions. Significant decreases in swimming ability were in fact observed in 2001 and 2002 (thesis work of D. Fryer), and decreases in osmoregulatory ability were observed in 1999, 2000, and 2001 (thesis work of L. Haley). Some changes were also observed in lipid oxidative stress indices and vitamin E reserves (dissertation work of T. Welker).

Current work, wild fish.–In 2003, the nominal growth in length of migrating W fish (6.3mm, LGR to BON) was positively correlated with travel time; length-controlled lipid and protein masses of W fish decreased, however, from LGR to BON. The decrease in length-controlled protein content was –18%, compared with –15% in hatchery fish. Despite the slightly greater loss of protein in W fish between LGR and BON, length-controlled protein mass was significantly higher for W fish than for H fish at both sites. Similarly, mean condition factors of W fish sampled at LGR and at BON (1.02, 0.89) were significantly higher than those of H fish (0.95, 0.86). These findings differ somewhat from findings for 2002, when the LGR-to-BON decrease in length-controlled protein mass of migrating W fish was smaller (–11%) for W fish than for H fish (–19%).

Current progress, response to dam bypass.—In 2003, 31% of the H fish sampled at BON had experienced two or more bypasses at upstream dams. Exposure to dam bypass systems was negatively correlated with the quantity of lipid and protein reserves (as percentages of body mass and as length-controlled masses), as were also the nutritional blood-chemistry indices total protein, cholesterol, and alkaline phosphatase. These results support the hypothesis that multiple bypass exposures result in decreases in nutritional condition, or, alternatively, that the probability of bypass passage is higher for fish with lower nutritional condition. A significant correlation was found between bypass exposure and fish length, indicating that smaller fish had a higher probability of bypass than larger fish. This relationship was not, however, responsible for the negative correlation between bypass exposure and fish energy reserves.

Of the W fish sampled at BON in 2003, 30% had experienced two or more bypasses at upstream dams. Neither percentage lipid, percentage protein, length-controlled lipid content, length-controlled protein content, nor blood-chemistry indices were correlated with bypass exposure. No relationship was found between bypass exposure and body length. These findings contrast with the significant correlations between bypass exposure and energy content observed for H fish.

ASSESSMENT OF DISTRIBUTION OF NEW ZEALAND MUDSNAILS IN SILVER CREEK, IDAHO

Principal Investigator:	Christine M. Moffitt, Ph.D.
Student Investigator:	Christopher James
Funding Agency:	Idaho Department of Fish and Game, The Nature Conservancy
Completion Date:	30 June 2006
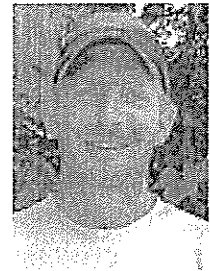
Objectives:
- Determine the distribution of New Zealand mudsnails in the Silver Creek Drainage.
- Examine the seasonal changes in the distribution of New Zealand mudsnails in Silver Creek.
- Evaluate the differences between populations of New Zealand mudsnails located downstream of Hayspur State fish hatchery in the Silver Creek drainage with snail populations downstream of Hagerman National Fish Hatchery.

Progress:
New Zealand mudsnails *Potamopyrgus antipodarum* have been identified in Silver Creek, Blaine County, Idaho. We began studies in 2004 to determine the extent of this distribution, to better understand the likelihood of expansion of this species within the drainage. In June-August 2004, we sampled the drainage for New Zealand mudsnails using a kick net and a standard sampling protocol. We systematically selected sampling sites from digital maps at 1 km intervals throughout the Silver Creek drainage from the headwaters to approximately 3 km downstream from the town of Picabo, Idaho. New Zealand mudsnails were identified at 5 of the 56 sites visited, and the relative abundance of snails from a 30 sec kick net sampling effort ranged from 2 to 2,220 snails. Using a modified Hess sampler, we estimated the density of snails at two positive sites in the drainage to range from 12 to 25,640 snails/m^2. Based on our sampling, we conclude that New Zealand mudsnails are found only in lower Loving Creek, Butte Creek, and in Silver Creek near the Nature Conservancy's Silver Creek Visitor Center. Summer temperatures that ranging between 14.6 and 19.6°C during July 2004, but winter temperature averaged at least 10°C lower. We postulate that winter temperatures may be limiting the distribution of New Zealand mudsnails in the drainage, and we found a positive correlation of winter temperatures above 0°C with the presence of snails. Areas that have winter water temperatures that drop to 0°C did not have snails. During the winter of 2004-05, and the summer of 2005, we compared the densities of NZMS in Silver Creek (spring fed but with variable water temperatures) with densities of NZMS in Riley Creek (constant winter and summer water temperatures). A total of 295 samples were collected during those two sampling periods and another 161 samples will be collected during the winter of 2005-06. Samples will be analyzed to assess how differing temperature regimes in these two spring-fed streams are affecting NZMS population dynamics, distribution, and reproductive potential. In addition we conducted laboratory studies of survival of snails in low water temperatures to confirm our hypotheses.

STRATEGIES THAT CAN REDUCE THE RISK OF NEW ZEALAND MUDSNAIL INFESTATION AT FISH PROPAGATION FACILITIES DURING FISH TRANSFER OPERATIONS

Principal Investigator:	Christine M. Moffitt, Ph.D.
Student Investigator:	Rolita Louise Bruce
Funding Agency:	U.S. Fish and Wildlife Service
Completion Date:	15 August 2006
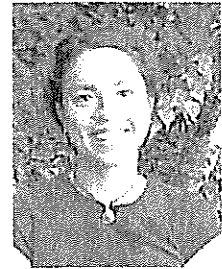
Objectives:
- Test the effectiveness of ozone, copper and electrical arrays or other agents that can be used to contain, exclude or kill snails in water sources.

Progress:

The New Zealand mudsnail (NZMS) is a small prosobranch snail of the Hydrobiidae family. It is native to New Zealand and is found in lentic and lotic systems and somewhat brackish estuaries. NZMS were first identified in North America in 1987 in the Middle Snake River near Hagerman, Idaho. Although not known, the likely mode of introduction into the Hagerman Valley was through aquaculture transport. Since the mid 1980's NZMS have been detected in the Middle Snake River drainage and in other western waterways and recently found in Lake Ontario of the Great Lakes. In high biomass, the NZMS can affect functioning of the aquatic ecosystem. This invasive species has become established in several fish hatcheries, and has caused concern to the FWS because of potential impacts to native threatened snails, and because of risks of introduction elsewhere from fish transfers.

Studies in our laboratory and field observations have shown that NZMS are likely in higher densities surrounding fish hatcheries that use ground water sources for rearing fish. These warmer water conditions appear allow a refuge for snails, as freezing water temperatures that remain at 0°C more than 48 h are lethal to the snails, and lower water temperatures likely decrease reproduction. The NZMS often occupy small gravel substrate especially in the fall, winter and spring.

We have conducted several trials to determine if ozone can be effective in killing NZMS. Ozone is frequently used in hatcheries to provide pathogen control and improve water quality. Concentrations of up to 0.6 mg/L were not effective in killing adult sized snails, even when applied for 30 minutes. We are currently testing the effects of ozone on newly hatchery embryos. These may be more vulnerable than the adult snails with more substantial snails.

In addition, we have begun plans for collaborations with two aquaculture engineers. We have approached Engineer Brian Brazil from the Dept of Agriculture Agricultural Research Service, Center for Cool and Cold Water Aquaculture, and U.S. Geological Survey engineer Baraby Watten from the Leetown Science Center to collaborate on design of screens for cleaning water sources, providing assistance with proposed depuration strategies, and overall design of control systems. Both have experience with ozone and other gas control measures.

EXPLORING FEASIBILITY OF PROPOSED CONTROL STRATEGIES FOR NEW ZEALAND MUD SNAILS AT FISH HATCHERIES

Principal Investigator: Christine M. Moffitt, Ph.D.
Student Investigator: Rolita Louise Bruce
Funding Agency: U.S. Geological Survey, Special
                                     Scientific Support Project
Completion Date: 30 September 2007

Objectives:
- Pursue water system treatments or barriers that can successfully filter out invading snails.
- Determine the range of time that NZMS are viable in the GI tract of a typical salmonid.
- Determine if there are chemical treatments that would be lethal to NZMS, and not harmful to fish, that would be given to fish prior to stocking to eliminate survival of snails in the fish fut.
- Identify potential chemical treatment candidates including copper sulfate, or other compounds that may have the ability to kill snails that may be resident in the GI tract of fish.
- Determine if chemical biocides would be effective applied to ponds, springs, or areas lacking fish to kill existing NZMS and yet not violate water quality requirements of harm listed fish.

Progress:
This project is linked to the above project that is funded by the U.S. Fish and Wildlife Service, and provides a collaboration of FWS with Unit scientists and students. Graduate student L. Bruce is funded as a SCEP student through the FWS, region 1.

Fish stocking and fish transfers may accelerate the spread of New Zealand mud snails to other locations. Fish movements (via natural migrations or by stocking) have been documented as likely vectors of snail range expansion as the snails can survive transit through the gut of trout. Fish reared in state and federal hatcheries in the Hagerman Valley that is positive for NZMS are used in supplementation and stocking programs throughout Idaho run by Idaho Department of Fish and Game, the Shoshone-Bannock and Nez Perce tribes, and the U. S. Fish and Wildlife Service. Private fish growers sell trout for stocking in private ponds, and to some public agencies. In 2004, the U.S. Fish and Wildlife Service identified New Zealand mud snails as harmful non-target invertebrates that could be transported to fish release sites during an agency Hazard Analysis and Critical Control Point Planning (HACCP) process. As a result the FWS determined that they could not safely stock trout reared at their National Fish Hatchery in into waters of the Clearwater River, Idaho. With increased concerns regarding the potential consequences of invasive New Zealand mud snails in waterways, there is a serious need to develop control strategies for New Zealand mud snails in fish farms and their effluents. The University of Idaho has been working with Hagerman NFH and the FWS to determine ways to depurate fish before planting to remove all live snails from their gut, so that they could be safely stocked.

We have determined that NZMS can survive transit through the gastrointestinal tract of rainbow trout. We force-fed four large snails to each of 40 individual fish held in aquaria. Fish were sampled at five time intervals (3, 6, 12, 24 and 48 hours) following feeding to determine the number of alive and dead snails in the stomach, anterior intestine, and posterior intestine. We

found live snails in all gastrointestinal tract regions and approximately 8 - 12% of the snails in the fish fecal material were alive. Snail survival appears to decrease as time exposed in the trout gastrointestinal tract increases.

Our research will continuing to explore the effects of snail size, meal size, and fish feeding regime on snail transit time and survival. Our ultimate goal is to provide a potential depuration strategy to reduce the risk of transferring snails during fish stocking.

EFFECTS OF WATER TEMPERATURE ON GROWTH OF PHYSIOLOGY OF REDBAND TROUT

Principal Investigator: Christine M. Moffitt, Ph.D.
Student Investigator: John Cassinelli
Staff: Boling Sun
Funding Agency: Idaho Department of Fish and Game
Completion Date: 31 December 2007

Objectives:
- Do redband trout from a desert population have higher survival in a warm water environment than redband trout from a montane population?
- Do redband trout from a desert population have faster growth in a warm water environment than redband trout from a montane population?
- Do particular physiological characteristics measured within desert and montane populations of redband trout enable desert populations to withstand a warmer environment?

Progress:
In southern Idaho, native redband trout are found in the Snake River drainage below Shoshone Falls. The habitat redband trout occupy within the Snake River drainage varies from high mountain streams with high flows and cool water temperatures to low desert streams with little flow and warm temperatures. In southwest Idaho, desert populations of redband trout are found in Snake River subbasins including the Owyhee, Bruneau, and Jarbidge River drainages, Salmon Falls Creek drainage, as well as tributaries to the Snake along the Owyhee range. The majority of these streams are low gradient with high spring runoff and low flows into late summer and early fall. During months of low flow, afternoon temperatures have been recorded as high as 32°C for short periods of time.

In 1995, all redband trout in the Snake River upstream of Brownlee Reservoir to Shoshone Falls were petitioned for listing under the Endangered Species Act (ESA). This petition was denied by the U.S. Fish and Wildlife Service, because the FWS had insufficient information to show that the interior redband trout of the middle Snake River were a distinct population segment under the ESA. Currently, redband trout are considered a species of special concern by the U.S. Fish and Wildlife Service and the American Fisheries Society and are classified as a sensitive species by the Idaho Department of Fish and Game, the U.S. Forest Service, and the Bureau of Land Management.

This graduate research will focus on defining any physiological differences and growth characteristics of desert populations and the montane populations. Using wild gametes from wild captured fish we will rear these in a controlled setting and test groups of desert and montane fish in a series of laboratory trials. We will evaluate significant differences in growth and survival between desert and montane populations of redband trout in two temperature regimes: one to similar desert temperatures, and one to simulate montane temperatures. We will evaluate differences in physiology and growth and stress among the test populations. Graduate student Cassinelli has started his work as a graduate student in August 2005. He has begun preparations for collection of fish to test, and has focused on writing a study plan for his project.

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INFRASTRUCTURE TO COMPLETE FDA REGISTRATION OF ERYTHROMYCIN

Principal Investigator: Christine M. Moffitt, Ph.D.
Funding Agency: DOE – BPA (LSRCP)
Completion Date: 30 September 2006

Objectives:
- Keep an active dialog with FDA to resolve any outstanding issues during their review of the Phase I Environmental Impact Assessment, and assist FDA with other areas of concern or data submissions needed to assure that all components of the public master file and drug claim for erythromycin to control bacterial kidney disease are completed.
- Interact with Ms. Roz Schnick, National Aquaculture NADA Coordinator, to assist in information needs for potential drug manufacturing sponsors as they prepare the manufacturing claim.
- Maintain an adequate infrastructure to assure a source of experimental premix is in place during completion of the drug approval submission
- Submit for publications manuscripts from studies and data collections previously submitted to FDA. Serve as a resource for others working with erythromycin to control bacterial kidney disease

Progress:
This project has been a major effort over many years to approve erythromycin for treatment of bacterial kidney disease in salmon. The requirements of the Food and Drug Administration's, Center for Veterinary Medicine (CVM) for technical data submissions regarding product Efficacy, Target Animal Safety, Human Food Residues, Human Safety from Antibiotic Resistance have been completed, reviewed and accepted by the CVM as adequate to support the label claim.

Progress has been slow over the years due to regulatory concern about aquaculture drugs. Though this project and the submissions we have been able to provide detailed information on the risks of erythromycin in salmonid aquaculture. This information has allowed the CVM to move forward with the approval process and to understand that the use of the antibiotic in salmonids is of low risk to humans.

The risk assessment document submitted by the University of Idaho has been distributed to others as a model for addressing these issues. Outstanding issues of environmental safety were

addressed with a submission of a risk assessment document following the CVM guidance as an Environmental Impact Assessment, Phase 1, using Guidance Document 89. This document has not completed the review process in CVM. It provides a detailed profile of use patterns and unadjusted works-case scenario effluents, mitigation procedures and structures at participating hatcheries with estimation of range of risks to the environment following existing mitigation.

In May of 2005, we held a meeting with the drug company sponsor, Bimeda Animal Health. This drug company had been a silent partner for many years and formally joined the project following the passage of the MUMS legislation for Minor Use Minor Species drug approval requirements. This legislative act allowed for a longer exclusivity arrangement and other advantages for drug companies to sponsor products with minor use. Since that time the sponsor has been working with the University of Idaho to prepare a submission that contains detailed information about the manufacturing and testing of the product. We are working to complete the public master file within this coming year so that a label claim can be published in the Federal Register by 2007.

ENVIRONMENTAL AND SOCIAL COSTS OF LARGE-SCALE PRODUCTION OF BEEF AND FISH FOR HUMAN CONSUMPTION

Principal Investigator:	Christine M. Moffitt, Ph.D.
Funding Agency:	Visiting Scholar Fulbright Program
Student Investigator	Lubia Cajas Cano
Completion Date:	30 August 2006

Progress:
Large-scale production of any meat uses resources (e.g., energy, labor, water) and creates byproducts (including the meat itself and other byproducts of production such as waste, both liquid and solid), which must be managed to maximize production and minimize cost to the environment and to society. Comparing only the nutritional value of different kinds of meats (such as beef, chicken, and fish) determining which is "best" fails to capture the overall costs to the environment and to society of producing meats of different types is not enough, it is necessary to examine all of these costs, not just the nutritional ones, and put them into perspective on a per unit basis when making decisions that can have serious and long-term impacts on the world we live in. The goal of the proposed research is to measure and compare the environmental and social costs of large-scale production of beef and fish for human consumption with a concern for identifying ways to reduce impacts through mitigation measures.

The research is focusing on beef and rainbow trout production, as two industries of high importance in Idaho. We have collected quantitative and qualitative data on the cost of inputs, such as feed, labor, land, and water, and outputs, such as liquid and solid waste and prevention and remediation of pollution from these, for both the fish and beef production systems, especially in Idaho, Hagerman Valley. During the summer of 2005 graduate student, Lubia Cajas Cano, a Fulbright Scholar from Guatemala, met with extension agents to collect data on the size of facilities, infrastructure, food sources, worker infrastructure and management, and use of products and byproducts. Additional data for comparisons will be obtained from the Food and Agriculture Organization (FAO), the U.S. and Idaho State Departments of Agriculture, and from

the primary literature. Information from this project will help the student develop more sustainable animal protein production in her home country.

EFFECTS OF WATER TEMPERATURE AND PIT-TAGS ON THE SURVIVAL, GROWTH, PHYSIOLOGY, AND HEALTH STATUS OF SUB-YEARLING FALL CHINOOK SALMON

Principal Investigator: Christine M. Moffitt, Ph.D.
Collaborator: James L. Congleton, Ph.D.
Student Investigator: Jeffrey Yanke
Staff: Boling Sun
Funding Agency: U.S. Fish and Wildlife Service
Completion Date: 31 December 2005
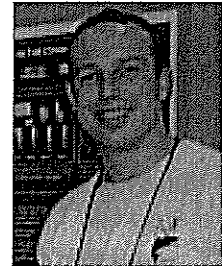
Objectives:
- Determine the effects of elevated temperatures on the blood chemistry, survival and growth of sub yearling fall Chinook salmon.
- Evaluate any effects of PIT (Passive Integrated Transponder) tags on the survival and health of sub yearling fall Chinook salmon exposed to different water temperatures
- Evaluate blood chemistry parameters and survival of sub yearling fall Chinook following an acute seawater challenge.

Progress:
The effects of PIT tagging on fish condition and survival of fall Chinook salmon juveniles have never been evaluated at water temperatures above 14°C, which fall Chinook salmon juveniles routinely experience during seaward migration. Although several field studies using PIT tags have documented an inverse relationship between temperature and survival for fall Chinook salmon subyearlings, it is unclear if temperature-dependent PIT tagging effects biased the results.

In this study, effects of PIT tags and high water temperatures were evaluated during short-term (42 d) and long-term (80 d) trials. Fall Chinook salmon subyearlings were either implanted with PIT tags or not tagged (control) and acclimated to one of four treatments of 16, 20, 24, or 28°C. Survival was monitored, and fork length and blood plasma samples were collected at intervals during both trials. Survival and growth at all temperatures were not affected by PIT tagging.

Complete mortality was observed when water temperatures exceeded 26°C. Maximum survival, growth and metabolism rates were observed at 16 and 20°C. During the short-term trial, exposure to 24°C did not affect survival, but was associated with lower feed and metabolic conversion rates and slower growth. During the long-term trial, exposure to 24°C was associated with negative growth and metabolism rates, increased levels of cellular damage, and lowered survival.

The absence of PIT tagging effects at all temperatures suggests that results from previously conducted field studies were not biased by PIT tagging. Maximum water temperature standards of 20°C for the lower Snake River are warranted, and summer flow augmentation will likely

prevent reservoir temperatures from approaching 24°C, which adversely affected growth and development of fall Chinook salmon subyearlings in this study.

SPATIALLY BASED MONITORING AND MODELING OF RESISTANT MICROORGANISMS AT FRESHWATER AQUACULTURE FACILITIES

Principal Investigator:	Christine M. Moffitt, Ph.D.
Post Doctoral Investigator:	S. M. A. Mobin, Ph.D.
Staff Assistant:	Michael Colvin
Funding Agency:	The Northwest Center for Aquaculture Research and Education
Completion Date:	15 September 2006

Objectives:
- Conduct preliminary screening of fish their water sources, and effluent from one or two public aquaculture facilities in the Hagerman valley.
- Use GIS tools to prepare maps of the water network, location of the facilities, treatment reservoirs, and discharge locations of these facilities.
- After preliminary data are available, and GIS maps prepared, develop plans and collaborations to provide a more comprehensive monitoring and mapping of the region.

Progress:
Aquaculture systems have come under increasing scrutiny by regulatory agencies and by natural resource advocacy organizations. Some perceptions are perpetuated because of a lack of solid information and more complete understanding of the impacts of these facilities on the environment, and on the quality of food produced by aquaculture. Of particular interest to many regulators and the public is: what are the effects of antimicrobials used in aquaculture? This pilot project was designed to gain information on the suite of bacteria in the inflow, outflow, fish and snails associated with Hagerman State Hatchery. We will consider expanding sampling to other sites in the area after completion of the pilot project.

Sampling was conducted in December and January of 2004-5. To understand the flow of water through the system and upstream, we created a GIS coverage and geo referenced data sets, and shared this with Hatchery managers at the State and Federal Hatchery.

For the pilot study, two adjacent raceways were selected for sampling water and New Zealand mudsnails (NZMS) from inflow and outflow, and fish from raceways. Each sample was examined for total heterotrophic bacteria, and the bacteria were characterized to determine the likely genus and species when possible using biochemical characteristics. The two raceways had a common inflow from Riley Creek and emptied to a common drain. During the production periods at the hatchery, water sources from Tucker Springs and Riley Creek are utilized depending on need. Water flow from Riley Creek to the selected raceways began 17 days prior to sampling on 27 November 2004. Rainbow trout were moved from Tucker Spring water to Riley Creek water seven days prior to sampling. Samples of bacteria from fish, water, and New Zealand mudsnails (NZMS) were collected and screened for viable aerobic heterotrophic bacteria. The posterior intestine from 6 fish per raceway was combined and homogenized in a

ground glass tissue grinder with tryptic soy broth (TSB). Samples of New Zealand mudsnails were disinfected NZMS with 70 % ethanol and blotted dry, combined into pools (0.5 g) and homogenized with a ground glass tissue grinder and TSB. The homogenized material was further diluted with TSB and a series of ten fold series of dilutions were made, and each dilution plated on tryptic soy agar (STA). Water samples were plated directly onto TSA plates.

Average temperature during the sampling period for the common inflow averaged 14°C. Water quality analysis showed few differences between inflow waters. Microbial plat counts (colony forming units) averaged 2,600 CFU per mL of water in the inflow, and averaged 12,500 CFU per mL for outflow water. The fish GI tract samples from each raceway were varied from less than 300,000 CFU to more than 50,000,000 CFU, to average 25,850,000 CFU per g of posterior intestine. The NWMS collected in the outflow averaged more than 10 fold higher in CFU than in the inflow waters (315,000 vs 5,100,000 CFU per g of whole snail. We detected 12 different genera of bacteria in samples. We few resistant isolates were detected, but one isolate of *Streptococcus bovis* a cattle based Streptococcus, was detected in outflow water samples and was resistant to Oxytetracycline. *Enterococcus faecium* was detected in snails sampled from the inflow but the isolate was not resistant to either of the drugs tested. Other genera identified in sampling included: *Acinetobacter, Aeromonas, Aerococcus, Comamonas, Pantoea, Moraxellas, Pseudomonas, Sphingobacterium, Sphingomonas, Staphylococcus*. We did not find any *Campylobacter, Salmonella, Esherichia coli* O157, or *Shigella*.

Aquatic poikilothermic animals may not follow homoeothermic-based models of intestinal ecology. The flora may passively express a suite of microorganisms that enters the fish, or snails, from the water or feed, and changes dynamically over time. Data from several studies support a highly stochastic component to the response observed at any time, and factors such as temperature, nutrients, feed sources, and time of year will affect the profiles observed, and in other studies resistant bacteria are reported in areas surrounding or not correlated with aquaculture environments. We have used these data in other reports, and have proposed a follow up research project on NZMS to determine if they can amplify fish pathogenic bacteria in effluent areas.

EVALUATION OF ADULT PACIFIC LAMPREY PASSAGE SUCCESS AT MCNARY
AND LOWER SNAKE RIVER DAMS

Principal Investigator: Christopher Peery, Ph.D.
Student Investigator: Dustene Cummings
Funding Agency: U.S. Army Corps of Engineers
Closing Date: 31 December 2006

Objectives:
- Develop adult lamprey collection, tagging and release operations at McNary and Ice Harbor dams.
- Monitor movements and behavior of adult lamprey migrants at McNary and four lower Snake River dams.

Progress:
Over 100 adult Pacific lamprey were collected at McNary Dam, tagged and released to the Columbia and Snake rivers. Information was gathered on passage success, timing and potential bottleneck to migration this summer. This is the first information of this type collected in the Snake River. Plans are to sample twice this number of fish in 2006.

PASSAGE OF ADULT STEELHEAD IN THE YAKIMA RIVER

Principal Investigator: Christopher Peery, Ph.D.
Funding Agency: U.S. Bureau of Reclamation
Closing Date: 3 March 2006

Objectives:
- Using radio-telemetry to determine movement patterns, including migration timing of migration, location and duration of holding, and time to reach spawning areas.

Progress:
Over 200 adult steelhead were collected at Roza Dam, radio-tagged and released to the Yakima River downstream from the dam. Migration and spawning success was monitorind into the early spring of 2006. Data analysis and development of final reports is ongoing.

AN INTEGRATED APPROACH TO RESTORATION OF ANADROMOUS
SALMONIDS AND THEIR HABITAT IN THE ELWHA RIVER FOLLOWING DAM
REMOVAL

Principal Investigator:	Christopher Peery, Ph.D.
Student Investigator:	Nancy Wright
Funding Agency:	NOAA
Closing Date:	28 February 2007

Objectives:
- Train the Tribe's staff in methods to acquire, compile, and evaluate physical, ecological and socioeconomic datasets primarily through remote sensing and telemetry technology that is appropriately prices and scaled for the lower Elwha River, estuary and shallow nearshore areas.
- Develop of GIS tools that will organize the Tribe's current and expanding spatial data (GIS) collection into appropriate themes, scarles, and applications for multiple management purposes.
- Develop and apply a characterization of the lower Elwha River, estuary, nearshore physical, biological and socioeconomic parameters for long-term resource management b the Tribe.

Progress:
Initial raining of Tribal researchers was conducted on uses of acoustic telemetry to assess residence times and habitat use by juvenile coho salmon in the Elwah River estuary and nearshore. Funds were also used to purchase and training in use of habitat survey equipment. A comprehensive website to house critical ecological, social and cultural information on the Elwha River and Lower Elwha Klalam Tribe is underway. A full-scale telemetry evaluation with juvenile salmon will be conducted spring 2006. A workshop on mapping riparian vegetation is also planned for March 2006.

SURVIVAL AND MIGRATION BEHAVIOR OF JUVENILE SALMONIDS AT LITTLE GOOSE DAM

Principal Investigator:	Christopher Peery, Ph.D.
Funding Agency:	U.S. Geological Survey/U.S. Army Corps of Engineers
Completion Date:	31 March 2006

Objectives:
- Determine the approach path, route of passage, and tailrace egress for yearling Chinook salmon and juvenile steelhead at Little Goose Dam during two treatments of differing project operations.
- Estimate route-specific survival of yearling Chinook salmon and juvenile steelhead passing through Little Goose Dam during two treatments of differing project operations.
- Determine the approach path, route passage, and tailrace egress for subyearling Chinook salmon at Little Goose Dam relative to spill and powerhouse operations.

- Estimate route-specific survival of subyearling Chinook salmon at Little Goose Dam during two treatments of differing project operations.

Progress:
We assisted the U.S. Geological Survey Columbia River Biological Research Station, Cook, WA, conduct a comprehensive evaluation of juvenile salmon survival in the lower Snake. Data is being processed for analysis.

ESCAPEMENT AND SPAWNING DISTRIBUTION OF FALL CHINOOK SALMON IN THE DESCHUTES RIVER AND HANFORD REACH, COLUMBIA RIVER BASIN, USA

Principal Investigator:	Christopher Peery, Ph.D.
Funding Agency:	NOAA/Pacific Salmon Commission
Completion Date:	31 July2006

Objectives:
- Use radio telemetry to estimate total escapement of fall Chinook salmon to, and spawning distribution in, the Deschutes River and Hanford Reach area of the Columbia River by monitoring fish that were outfitted with radio transmitters at Bonneville Dam. Escapement estimates will be within ± 15 to 40% of the true value 95% of the time, depending on stock of interest.
- Use available basin-wide monitoring of radio-tagged salmon to estimate contribution of fall Chinook salmon from indicator stocks caught to Columbia River mixed-stock fisheries in 2004. Further, using previously collected data, we will conduct analyses of escapement of fall Chinook salmon stock to streams of origin within Columbia River basin.

Progress:
A total of 600 adult fall Chinook salmon were outfitted with radio transmitters and monitored as they migrated to spawning areas throughout the Columbia River. Telemetry data will be used to determine basin-wide escapement and harvest rates needed to determine best management of these ESA listed stocks.

EVALUATION OF PINNIPEDS EXCLUSION GATES ON PASSAGE OF ADULT
ANADROMOUS SALMONIDS AT BONNEVILLE DAM

Principal Investigator:	Christopher Peery, Ph.D.
Student Investigator:	Chris Anderson
Funding Agency:	U.S. Army Corps of Engineers
Completion Date:	30 September 2007

Objectives:
- A set of two acoustic transmitting devices and hydrophones will be installed in the base of the Washington (north)-shore fishway entrance at Bonneville Dam. The south-Shore entrance area will be left without acoustic deterrents. Hourly counts of sea lions in and near the two fishway entrances will be made daily. Total and median numbers of sea lions at the two locations will be compared using time-0series repeated measure ANOVA and paired t-tests(alpha=0.05).
- Make systematic observations of the number and locations of pinnipeds in the vicinity of Bonneville Dam.
- A randomized block design with and without modified entrance dates in place will be used to evaluate for potential effects of the gates on fish passage.

Progress: Placement of sea lion exclusion devices (SLEDS) and acoustic deterrents effectively prevented adult sea lions from entering fishways at Bonneville Dam. However, SLEDS appeared to delay salmon passage. Additional testing is planned for 2006.

AN EVALUATION OF TEMPORARY STRAYING OF ADULT FALL CHINOOK SALMON ON
MARK/RECAPTURE ESTIMATES IN THE DESCHUTES RIVER, COLUMBIA RIVER BASIN

Principal Investigator:	Christopher Peery, Ph.D.
Student Investigator:	Mark Dolous
Funding Agency:	U.S. Army Corps of Engineers
Completion Date:	30 June 2006

Objectives:
- Use radio telemetry to estimate proportion of adult fall Chinook salmon used in the whole river mark-recapture escapement estimate in the Deschutes River that exit the river prior to spawning, within ± 15% of the true value 95% of the time.
- Evaluate effectiveness of instream PIT tag interrogators to determine tributary exit rates for adult fall Chinnok salmon marked in the Deschutes River for escapement estimation program.

Progress:
Approximately 26% of radio-tagged fall Chinook salmon monitored in the Deschutes River wer last located in spawning areas outside the Deschutes River. Results were used to revise downward escapement estimates for this index stock.

BEHAVIOR OF WHITE STURGEON NEAR HYDROPROJECTS AND FISHWAYS

Principal Investigator: Christopher Peery, Ph.D.
Funding Agency: U.S. Army Corps of Engineers
Completion Date: 31 December 2005

Objectives:
- Describe the distribution, movements, and behavior of white sturgeon immediately downstream from dams including fish ladder entrances and exits, in fishways, navigation locks and immediate tailrace areas.
- Determine routes of passage taken by downstream migrants and if fallback occurs for fish that ascend fishways.

Progress: Radio and acoustic tagged adult sturgeon have been monitored in the vicinity of The Dalles Dam on the Columbia River for the past two years. We have been able to document extensive movement by fish up- and downstream from the dam. There appears to be a net downstream movement of fish at this project.

RADIO TELEMETRY OF ADULT SALMON AND ADULT LAMPREY THROUGHOUT THE WATERSHEDS OF THE WALLA WALLA DISTRICT

Principal Investigator: Christopher Peery, Ph.D.
Student Investigator: Ryan Mann
Funding Agency: U.S. Army Corps of Engineers
Completion Date: 30 September 2006

Objectives:
Determine effects of water temperature exposures for migrating adult salmon and steelhead on gamete quality and reproductive success for migrating adult salmon and steelhead.

Progress: There is evidence that gamete quality and survival may be lower in individual fish exposed to warm water temperatures. Analysis of results is ongoing.

TEST THE NATIONAL MARINE AND ESTUARINE CLASSIFICATION STANDARDS IN THE COLUMBIA RIVER ESTUARY

Principal Investigator:	Christopher Peery, Ph.D.
Student Investigator	David Griffith
Funding Agency:	NOAA
Completion Date:	15 May 2006
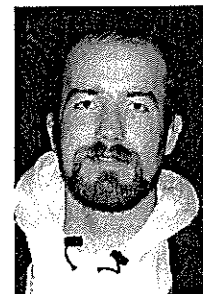
Objectives:
- Investigate macro and micro-scale temporal and spatial patterns of habitat use in the Columbia River Estuary by adult Chinook salmon migrants.
- Test newly developed marine and estuary seafloor and water column mapping technologies.
- Pilot application of NMEC standards within the CRE.

Progress:
Two years of telemetry data for adult fall Chinook salmon was used to assess habitat use in the lower Columbia River estuary. Results are used to test draft a habitat classification model developed for estuary and nearshore areas.

RESEARCH AND MONITORING INVOLVING RADIO TELEMETRY OF ADULT STEELHEAD KELTS IN THE SNAKE RIVER

Principal Investigator:	Christopher Peery, Ph.D.
Research Associate:	Charles Boggs
Funding Agency:	U.S. Army Corps of Engineers
Completion Date:	31 December 2005

Objectives:
- Evaluate fallback of adult salmon and Steelhead at Columbia and Snake River dams.
- Evaluate delay of adult salmon and Steelhead at Columbia and Snake River dams.
- Evaluate homing and the incidence of straying of adult salmon and Steelhead migrating to natal streams in the Columbia River basin.
- Assess the effects of passage through the Columbia and Snake rivers hydrosystem on the survival and reproductive fitness of adult salmon and Steelhead.

Progress: We continue to monitor for returning kelts that may be on repeat spawning runs from those tagged during previous years of this study. The final report for this study is being developed.

IDENTIFICATION OF COMPATIBLE SOURCE POPULATION FOR PACIFIC LAMPREY RECOVERY IN THE CLEARWATER RIVER, IDAHO

Principal Investigator:	Dennis L. Scarnecchia, Ph.D.
Graduate Research Assistant:	Scott Putnam, Sr.
Funding source:	Idaho Department of Fish and Game
Expected Completion Date:	Spring 2007

Objectives:
The objective of this study is to determine a genetically compatible source population of Pacific Lamprey *Lampetra tridentata* for potential adult translocation or hatchery supplementation program in the Clearwater River drainage. Pacific lamprey populations are declining in the Clearwater River basin. Idaho Department of Fish and Game (Idaho Department of Fish and Game) needs to identify a genetically compatible source population for potential adult translocation or a hatchery supplementation program in the Clearwater River drainage.

Progress:
To accomplish this objective, we have continued our collaboration with Dave Close and Dr. Margaret Docker, and have sent lamprey specimens from the Clearwater River drainage in for analysis. These samples were included them in the 1200 Pacific lamprey samples from northern BC to southern CA that he analyzed. State-of-the-art techniques indicate that we are still unable to detect significant genetic differences between Pacific lamprey populations. Idaho Department of Fish and Game is therefore evaluating how much more effort to put into identifying a genetically compatible Pacific lamprey source population for potential adult translocation or a hatchery supplementation program in the Clearwater River drainage.

THE EFFECTS OF DECLINES IN ANADROMOUS SOCKEYE SALMON ON GROWTH OF RESIDENT FISH IN LAKE CLARK NATIONAL PARK

Principal Investigator:	Dennis L. Scarnecchia, Ph.D.
Graduate Research Assistant:	Ryan Kreiner
Funding Source:	U.S. Geological Survey, National Park Service
Expected Completion Date:	Spring 2006
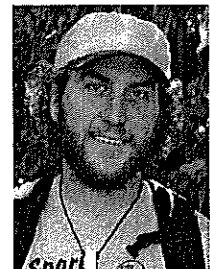
Objectives:
The objective of this study is to assess the relationship between anadromous sockeye salmon *Oncorhynchus nerka* and growth rates of resident fish in Lake Clark National Park. Alaska. It has been hypothesized that growth rates of arctic charr *Salvelinus alpinus* and lake trout *Salvelinus namaycush* are slower in lake systems lacking salmon runs than in those with salmon runs.

Progress: Field sampling was conducted, fish were aged with otoliths and fin rays, and growth rates of fishes characterized with von Bertalanffy growth curves. A draft thesis has been submitted for review.

DISTRIBUTION AND ABUNDANCE OF THE FISHES OF IDAHO

Principal Investigator:	J. Michael Scott, Ph.D.
Student Investigator:	Don Zaroban
Funding Agency:	Department of Environmental Quality
Completion Date:	Ongoing

Objectives:
- Compile records of occurrence for non-game fish species in Idaho, geo-reference the collection events, publish occurrence information via the proposed Field Guide to Native Fishes of Idaho, and make occurrence information available through the Idaho Digital Atlas, Idaho GAP, Orma J. Smith Museum of Natural History.
- Create and field test a species occurrence prediction model for Wood River sculpin and shorthead sculpin to address bias associated with occurrence only data sets and to delimit the range of the species, and publish model and results in peer reviewed/refereed journal.
- Compile records of fish introductions (native and alien species), geo-reference the introduction events, append results to existing Idaho Department of Fish and Game fish stocking database, publish process and results in peer reviewed/refereed journal.
- Assess status of Wood River sculpin population and potential for conflicting fishery management goals in the Wood River drainage created by stocking native and alien salmonids for recreational purposes in waters containing Wood River sculpin (an endemic species listed as a species of special concern), and publish results of status and management conflict assessment as separate articles in peer reviewed/refereed journal.

Progress:
Thousands of records of the fishes of Idaho have been compiled. Book contract procured for curatorial museum collection. Draft narratives of species accounts have been collected. National Science Foundation funding proposal submitted.

DISTRIBUTION, HABITAT ASSOCIATIONS, DISCUSSION OF POTENTIAL CONSERVATION ACTIONS AND FEASIBILITY OF PIT-TAGGING THE WOOD RIVER SCULPIN (*COTTUS LEIOPOMUS*)

Principal Investigator:	J. Michael Scott, Ph.D.
Student Investigator:	Don Zaroban
Funding Agency:	Idaho Environmental Protection Agency, Office of Species Conservation Concern
Completion Date:	30 September 2007

Objectives:

Inventory Wood River sculpin occurrence across its range.
- Method: single-pass electrofishing at randomly selected stream reaches

Develop a multivariate habitat association model to predict species occurrence.
- Method: logistic regression

Assess feasibility of using PIT tags to track individual Wood River sculpins.
- Method: PIT tag shorthead sculpins and observe survival, tag retention, net avoidance behavior and detectability.

Integrate findings through a modified aquatic Gap Analysis.
- Method: classify valley segments of the Wood River basin, document species distribution and develop predictive model of Wood River sculpin occurrence, compile land stewardship digital data layers.

Progress:

1. Progress: electrofishing conducted in 96 stream reaches between June 28th and October 15th, 2004. Funding has been obtained to conduct second year of data collection. Anticipate collecting data between July 5th and September 15th, 2006.
2. Progress: began graphic comparison of habitat parameters with sculpin presence and relative abundance. Collection of model validation habitat and fish data scheduled for 2006.
3. Progress: observations of survival, tag retention and net avoidance behavior data have been collected. Assessment of detectability of tagged sculpins pending reduction of stream flows.
4. Progress: valley segment classification initiated in April 2006. Documentation of species distribution and model development initiated in 2004, second set of data scheduled for collection in 2006.

Christine M. Moffitt, Ph.D.
* Completing empirical models to predict risks of infection of *myxobolus cerebralis* within river drainage

Christopher Peery, Ph.D.
* Evaluation of adult salmon, steelhead, and lamprey migration past dams and through reservoirs in the lower Columbia river and into tributaries

COMPLETING EMPIRICAL MODELS TO PREDICT RISKS OF INFECTION OF MYXOBOLUS CEREBRALIS WITHIN RIVER DRAINAGE

Principal Investigator:	Christine M. Moffitt, Ph.D.
Student Investigators:	Kara Anlauf, Michael Colvin
Funding Agency:	U.S. Geological Survey
Completion Date:	31 December 2004

Objectives:
- Understanding the ecology of whirling disease through aquatic habitat modeling of geospatial attributes.
- Understanding the distribution of early life history stages of fish within the Pahsimeroi River landscape in relation to water control and river access.

Results:
Stream habitat metrics at multiple spatial scales were used to build predictive habitat models of *Tubifex* spp., one of two obligate hosts in the life history of *Myxobolus cerebralis*, the causative parasite of whirling disease. This study was conducted in the Pahsimeroi River drainage, a tributary of the Salmon River located in eastern Idaho.

The objectives were to 1) Use landscape variables and field measured reach variables to construct predictive models of fine stream sediments, a favorable *Tubifex* spp. habitat feature, 2) Use bio-physical sediment core variables to identify the best predictive model of *Tubifex* spp. abundance, 3) Describe the relationships between reach habitat variables and core habitat variables, and 4) Use reach habitat variables to identify the best predictive model of *Tubifex* spp. presence.

Using a Geographic Information System (GIS), the drainage was partitioned into strata using stream channel slope. Study reaches were selected within these strata to pursue the study objectives. Four reach scale variables measured in the field and quantified for each 100-m reach and six landscape variables estimated using a GIS at three different geographic scales were used in the analysis. Each scale included the stream reach and three distances upstream (500 m, 2,000 m, and the total length upstream). Using linear mixed effect models, the best models predicting fine sediments were the reach model including the proportion of slow habitat and the multi-scale models that included the proportion of slow habitat measured at the reach scale and stream slope or the proportion of conifer cover or agriculture land types estimated for the total length upstream. Using linear mixed effect models, the most plausible model predicting *Tubifex* spp. abundance included the proportions of silt-clay and fine sand, and the abundance of the tubificid oligochaete *Limnodrilus hoffmeisteri*.

Several notable associations were observed between core and reach variables, with the proportion of silt-clay positively associating with the proportion of fine sediments estimated within a study reach. Finally, the total amount of potential *Tubifex* spp. habitat and reach slope were the best predictors of *Tubifex* spp. presence when using logistic regression models. These

results suggest that the best prediction of fine sediments was based on inter-related variables operating at different spatial scales. Additionally, the selection of particular microhabitats may be defined by the resources required by *Tubifex* spp. and the relationships between stream habitat variables at multiple scales. The parasite *Myxobolus cerebralis* has been implicated in the declines of salmonid species in the west. We observed a high degree of fluvial disruption in the Pahsimeroi River drainage. We found evidence that fluvial disruptions did exist before the settlement of the valley by Europeans and exacerbated since then. We used data from sentinel exposures conducted from 2001-2003 to evaluate factors hypothesized to affect the distribution and intensity of *Myxobolus cerebralis*, the causative agent of salmonid whirling disease. We observed no patterns in infection severity consistently relating to abiotic variables.

Over time we observed a variable infection in the middle Pahsimeroi River reach ranging from none to severe *M. cerebralis* pathology. On the lower Pahsimeroi River reach, we observed a consistent detectable pathology. We compared information gathered on the fish distributions and relative abundance to sentinel exposure results to evaluate the possible role of the salmonid host on infectivity of *M. cerebralis*. We observed differences in fish compositions in stream reaches that may be linked to *M. cerebralis* infection dynamics.

EVALUATION OF ADULT SALMON, STEELHEAD, AND LAMPREY MIGRATION PAST DAMS AND THROUGH RESERVOIRS IN THE LOWER COLUMBIA RIVER AND INTO TRIBUTARIES

Principal Investigator: Christopher Peery, Ph.D.
Student Investigators: Amy Pinson, Chris Anderson, David Griffith
Funding Agency: U.S. Army Corps of Engineers
Completion Date: 30 September 2005

Objectives:
- Evaluating the degree and effects of fish fallback at dams
- Identifying sources of delay and loss in the system and effects of environmental variables on passage
- Evaluating homing and straying of returning adult migrants
- Evaluating the energy use and reproductive success of adult salmonids during their upstream migrations
- Evaluate reproductive successes and swimming performance of Pacific lamprey, and factors that affect their passage at dams.

Results:
A series of technical reports and peer-reviewed manuscripts have been prepared from this project.

Jeffrey H. Braatne, Ph.D.
- Baseline Monitoring of floodplain vegetation

Oz Garton, Ph.D.
- A metapopulation approach to the conservation of the white-headed woodpecker in the interior west
- Survival estimation and sensitivity analysis of the white-headed woodpecker (picoides albolarvatus)
- An assessment of the distribution and abundance of the white-headed woodpecker *(picoides albolarvatus)* in the interior Columbia Basin
- Using the metapopulation concept to understand the spatial and temporal population dynamics of elk in Idaho

Wayne Melquist, Ph.D.
- Idaho's important bird areas program
- Further understanding and knowledge of wildlife in Idaho

Janet Rachlow, Ph.D.
- Black bear habitat selection and highway crossing patterns

Kerry Reese, Ph.D.
- Mountain quail translocation
- Translocation of trumpeter swans

J. Michael Scott, Ph.D.
- Recovering threatened and endangered species on the national wildlife refuge system
- Natal dispersal and philopatry in two species of sympatric buteos in southern California
- Focal species as conservation targets
- Habitat analysis: toward converting a set of competing techniques into a set of competing hypotheses
- Assessing avian diversity and identifying conservation targets in the national wildlife refuge system
- Biological integrity and diversity: waterfowl and the national wildlife refuge system
- Ecological content and context of national parks
- Ecology of the Nightingale Reed Warbler on Saipan in Micronesia
- Use of advocacy in peer reviewed articles in the natural resource sciences

R. Gerald Wright, Ph.D.
- Vascular plant inventory of expanded Craters of the Moon National Monument and Preserve
- Phase III monitoring report and vital signs protocol development
- Establishment of the Upper Columbia Basin Network inventory and monitoring program support office

- Identification of rare plant populations within fuel reduction areas at Lake Roosevelt National Recreation Area and Lake Roosevelt National Recreation Area vegetation mapping project using ASTER satellite data
- Lake Roosevelt National Recreation area vegetation mapping project using ASTER satellite data
- Vegetation mapping for the upper Columbia Basin network

BASELINE MONITORING OF FLOODPLAIN VEGETATION

Principal Investigators:	Jeffrey H. Braatne, Ph.D., P.B. Shafroth, Ph.D., U.S. Geological Survey-Fort Collins, CO
Student Investigator:	Chanoane Hartt
Funding Agency:	U.S. Geological Survey
Completion Data:	31 December 2005
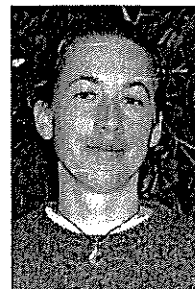
Objectives:
• Baseline studies of floodplain vegetation along the Elwha River, WA

Progress:
Field data on floodplain vegetation and geomorphology was collected during the summer of '03 and spring/summer/fall of '04. Research activities included establishment and sampling of 15 cross-valley transects within the Elwha River Basin:
• five in the "control" reach in Geyser Valley (upstream of Glines Canyon Dam),
• five along the river reach between Glines Canyon and Elwha Dams, and
• five in the delta reach below the Elwha Dam (outside ONP boundaries).

The topography of each transect was surveyed (GPS and rebar monumented), vegetation patch types and geomorphic surfaces identified, and vegetation plots established for sampling of tree, shrub and herbaceous plant species (140 tree plots, 272 shrub plots and 275 herbaceous plots). Point and line-intercept data was also recorded along the entire length of each study transect.

Investigators are currently analyzing data, preparing manuscripts for publication and extending their analyses to floodplain soils during the 2006 growing season. Additional funds are currently being sought to expand the sampling of these floodplain ecosystems prior to removal of the Glines Canyon and Elwha Dams in 2008.

Results include: topographic cross-sections for 15 transects; tree age-classes, density, cover and basal area by species; shrub species composition and cover; herbaceous species composition and cover; dominant sediment particle sizes

A METAPOPULATION APPROACH TO THE CONSERVATION OF THE WHITE-HEADED WOODPECKER IN THE INTERIOR WEST

Principal Investigators: Oz Garton
Student Investigator: Rita D. Dixon
Completion Data: 31 December 2006

Objectives:
The White-headed Woodpecker (*Picoides albolarvatus*) is considered an at-risk species throughout its northern range. This species relies on large-diameter ponderosa pine for all aspects of its life history, including nesting, roosting, and foraging. However, the continued fragmentation of ponderosa pine, low snag densities, and conversion to fir-dominated stands pose threats to the long-term viability of White-headed Woodpecker populations. Currently, there is an inadequate understanding of the effects of landscape heterogeneity on the dynamics of White-headed Woodpecker populations. Likewise, we have lacked the demographic data needed to evaluate the stability of these populations.

My overall objectives are to estimate the population size, survival rates, and stability of White-headed Woodpeckers in the Interior West, investigate metapopulation structure and dynamics, and examine the effects of landscape heterogeneity on populations.

Progress:
I have completed drafts of 2 chapters of my dissertation and have included abstracts for these below. The chapter on landscape heterogeneity and metapopulation biology is in progress and I expect to have a draft by the end of this summer.

AN ASSESSMENT OF THE DISTRIBUTION AND ABUNDANCE OF THE WHITE-HEADED WOODPECKER *(PICOIDES ALBOLARVATUS)* IN THE INTERIOR COLUMBIA BASIN

Principal Investigators: Oz Garton
Student Investigator: Rita D. Dixon
Completion Data:'   31 December 2006

Objectives:
Abstract. I assessed the distribution, density, and habitat characteristics for the White-headed Woodpecker (*Picoides albolarvatus*) and associated forest bird species at point transects in the Interior Columbia Basin (ICB) in spring, 1998. Point transects were primarily conducted along road transects, with all points ultimately classified into one of 16 habitat types. The 1998 field effort spanned three states (Oregon, Idaho, Washington), 12 National Forests, three tribal lands, as well as state and private lands within the ICB region.

Progress:

A total of 545 points were surveyed between 10 April 1998 and 19 May 1998 on 54 transects with an average of 10 points per transect. A total of 104 bird species were detected during point transects and included 11 woodpecker species. The total density for all species ranged from 4.33 birds/40 ha in young ponderosa pine (*Pinus ponderosa*)/Douglas-fir (*Pseudotsuga menziesii*) to 480.34 birds/40 ha in understory reinitiations. There was no significant difference in the density of birds among habitat types (ANOVA, $F_{11, 1272} = 1.482$, $P = 0.132$). A total of 76 White-headed Woodpeckers were observed on 29 transects (59 points). Density estimates for White-headed Woodpeckers ranged from 0.13 birds/40 ha to 5.36 birds/40 ha with the highest densities in ponderosa pine dominated forest types.

SURVIVAL ESTIMATION AND SENSITIVITY ANALYSIS OF THE WHITE-HEADED WOODPECKER (*PICOIDES ALBOLARVATUS*)

Principal Investigators: Oz Garton
Student Investigator: Rita D. Dixon
Completion Data: 31 December 2006

Objectives:

Abstract. I estimated the survival rates of White-headed Woodpecker (*Picoides albolarvatus*) eggs, nestlings, fledglings, and adults to identify key stages that influence the long-term population dynamics of this rare bird associated with large-diameter ponderosa pine (*Pinus ponderosa*) forests of the Interior West. I calculated the elasticity associated with each age-specific vital rate based on 500 replicates of a stochastic Leslie matrix model (Leslie 1945, 1948). Age 0 survival was associated with highest elasticity for 69% of the replicates and age 1 reproduction was associated with highest elasticity in the remaining 31%. The mean finite rate of increase (λ) associated with these elasticities was 1.083 ± 0.008 95% C.I., which implies a stable population.

Progress:

These results indicate that management of White-headed Woodpeckers should focus on obtaining more precise estimates of age-specific survival as well as providing suitable nest-sites and habitat for these early life stages.

USING THE METAPOPULATION CONCEPT TO UNDERSTAND THE SPATIAL AND TEMPORAL POPULATION DYNAMICS OF ELK IN IDAHO

Principal Investigators: Oz Garton
Student Investigator: Jocelyn L. Aycrigg
Funding Agency: Idaho Department of Fish and Game
Completion Data: 30 June 2006

Objectives:

Large mammals, such as Rocky Mountain elk (*Cervus elaphus nelsoni*), exemplify the challenge of managing wildlife populations over large spatial areas because they have seasonal and annual ranges that often cover areas the size of watersheds or sub-basins, respectively (Wisdom & Cook 2000). To address the challenge of managing elk, our research emphasizes spatial analysis of populations at the landscape level. We can meet this challenge by focusing on the metapopulation concept, which encompasses the dynamics, interactions, and processes of multiple populations over large areas. This directs our research to look at the 'big picture'.

Our goal is to bring the ecological concept of metapopulations into reality where it can be applied to management questions and emphasize the dynamics of management practices at landscape scales. Our objectives are to (1) use demographic and genetic characteristics to delineate elk metapopulations; and (2) model the influence of extrinsic factors (i.e., harvest levels, predator impacts, habitat change, weather, essential mineral levels, and road patterns) on each metapopulation. We will apply a hierarchical approach using both local and large spatial extents to ensure the most appropriate scale is analyzed.

Results:

For our first objective, we have used genetic analysis to delineate elk populations in Idaho. Elk tissue samples were collected from across the state. Using microsatellites at multiple loci, we examined genetic population substructure with 4 approaches. Individuals were clustered into local populations based on their relative similarity or dissimilarity to each local population using genotypes and geographical location. Our results indicated a moderate level of genetic differentiation between specific regions of the state; however, clustering algorithms results indicate a single large population of elk. Based on these preliminary results we would like to further examine the genetic data association with geographical location. Incorporating geographical locations of the samples into our genetic analysis may improve our ability to determine genetic differentiation between elk populations in Idaho.

We will concentrate on our second objective once our results of our first objective are finalized.

IDAHO'S IMPORTANT BIRD AREAS PROGRAM

Principal Investigator: Wayne Melquist, Ph.D.
Cooperating Investigators: Rex Sallabanks, Ph.D. and Colleen Moulton
Funding Agency: Idaho Department of Fish and Game
Completion Date: 30 June 2006

Objectives:
- To accept nominations for Important Bird Areas (IBAs) statewide; review and recognize nominated IBAs; initiate bird monitoring activities at wetland IBAs; and gather information on the distribution and abundance of nongame birds at Idaho's IBAs.

Progress:
Idaho's Important Bird Areas (IBA) Program continued to grow in 2004/2005 under the guidance of Colleen Moulton, Idaho's IBA Coordinator. Colleen made numerous requests for nomination forms for important areas for birds that had yet to be recognized as IBAs. Several nominations were received, reviewed by the IBA technical committee, and officially accepted into the IBA program; examples include Sterling WMA and the Snake and Clearwater Rivers Confluence. Nomination forms are expected in the near future for several other key sites for birds, such as Mormon Reservoir in the Magic Valley region of southern Idaho.

Colleen's efforts to update Idaho's IBA program have now resulted in 58 officially recognized IBAs, representing 3.8 million acres of wetland and upland habitat throughout the state, and including a variety of land ownerships. All six National Wildlife Refuges in Idaho have been identified as IBAs, as well as 13 Idaho Department of Fish and Game Wildlife Management Areas.

Colleen is now focusing on implementing the next phase of the IBA program - bird monitoring. As a result, monitoring was initiated at five wetland IBAs in 2004, with many more sites added to the monitoring component of the IBA program in 2005. Monitoring is being conducted under the Idaho Bird Inventory and Survey (IBIS) program, which Colleen also coordinates. Wetland IBAs are the initial focus of the IBIS program so that much-needed information on the distribution and abundance of Idaho's waterbirds and shorebirds can be gathered.

Six technicians were hired to work with Colleen during the 2005 spring and summer seasons with the goal of implementing statewide, coordinated, all-bird monitoring at most of Idaho's IBAs. During this 2005 season, waterbirds were monitored at 23 IBAs. Monitoring efforts included monthly waterbird counts, marsh bird playback surveys, and colonial waterbird nest counts. Volunteer interest in monitoring IBAs is also growing.

Since May 2004, waterbirds at Silver Creek Preserve have been monitored monthly, year-round, by volunteers, and year-round monitoring by volunteers at several more IBAs will be initiated soon. In addition, Colleen is building an "Adopt-an-IBA" Program, which seeks to encourage more community participation in the IBA Program, particularly from local Audubon chapters.

FURTHER UNDERSTANDING AND KNOWLEDGE OF WILDLIFE IN IDAHO

Principal Investigator: Wayne Melquist, Ph.D.
Cooperating Investigators: Chuck Harris, Ph.D., Dan Davis, USFS
Funding Agency   Idaho Department of Fish and Game
Completion Date: 30 June 2006

Objectives:
- Focus on forest carnivore surveys and research in the Clearwater and adjacent National Forests.

Progress:
This project is a coordination program that involves several individual projects identified and reported elsewhere, see Black Bear Project, pages 50-51.

BLACK BEAR HABITAT SELECTION AND HIGHWAY CROSSING PATTERNS

Principal Investigator: Janet Rachlow, Ph.D.
Student Investigator: Jesse Lewis
Funding Agency: Idaho Department of Fish and Game
Completion Date: 30 June 2007

Objectives:
- Evaluate habitat selection and movement patterns by black bears (*Ursus americanus*) within the corridor of Highway 95 in northern Idaho.
- Develop predictive models of habitat association for crossing locations along Highway 95.
- Compare results of habitat selection across a range of GPS telemetry acquisition intervals.
- Quantify how habitat variables affect GPS collar performance across the range of variation within the study area.

Progress:
During 2005, 11 black bears (9 males, 2 females) and 1 female grizzly bear were fitted with GPS collars. We acquired 7 black bear data sets during the summer of 2005 from collars that were dropped, from one animal that was recaptured, and from one bear that was harvested. Only 2 bears of those 7 animals crossed the highway during the period of time when they were collared (1-3 months). One adult male made 1 highway crossing in traveling from the Purcell Mountains west to the Selkirk Mountains, and 1 adult female made 16 road crossings over the course of 3 weeks. The other 5 bears did not cross the highway, but used areas adjacent to the highway. Using the Brownian bridge approach (Horne 2005), we analyzed the 16 highway crossing locations of the adult female. She used 3 distinct areas when crossing the highway and appeared to select crossing locations that were within forested cover and away from human development.

We completed an assessment of how habitat variables affect GPS collar performance during 2005. Specifically, we assessed: 1) how canopy cover and terrain obstruction affected fix rate,

proportion of 3-dimensional fixes, location error, and Positional Dilution of Precision (PDOP) at 48 test sites; 2) the relationship between PDOP values and location error; and 3) how 4 different data-screening options affected data reduction and location error for 8 data sets of black bear GPS locations. Fix rates for test collars were high in all habitats (mean = 99.5%, range = 97.9–100%) and were not related to canopy cover or terrain obstruction. However, habitat variables strongly influenced location error, PDOP values, and proportion of 3-dimensional fixes. Mean value for the 95% circular area probable (CEP; radius of a circle centered on the true location that incorporates 95% of estimated locations) was 107 m for all test sites, and increased markedly with canopy cover and terrain obstruction. The CEP for 2-dimensional fixes was significantly larger ($p = 0.007$) than for 3-dimensional fixes. We evaluated 4 data-screening options to reduce location errors that were based on fix category (2 versus 3-dimensional fixes) and PDOP values. For our 8 black bear data sets, data reduction ranged from 8–35%. These analyses will be used to choose a data-screening method that will be applied to all location data prior to habitat analyses.

MOUNTAIN QUAIL TRANSLOCATION

Principal Investigator:	Kerry Reese, Ph.D.
Student Investigator:	Ashley Martens, John Stephenson
Funding Agency:	Idaho Department of Fish and Game
Completion Date:	30 June 2006

Objectives:
• Reintroduce mountain quail into Asotin Creek Wildlife Management Area in Washington and Craig Mountain Wildlife Management Areas in Idaho.

Progress:
On 12 March 2005, we translocated 73 mountain quail into the Asotin Creek (AC) Wildlife Management Area in Washington and 72 into the Craig Mountain (CM) Wildlife Management Area in Idaho. Translocated birds moved up to 19 km from the release sites. Twelve nests were located a mean distance of 3.4 km from the release sites (range 0.1 – 8.5 km).

At Asotin Creek, 33 of 50 radiomarked birds died within six months of release; six were never relocated after release; seven were relocated but then disappeared from the study area or transmitter failed; and four birds were alive at the end of the six month period.

At Craig Mountain, 36 of 50 radiomarked quail died within six months; one was never relocated after release; four were relocated but then disappeared or transmitter failed; and nine were alive at the end of the six month study period. Seven nests were incubated by males and five incubated by females. Mean clutch size was 10.2 ± 0.80 eggs and the mean hatch size was 9.9 ± 0.90 chicks. Eleven of twelve (92%) nests hatched successfully. Minimum mean brood (n = 7) size at 28 days was 6.9 ± 1.3 chicks. At least 48 chicks were alive at the end of July. Ashley Martens left the project and was replaced with a new MS student, John Stephenson.

TRANSLOCATION OF TRUMPETER SWANS

Principal Investigator:	Kerry Reese, Ph.D.
Student Investigator:	Darlene Kilpatrick
Funding Agency:	Idaho Department of Fish and Game
Completion Date:	30 June 2006

Objectives:
- The primary objective is to determine whether winter translocation of trumpeter swan cygnets is effective at increasing the distribution of the species.

Progress:
Trumpeter swan cygnets have been trapped each of the past several winters in the Island Park area of Idaho. Control birds were radio-marked and released at point of capture and translocated cygnets were radio-marked and moved to release sites along the Bear River, Idaho.

In the winter of 2002-2003, 78 cygnets were captured and 39 were translocated. In 2003-2004, 100 cygnets were captured and 51 were translocated. In 2004-2005, 103 cygnets were captured and 51 were translocated. Birds were monitored over each winter until migration moved them north. Darlene Kilpatrick has draft thesis with an expected completion date of May 2006.

RECOVERING THREATENED AND ENDANGERED SPECIES ON THE NATIONAL WILDLIFE REFUGE SYSTEM

Principal Investigator:	J. Michael Scott, Ph.D.
Student Investigator:	Emmi Blades
Funding Agencies:	U.S. Geological Survey/Environmental Science
Completion Date:	Ongoing
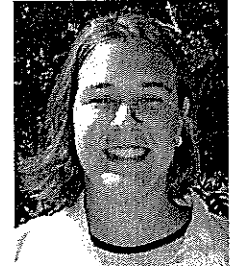
Objectives:
The goal of this project is to evaluate the recovery planning process for threatened and endangered species for which refuges have been established under the Endangered Species Act on the National Wildlife Refuge System (NWRS). Specific project objectives include:
- Assessing recovery planning, habitats and home range sizes for threatened and endangered species for which refuges have been established to evaluate their representation, resiliency and redundancy on the NWRS.
- Identifying threatened and endangered species for which refuges have been established that could serve as conservation targets for strategic growth and habitat management in the NWRS.

Progress:
Sixty-one U.S. Fish and Wildlife Refuges that were established to protect endangered species have been identified; species for which refuge established identified, size of refuges and number of parcels determined.

Recovery plans were reviewed and linked to management actions on refuges to support recovery plan objectives.

Home-range sizes and habitat requirement for species have been identified and are being used to determine population size that could be supported on a refuge.

The results of this effort will be reported out as genetically viable, demographically viable, or evolutionarily viable population sizes. Anticipated completion date is Spring 2007.

NATAL DISPERSAL AND PHILOPATRY IN TWO SPECIES OF SYMPATRIC BUTEOS IN SOUTHERN CALIFORNIA

Principal Investigator:	J. Michael Scott, Ph.D.
Student Investigator:	Peter Bloom
Funding Agency:	Peter Bloom
Completion Date:	December 2007
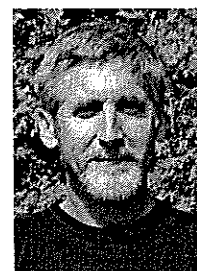
Objectives:
Evaluate the long-term conservation implications of philopatry in heavily modified Coastal sagebrush and chaparral and associated environments
- Where do they go?
- Are the two species philopatric? Why or why not?
- What proportions of each sex of the two species are philopatric?
- What proportions of the fledgling red-tailed hawks migrate outside the natal region and what proportion remain?
- What proportion of the fledgling red-shouldered hawks disperse outside the natal region and what proportion remain.
- Do the two species exhibit sex-biased dispersal?
- Is there any evidence that breeding dispersal moves of red-shouldered hawks are closer to the natal territory?
- What proportion of young move > 100 km?
- Is there a latitude or other factor that predicts northward vs. southward movement of Red-tailed Hawks across North America?
- Do the data on natal dispersal distances provide any support for Wright's "isolation by distance" hypothesis?

Progress:
During the springs of 1970-2002, we banded 3,860 nestling red-tailed hawks (Figure 2) and of 2,112 nestling red-shouldered hawks (Figure 3) resulting in 73 (1.89%), breeding age red-tailed hawk recaptures, and 99 (4.69%) breeding age red-shouldered hawk recaptures of known sex respectively (Table 1). Another in as yet unanalyzed, nearly equal number of pre-breeding aged red-tailed hawks and pre-breeding aged red-shouldered hawks were also recaptured of presumed known sex. The BBL provided 121 (3.13%) breeding aged red-tailed hawk recoveries and an unanalyzed number of pre-breeding aged red-tailed hawks, as well as 82 (3.88%) breeding aged

and an unanalyzed number of pre-breeding aged red-shouldered hawk recoveries, all of mostly unknown gender from the above total bandings during this study.

Migratory movements of juvenile red-tailed hawks banded in southwestern California are atypical for avian species.

First year juvenile red-tailed hawks were recovered, and sometimes recaptured in Idaho, Montana, Utah, Nevada and northern California as much as 1,000+ km away from their natal territory (Figure 4). However, no live or fresh mortalities were found in any state other than California after approximately 24 months of age.

Mean post migration red-tailed hawk natal dispersal distances for 45 recaptured males was 5.61 km +/- 0.63 SE with a median of 4.45 (range 0 - 26.25 km). The mean for 28 recaptured female red-tailed hawks was 5.41 km +/- 0.67 SE with a median of 4.48 (Figure 6). Interestingly, female red-tailed hawks did not disperse significantly further than males (P=0.90) (Figure 6, 7). Distances moved between the natal territory and breeding area were relatively short for a bird with the demonstrated flight capabilities of a large hawk. Preliminary analysis of recapture data indicates that sex-biased dispersal does not exist in red-tailed hawks of this population.

Fifty-four recaptured male red-shouldered hawks moved a mean of 8.73 km +/- 1.07 SE with a median of 5.76 (range 0 – 31.0), while 45 females moved a mean of 13.49 km +/- 1.66 SE with a median of 9.00 (range 0 -49.0). Female red-shouldered hawks dispersed significantly further than their mates on the study area (P=0.0189).

In contrast to red-tailed hawks, only four red-shouldered hawks moved more than 100 km and none undertook predictable large scale north bound juvenile migrations, although the majority of short distance movements were north bound. However, two radioed hawks did exhibit what could be referred to as vagrancy (Shields 1983) to the east into Nevada and to the south into Baja California del Sur, or what Mayr (2001) described on a larger scale as "… the spread of individuals of a species beyond the current species range," essentially potential founders.

Preliminary analysis of recapture and recovery data from both species suggests that the red-tailed hawk is highly philopatric and that the red-shouldered hawk is less so. The fact that the red-tailed hawk is strongly philopatric is of particular interest because many juveniles make a large >500 km north-northeast movement and could nest anywhere between the natal area and their summering range but usually return to within 10 km of where they fledged.

FOCAL SPECIES AS CONSERVATION TARGETS

Principal Investigator: J. Michael Scott, Ph.D.
Student Investigator: Jennifer Jensen
Funding Agency: U.S. Geological Survey
Completion Date: 30 September 2006

Objectives:
Habitat management strategies used by the U.S. Forest Service (USFS) and the Bureau of Land Management (BLM) often incorporate the idea of "focal," "indicator," or "umbrella" species, where a select set of species are used to set management priorities. In Idaho, these focal species are often meso-carnivores, raptors, or species associated with specific habitats (e.g., Canada lynx, Northern goshawk, Coeur d'Alene salamander, sage grouse). Managing the majority of land in Idaho, the USFS and BLM are in the position to provide habitat protection for a number of species. However, it is unknown whether current management strategies based on focal species allow for adequate protection of other terrestrial vertebrates known to regularly breed in the state.

- Identify the species selected for management by USFS across the U.S.
- Assess the adequacy of current and future conservation areas for focal species and/or habitat specialists to provide sufficient protection for other non-focal, under-represented cover types and terrestrial vertebrates.
- Evaluate the effect of geographic variability in habitat selection by the focal species.

Progress:
To date, a preliminary draft is being prepared to characterize indicator species selections based on the various planning rules implemented by the USFS over the past three decades, as well as identification of trends in species and habitat selection/monitoring strategies as a whole, within specific management regions and for Idaho separately.

A final report for focal species selections and habitat associations for Idaho is near completion. A manuscript based on a qualitative analysis of Idaho's focal species selections is preparation for submission to the peer-reviewed journal, Northwest Science.

Reserve selection algorithms (e.g., SITES, MARXAN, RESNET) are currently being applied to land stewardship parcels based on ID-GAP derived datasets. The algorithms are applied to help identify areas outside of national forests that are important for focal species based on habitat richness and diversity within each ownership parcel. Reserve selection results will be compared to habitat needs for other native species of Idaho.

HABITAT ANALYSIS: TOWARD CONVERTING A SET OF COMPETING TECHNIQUES INTO A SET OF COMPETING HYPOTHESES

Principal Investigator:	J. Michael Scott, Ph.D.
Student Investigator:	William Kristan
Agency Funding:	U.S. Geological Survey
Completion Date:	30 September 2006

Objectives:
- Develop the necessary understanding of the implicit assumptions of the most commonly used current techniques and the most promising new techniques by applying them to data that contain known habitat relationships.
- Apply the insights derived from the modeling exercises to real existing data sets that occupy a wide range of ecological conditions.

Progress:
Project has been completed and a symposium on hierarchical approaches to modeling species distributions was held at the 2004 meeting of the Cooper Ornithological Society in LA Crosse, Wisconsin. Six papers were presented at symposium and overview of the hierarchical modeling of bird distributions. Six papers from the symposium will be published in a special section of the February 2006 issue of the *Condor* provided a compendium of concepts and methods for predicting species occurrences at multiple temporal and spatial scales.

Conclusions suggest that we are not yet adequately dealing with ecological and statistical problems that confront our attempts to model species distributions. Model predictions are often widely different from observed distributions. We often lack the basic natural history and habitat association information to populate are increasingly complex statistical models. There is a great need to better match statistical approaches with ecological structure at scales that are ecologically and biologically relevant.

ASSESSING AVIAN DIVERSITY AND IDENTIFYING CONSERVATION TARGETS IN THE NATIONAL WILDLIFE REFUGE SYSTEM

Principal Investigator:	J. Michael Scott, Ph.D.
Student Investigator:	David Rupp
Funding Agencies:	U.S. Geological Survey/Environmental Science
Completion Date:	30 September 2006

Objectives:
- The goal of this project is to create a list of bird species ranked by conservation priority to present to the National Wildlife Refuge System (NWRS) for use in strategic growth at the national level and for habitat management strategies at the refuge level. Specific project objectives are to:
- Assess the representation and redundancy of America's bird diversity on the NWRS.
- Identify bird species that could serve as conservation targets for strategic growth and habitat management in the NWRS.

Progress:
Three substantial steps have been made in the progress of this project:
- In the spring, a committee was formed for the support and guidance of this project. The student investigator presented a proposal to both the committee in a private meeting and to the Department of Fish and Wildlife Resources at a weekly seminar.
- In the summer the student made contact with many refuges via personal visits or phone calls to gain a greater understanding of the diversity of the NWRS and the various bird checklists that are available to the public. The 25 refuges contacted or visited represent 13 states and 5 FWS regions. Other FWS staff were contacted to receive guidance or support in developing the project. Staff included members of the Division of Realty, Planning, Partners in Flight, and refuge managers and biologists. Further contacts will be needed in the future.
- The database for this project was developed in Microsoft Access. It is designed to include data on variables involving bird species, the refuges, and the bird checklists. Key variables in this project are the distribution of refuges by Bird Conservation Region and the categorization of bird species on the Green List by the American Bird Conservancy. Collection of the bird checklists and other important data is moving along well.

BIOLOGICAL INTEGRITY AND DIVERSITY: WATERFOWL AND THE NATIONAL
WILDLIFE REFUGE SYSTEM

Principal Investigator:	J. Michael Scott, Ph.D.
Student Investigator:	Anna Pidgorna
Funding Agency:	Environmental Science Program
Completion Date:	31 October 2006

Objectives:
- To assess the occurrences and abundance of waterfowl species on each of the 545 National Wildlife Refuges during three stages of waterfowl lifecycle (breeding, wintering, and migration) in order to measure representation and redundancy.
- To assess the occurrences and abundance of waterfowl species on each of the National Wildlife Refuges within the four North American migratory bird flyways during three stages of waterfowl lifecycle (breeding, wintering, and migration) in order to measure representation and redundancy.
- To assess the occurrences and abundance of waterfowl species on each of the National Wildlife Refuges within the 20 climatic zones during three stages of waterfowl lifecycle (breeding, wintering, and migration) in order to measure representation, redundancy, and resiliency.
- To identify whether or not the purposes for which a refuge was established correspond to how waterfowl uses that refuge.
- To design a method for assessing resiliency of waterfowl species on National Wildlife Refuge lands.
- To assess the resiliency of waterfowl species on National Wildlife Refuge lands.

Progress:
- A comprehensive database has been created in Microsoft Access to facilitate both data entry and query.
- Individual checklists have been obtained for each of 281 National Wildlife Refuges and entered into the database.
- An additional number of National Wildlife Refuges (218) have been shown to have at least some type of bird checklist (many of which are a single checklist for several refuges, often located in close proximity to one another.)
- Bird checklists for 384 refuges have been entered into the database.
- Preliminary results indicate 46 of 47 waterfowl species satisfy the principles of representation and redundancy at the national scale.
- In addition, 42 of the 45 waterfowl species nesting in the United States satisfy the principles of representation and redundancy during the breeding stage (also at the national scale).
- A preliminary method to assess resiliency has been identified. It is based on waterfowl population trends, representation and redundancy of waterfowl species within different climatic zones, and the quality of the refuge habitat.

ECOLOGICAL CONTENT AND CONTEXT OF NATIONAL PARKS

Principal Investigator: J. Michael Scott, Ph.D.
Student Investigator: Leona K. Svancara
Funding Agency: National Park Service
Completion Date: May 2007

Objectives:

What will the National Park Service (NPS) system look like on its 100th and 200th birthdays? What species and ecological processes will be maintained within park boundaries? The answers depend, at least in part, on the current level of representation of natural resources within park boundaries, the spatial distribution of the parks and the integrity of the surrounding landscape. An ever-increasing human population has resulted in ours being one of the most economically and technologically advanced nations in the world. It has also resulted in numerous ecological impacts including habitat loss and fragmentation, pollution, invasions of exotic species, and species extinctions.

Our objective is to assess the ecological content and context of the national park system at multiple spatial scales by quantifying the level of representation, redundancy and resiliency of natural resources. We intend to quantify the level of representation of biological and geophysical features as well as the spatial and temporal patterns of broad-scale external threats influencing matrix permeability and consistency.

The NPS identified 243 park units in the coterminous US as containing "significant natural resources." These parks represent 1.4% of the coterminous US, average 47,900 ha in area (median 2,400ha) and range from 4ha to over 1.3 million ha. The parks represent 1369 subunits with an average of 6 subunits per park. While the greatest number of parks occurs in the Colorado Plateau and Arizona/New Mexico Plateau Ecoregions, the largest occur in the Mojave Basin and Range Ecoregion. The ecoregions with the greatest land area protected by NPS units include the Southern Florida Coastal Plain (30.5%), Mojave Basin and Range (21.6%) and Canadian Rockies (21.5%). In general, NPS units protect higher elevations, somewhat steeper slopes, and more rocks/ice.

Progress:

We are assessing the resiliency of these parks based on the context of surrounding lands, a crucial factor in the effectiveness of parks as conservation areas and the ability of the National Park Service to manage for the "unimpaired" mission. We have defined multiple layers of context based on 10km and 50km buffers, adjacent counties, and hydrologic units and assessed representation of landcover, nighttime stable lights, road density, and human population density. Ecoregions in the East, Midwest and along the West coast have experienced the greatest percentage conversion of lands adjacent to park units. The average human population size in counties adjacent to NPS units has increased faster than the national average. Thirty-eight percent of parks have experienced 60-100% increase in population size from 1950-1990 in at least 1 neighboring county. Numerous ecological, social, and economical variables still need to be addressed.

ECOLOGY OF THE NIGHTINGALE REED WARBLER ON SAIPAN IN MICRONESIA

Principal Investigator:	J. Michael Scott
Government Technical Rep.:	Steve Fancy, U.S. National Park Service
Funding Agency:	U.S. Geological Survey
Graduate Student:	Steve Mosher
Completion date:	1 July 2006

Objectives

The U.S. Fish and Wildlife Service provided funding to the U.S. Geological Survey's Pacific Island Ecosystems Research Center (PIERC), to provide management relevant information on the ecology of the Nightingale Reed-Warbler on Saipan:

- home range and movements of adult reed-warblers
- description of eggs, nests, and nestlings
- breeding biology

Each aspect constituted a separate chapter in this thesis and I have given specific objectives within each chapter. I hope that these new data on the ecology of the Nightingale Reed-Warbler will prove valuable towards continued preservation of this species throughout the Mariana Islands.

Results:

Nightingale Reed-Warblers (*Acrocephalus luscinia luscinia*) were studied on the island of Saipan in the Northern Mariana Islands from January 1997 through July 1998. We described the first verified nests, eggs, and nestling for this species. Nests were located within three habitat types: upland introduced tangantangan (*Leucaena leucocephala*) forest, a native mangrove (*Bruguiera gymnorrhiza*) wetland complex, and a native tall reed (*Phragmites karka*) wetland. Tree species used for nesting included five native species (*Casuarina equisetifolia* [$n = 6$], *Ochrosia mariannensis* [$n = 4$], *Hibiscus tiliaceus* [$n = 4$], *B. gymnorrhiza* [$n = 3$], *Thespesia populnea* [$n = 1$]) and two introduced species (*L. leucocephala* [$n = 79$], *Pithecellobium dulce* [$n = 2$]), as well as one native reed species (P. karka [$n = 1$]. Nests were composed primarily of dry vine stems (*Momordica charantia* and/or *Passiflora foetida*) with tendrils, needle-like branchlets of ironwood, and tangantangan petioles. Mean nest height was 4.3m ± 1.3 (2.3-10.0 m, $n = 83$).

Eggs shape was subelliptical and coloration varied from dull white to cream to ivory-buff. Eggs were spotted, speckled, and blotched with gray, brown, black, and rust colored markings. Mean clutch size was 2.3 (range 2-4, $n = 39$) with a mode of two.

The reproductive biology of the endangered Nightingale Reed-Warbler (*Acrocephalus luscinia*) was studied on the island of Saipan in the Northern Mariana Islands of Micronesia. Fifty-one active Nightingale Reed-Warbler nests were located within two habitat types: upland introduced Tangantangan (*Leucaena leucocephala*) forest and a native mangrove (*Bruguiera gymnorrhiza*) wetland complex.

Nightingale Reed-Warblers are apparently monogamous. Males defend mates and nest sites, but not feeding territories. Females construct the nest with limited help from the male. Nest

construction took approximately 3-4 days. The female and male both incubate and brood young. The breeding season has two peaks: January through March and July through September, but nesting appears possible during any month of the year. Pairs can have more than one clutch per year. Pairs that lost eggs or nestlings during their first attempt of a breeding peak would renest up to at least two more times before giving up during that breeding period. Pairs that fledged young during a peak did not renest until the next breeding peak. The majority of adult birds that displayed body, primary, or tail molt occurred between breeding peaks.

The modal incubation period was 16 days. 86% of all nest failure was due to predation or stochastic weather events (super-typhoons). Interspecific competition for foraging or nest sites caused the failure of at least one nest. Chicks fledged at 16.7 ± 1.7 days of age, and were dependent on the parents for an extended period of time, with some family groups observed after 9.5weeks after leaving the nest. One peer reviewed publication appeared in the Wilson Bulletin.

USE OF ADVOCACY IN PEER REVIEWED ARTICLES IN THE NATURAL RESOURCE SCIENCES

Principal Investigators:	Janet Rachlow Ph.D., J. Michael Scott, Ph.D.
Funding Agency:	U.S. Geological Survey, Idaho Department of Fish and Game
Completion Date:	November 2007

Objectives:
- Determine the frequency with which value laden language is used and preferred policy outcomes are stipulated in peer reviewed journals in the Natural resource sciences.

Progress:
Fifty articles from each of six natural resource journals; Ecological Applications, Journal of Wildlife Management, North American, Journal of Fisheries, Management, Forestry Science, Conservation Biology and Journal of Range Management were reviewed for use of value laden language and stipulation of preferred policy outcomes.

The use of value laden language was found in all journals most frequently in Conservation Biology and Journal of Range Management. The stipulation of preferred policy outcomes was also found in each of the journal again most frequently in Conservation Biology and Journal of Wildlife Management.

We will co-host a symposium on advocacy in Natural Resource Sciences at the 2006 meeting of the Society for Conservation Biology. Presentations by prominent conservation biologists and senior administrators of natural resource agencies as well as a roundtable discussion by editors of Conservation Biology and Bioscience will be featured at the symposium. An overview of our results will also be presented.

VEGETATION MAPPING FOR THE UPPER COLUMBIA BASIN NETWORK

Principal Investigator: R. Gerald Wright, Ph.D.
Government Technical Rep.: Leona Svancara, Gina Wilson
Funding Agency: National Park Service
Completion Date: 1 May 2006

Objectives:

The work accomplished under this task agreement will complete vegetation mapping in two Upper Columbia Basin Network (UCBN) parks, Big Hole National Battlefield and Whitman Mission NHS, using ASTER satellite data. The objectives of this project are:

- To determine the current (~2000) spatial distribution and size of land cover types within and surrounding these parks at a thematic resolution, based on the National Vegetation Classification System, most appropriate for long-term monitoring and management.
- To provide a cost-effective and timely product with resolution and accuracy standards similar to the NPS Vegetation Mapping Program, 0.05 ha MMU, >80% accuracy/class.
- The results of this project will allow UCBN staff to identify, map, and monitor changes in the patterns of land cover on lands within and adjacent to the parks and will provide base-level support for various vital sign monitoring (e.g., sampling design, view shed analysis, focal species occurrences).
- This project will enable Network staff and resource managers to assess land use impacts and make better-informed resource management decisions.

Progress:

Research Technician Gina Wilson has the lead on this project. To date, draft vegetation maps for Whitman Mission NHS, Nez Perce NHS, and John Day Fossil Beds National Monument have been produced and are being evaluated by park personnel. Maps for Lake Roosevelt are in progress. The remaining parks in the network will be mapped throughout 2006.

VASCULAR PLANT INVENTORY OF EXPANDED CRATERS OF THE MOON NM AND PRESERVE

Principal Investigator: R. Gerald Wright, Ph.D.
Government Technical Rep.: John Apel
Funding Agency: National Park Service
Completion Date: 30 January 2008

Objectives:

- Complete the documentation of a target of 90 percent of all vascular plant taxa known or believed to occur on the expanded unit of Craters of the Moon NM and Preserve via vouched plant specimens.
- Field work to collect taxa not previously collected which are believed to occur in the expanded section of the monument, determinations of resulting collected specimens, and database completion tasks are needed to accomplish this initiative.

Progress:

Completed initial field survey study conducted and database design of location extent and documentation voucher specimens estimated.

PHASE III MONITORING REPORT AND VITAL SIGNS PROTOCOL DEVELOPMENT

Principal Investigator: R. Gerald Wright, Ph.D.
Government Technical Rep.:   Lisa Garrett
Funding Agency: National Park Service
Completion Date: 1 November 2009

Objectives:
- Based on the results of the Phase I study of the nine park units in the Upper Columbia Basin Network, Phase II of the study will develop a set of conceptual models that show the pathways and interactions between the various resources in the parks, and identify, via these models and interactive workshops a list of key resources or vital signs to be considered in a long-term monitoring plan.
- Phase III of the study will be the development of a long-term monitoring plan that incorporates specific vital signs and the protocols and responsibilities for monitoring each.

Progress:
- Objective 1 has been completed. Based on the conceptual models, workshops with resource experts held at the University of Idaho, and workshops held with the staff of each of the park units, 18 vital signs were selected for monitoring in at least one of the nine parks. Vital signs selected included those where the network will develop the monitoring plans and protocols and those were the vital signs are monitored by a given park or another federal or state agency and form which the data will be compiled by the network. The details of the entire process are contained in the Phase II report cited below. This report is now being used by network staff to develop a specific long-term monitoring plan under Phase III.

The work accomplished under this task agreement will assist in completion of the Upper Columbia Basin Network monitoring plan. The goal of this project is to provide technical assistance in all phases of the development of the Phase III report and vital signs protocol development for the Upper Columbia Basin Network.

ESTABLISHMENT OF THE UPPER COLUMBIA BASIN NETWORK INVENTORY AND MONITORING PROGRAM SUPPORT OFFICE

Principal Investigator: R. Gerald Wright, Ph.D.
Government Technical Rep.:   Lisa Garrett
Funding Agency: National Park Service
Completion Date: 1 January 2009

Objectives:
- To establish a NPS support office for the Upper Columbia Basin Network and staff with appropriate NPS employees.

Progress:
A program support office for the NPS Upper Columbia Basin I&M Network was established in Moscow in 2003. It was initially staffed by one NPS employee, Lisa K. Garrett who serves as

Network Coordinator and reports to the Pacific West Region coordinator in Seattle. Subsequently, a second position as network program/data manager was established and filled by Leona Svancara in 2004. A network statistician was hired in 2006 through the University of Idaho. Currently, the network is advertising for a network ecologist who will be an NPS employee. Funds in this subagreement support the administrative costs and functions of the network office and will be renewed annually

IDENTIFICATION OF RARE PLANT POPULATIONS WITHIN FUEL REDUCTION AREAS AT LAKE ROOSEVELT NATIONAL RECREATION AREA AND LAKE ROOSEVELT RECREATION AREA VEGETATION MAPPING PROJECT

Principal Investigator:	R. Gerald Wright, Ph.D.
Government Technical Rep.:	Jerald Weaver
Funding Agency:	National Park Service
Completion Date:	1 October 2008

Objectives:
- Develop an accurate ground verified map of the location and distribution of invasive exotic weeds within Lake Roosevelt National Recreation Area in accordance with the methods outlined below.
- Incorporate project results with the 2003 survey data that are being used to prioritize areas for control using three management classes: a) isolated weed populations and/or weed species that spread quickly, b) areas that contain both large and isolated weed patches, and c) areas with widespread infestations of weeds.
- Use invasive plant distribution data to continue strategic planning for comprehensive management and control of exotic plants. This effort will be coordinated with the NPS national strategic plan for invasive species monitoring and control.
- To map rare plant species locations along the shoreline of Lake Roosevelt in areas owned by the NPS and slated for fuel reduction.

Progress:
A total of 23 areas slated for fuel reduction via prescribed burns were surveyed for both rare and exotic noxious weeds during the late spring of 2005. The areas surveyed were along the north arm of Lake Roosevelt between Kettle Falls and Ft. Spokane. Surveyed areas varied in size from 17 to 135 ha. Areas were primarily xeric southwestern exposures dominated by dog-eared stands of ponderosa pine, the primary target of the fuel reduction. GPS was used to map all infestations of exotic noxious weeds on the sites. In general, probably due to minimal physical disturbances and the xeric nature of the sites, noxious weeds were not common on any of the sites. The primary species mapped included common St. Johnswort, dalmation toadflax, spotted and diffuse knapweed, sulfur cinquefoil, and Canada thistle. No state or federally classified rare plants were found on any of the site.

LAKE ROOSEVELT NATIONAL RECREATION AREA VEGETATION MAPPING PROJECT USING ASTER
SATELLITE DATA

Principal Investigator: R. Gerald Wright, Ph.D.
Government Technical Rep.:   Jerald Weaver
Funding Agency: National Park Service
Completion Date: 1 May 2006

Objectives:
- To determine the location and size of plant communities as defined in the Standardized National Vegetation Classification System at Lake Roosevelt National Recreation Area.
- To enable the Lake Roosevelt Chief of Compliance and Natural Resources and others to monitor plant communities over time, and assess land use impacts in regards to plant communities.

Progress:
The cooperator will provide a computer-generated vegetation classification key based on ASTER imagery. These notes will include, at a minimum, the following: plant association(s)/alliances - as defined by the Washington State Gap Analysis program - encountered in the project area; a list of dominant species found in each community type (include scientific and common names); or invasive species with appropriate maps and forms. Because ASTER does not acquire images on a regular basis, the thematic resolution of the final classification is dependent on the imagery dates. Given the late date of the imagery currently available (September 27, 2000) a detailed classification of plant associations/alliances may not be easily determined for all vegetation types (e.g., grasslands).

Classification schemes will be site truthed. Field notes will include the dates the area was surveyed, inspector's name, and identification of the dominant plant associations encountered using vegetation classification key. When the plant association is not defined in the guide, as with unique habitats, the habitat will be identified using the dominate species present in each life form. Such as *Populus tremuloides/Symphoricarpos albus/Calamagrostis rubescens* to describe an aspen grove with a dominant snowberry shrub and pinegrass understory.

In describing the community, common species will make up at least 1% of the total vegetative cover. To be considered abundant, a species needs to make up at least 25% of the total vegetative cover.

A draft vegetation layer and technical report has been prepared. The final report will be submitted to the NPS Research Coordinator and the RM-CESU host university by July 1, 2006.

Wayne Melquist, Ph.D.
- Black bear project
- Northern Idaho carnivore project
- Population status and habitat use of Clearwater wolverine

Janet Rachlow, Ph.D.
- Moose on the Palouse: Habitat Selection in an Anthropogenic Landscape
- Moose ecology project
- Boise Zoo squirrels
- Lamb production in California bighorn sheep
- Pygmy rabbit survey

Kerry Reese, Ph.D.
- Mountain quail habitat study
- Jarbridge greater sage-grouse ecology project

J. Michael Scott, Ph.D.
- Determination of recovery plan populations goals
- Development of unmanned airborne vehicle for monitoring wildlife

R. Gerald Wright, Ph.D.
- Biological data investigation in northern semi-arid national parks
- Coordination of monitoring program for the northern semi-arid network and completion of phase I report for monitoring
- Peer reviews of national park service monitoring plans
- Landscape analysis of black bear distribution patterns in Olympic National Park
- Expansion of moose in Idaho
- Digital image library: Channel Islands National Park
- Habitat use and moose browsing effects in Rocky Mountain national park

BLACK BEAR PROJECT

Principal Investigator:	Wayne Melquist, Ph.D.
Cooperating Investigators:	Jon Rachael, Hollie Miyasaki
Funding Agency	Idaho Department of Fish and Game
Completion Date:	30 June 2005

Objectives:
- Estimate population size and harvest rate of black bears in Game Management Unit 39 in southwest Idaho through use of DNA mark-recapture techniques.

Results:

Work was initiated in the 3,069 km^2 study area in Game Management Unit 39 north and west of the Middle Fork Boise River in June 2003. The study area is comprised predominately of Boise National Forest land, but includes lands owned and managed by Idaho Department of Lands, Boise Cascade, and private landowners. The study area was divided into 48 8 km^2 sampling units in which barbed wire enclosures were set around a small bait or scent lures to capture hair samples from visiting bears.

Following an initial "capture" hair trapping session, hair traps were relocated within the sample units for 2 subsequent "recapture" trapping sessions. DNA extracted from bear hair samples will be used to identify bears as individuals, thus resulting in "marked" animals in the study area. The frequency of new captures vs. recaptures in subsequent hair capture sessions will enable estimation of the bear population within the study area. Further, tissue samples were collected from all black bears harvested by hunters in the study area, creating an addition recapture event, and allowing an estimate of harvest rate of the bear population.

Hair traps were set from June 16 through August 31 in 2003, 2004, and 2005. Harvest samples were collected in the fall of 2003, spring and fall 2004, and spring and fall 2005. Results from collection efforts and DNA analysis are listed in Table 1. Samples from 2005 are in the process of being sent to the lab (waiting for CITES permit) and we expect results by summer 2006. DNA samples from 2003 and 2004 show low recapture rates for both hair trapping and harvest. Therefore, we will conduct an additional field season in 2006 with the goal of increasing our sample size of marked individuals as well as recaptures. We will also continue to collect samples from the spring and fall black bear harvest in 2006.

Table 1. Number of black bear hair samples collected from hair traps and harvest in Idaho Department of Fish and Game Big Game Management Unit 39 during 2003, 2004, and 2005. Results from DNA analysis of the 2003 and 2004 data.

Year	# Traps Set/Visited	# Samples Collected/Sent from Traps	# Samples Collected from Harvest	# Individuals Marked	# Individuals Recaptured in Traps	# Individuals Recaptured in Harvest
2003	180/153	232/232	33	69	---	3
2004	251/184	204/204	112	135	1	6
2005	270/74	265/181*	92			

*2005 samples were sorted before sending. Sample without a minimum of 3 hairs and samples from non-target species were excluded.

NORTHERN IDAHO CARNIVORE PROJECT

Principal Investigator:	Wayne Melquist, Ph.D.
Cooperating Investigators:	Sam Cushman, Ph.D. and Dan Davis USFS; Chuck Harris, Ph.D. and Jim Hayden
Funding Agencies:	Idaho Department of Fish and Game and USFS
Completion Date:	30 June 2005

Objectives:
- The objective of the Panhandle fisher project was to document the occurrence, distribution, and genetic characteristics of fisher (*Martes pennanti*) populations in the Selkirk Mountains of Idaho.

Results:
Field work has been completed and a final report is being prepared.

POPULATION STATUS AND HABITAT USE OF CLEARWATER WOLVERINE

|	
Principal Investigator:	Wayne Melquist, Ph.D.
Cooperating Investigators:	Dan Davis and Mike Schwartz USFS; Chuck Harris, Ph.D.
Funding Agencies:	Idaho Department of Fish and Game and FWS
Completion Date:	30 June 2005

Objectives:
- Determine the status and ecology of the wolverine (*Gulo gulo*) and associated forest carnivores, and identify and provide proactive conservation measures for these species.

Results:
Project has been completed and a final report is being prepared as part of the Lolo Pass Redevelopment Project.

MOOSE ON THE PALOUSE: HABITAT SELECTION IN AN ANTHROPOGENIC LANDSCAPE

Principal Investigator:	Janet Rachlow, Ph.D.
Student Investigator:	Jon Muir
Funding Agency:	Idaho Department of Fish and Game
Completion Date:	30 June 2005
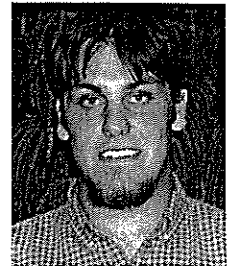
Objectives:

The goal of this research is to investigate habitat selection of moose (*Alces alces*) living in human-modified habitat in northern Idaho. Specific objectives include to:

- Assess patterns of space use by female moose in a recently established population.
- Evaluate the effects of human modification of habitat on resource selection at two spatial scales.
- Test whether summer temperatures affect habitat use in a population of moose near the southern edge of the species range.

Results:

We used radio telemetry to locate moose for investigation of habitat use and to evaluate calf production and survival in the Moscow Mountain. Eleven female moose were fitted with radio collars during March-April 2004, and an additional 5 collars were deployed in April 2005. We located individuals from the ground during May through August ≥ 2 times per week, and recorded ≥ 30 locations per individual per year. Home ranges were estimated for April through September using the fixed-kernel analyses in program SPACE USE.

Resource Selection Functions (RSF) were defined by a "used versus available" design (Manly et al. 2002). We delineated the study area boundary using a composite 99% kernel home range that incorporated all animal locations. We examined habitat selection within the study area (2nd order selection) and within individual home ranges (3rd order selection). To characterize the available resources at the 2nd order of selection, 2,250 random locations were cast within the study area. Availability of resources within home ranges was characterized using 90 random locations within each animal's 99% kernel home range (3 random locations for each observed moose location). We used logistic regression analyses to construct RSF models. Variable selection was completed using an information theoretic approach (AIC), as well as both forward and backward stepwise logistic regression.

We examined the effect of temperature on habitat selection using hourly temperature data derived from a SNOTEL weather station on Moscow Mt. to estimate temperature at the time of each animal relocation. Using a cumulative logit logistic regression, we evaluated the canopy closure category for each location relative to temperature and presence of a calf.

Sizes of home ranges were similar between 2004 and 2005, although placement differed moderately between years. Mean size of 99% fixed kernel home ranges was 3,542 ha. The large-extent (2nd order selection) RSF model for moose in the Moscow Mt. study area during diurnal periods indicated selection for areas dominated by western red cedar forest, but where timber and shrub cover were mixed. Moose in this area also selected home ranges that were closer to

standing water in the form of residential and agricultural ponds and lakes, closer to secondary roads, at higher elevations, closer to riparian areas, and further from human developments than was available at random within the study area. Within the home range (3rd order selection), the RSF model indicated that moose selected for Douglas fir/grand fir and open seral shrub fields with little or no timber overstory. In addition, moose selected areas further from human developments, closer to primary roads, closer to standing water, further from secondary roads, on easterly slopes, and closer to riparian zones.

Temperature significantly affected habitat use by moose during summer. Moose used closed canopy forest types with increasing temperatures ($P = 0.0435$), and females that had produced viable offspring were more likely to be located in closed canopy forest types than female moose without calves ($P = 0.0033$). When temperatures were >30° C we rarely located moose in open habitats, but moose were located in both closed and open canopy types when temperatures were ≤ 25°C.

MOOSE ECOLOGY PROJECT

Principal Investigator:	Janet Rachlow, Ph.D.
Student Investigator:	Jon Muir
Funding Agency:	Idaho Department of Fish and Game
Completion Date:	30 December 2005
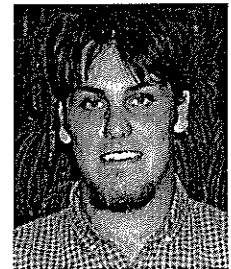
Objectives:
The goal of this work was to collect information on moose in the Sand Creek Wildlife Management Area and adjacent Big Bend ridge. Specific objectives included:
- Document patterns of space use for female moose.
- Collect data on individual reproduction and calf survival.

Results:
Twenty female moose were fitted with VHF radio collars during April 2005, and 9 of those individuals were relocated from the ground ≥ 2 times per week during May through August. Blood samples were collected from each female moose via jugular vienipuncture during immobilization. We used a pregnancy specific protein B (PSPB) assay to detect pregnancy prior to parturition in April 2005. Subsequent monitoring of radio-collared females was used to determine the number of calves produced during May-September of 2005.

Mean home range size (estimated using 99% fixed-kernel analyses in the program SPACE USE) during the spring and summer of 2005 was 11,403 ha, and the largest home range exceeded 39,500 ha. All female moose relocated consistently throughout the summer and early fall were observed moving relatively long distances from the capture location. Mean ± SE distance traveled from the capture location to the center of each individual home range was 38 ± 3 km for all females (n = 9, range = 20 to 50 km).

Evaluation of PSPB levels indicated that 14 of 20 individuals sampled were pregnant at the time of capture. A cutoff value of ≤ 93% PSPB binding was used to determine pregnancy following Huang et al. (2000). Of the 14 individuals determined to be pregnant at the time of capture, 8

were subsequently relocated from the ground. All 8 females were observed with a single calf, and all 8 calves were observed during the final week of ground-based monitoring in September 2005.

BOISE ZOO SQUIRRELS

Principal Investigator:	Janet Rachlow, Ph.D.	
Student Investigator:	Alisse Garner	
Funding Agency:	Idaho Department of Fish and Game	
Completion Date:	30 June 2005	

Objectives:
- To apply microsatellite analyses to two additional wild SIDGS populations, Scotch Pines and Sweet.
- To analyze samples from F1 (first generation) progeny of the Zoo Boise captive population to determine their parentage where possible.

Results:
The southern Idaho ground squirrel (*Spermophilus brunneus endemicus*), a subspecies of the Idaho ground squirrel, has undergone declines in numbers and has experienced degradation and fragmentation of habitat. Previously, we documented low levels of genetic diversity in SIDGS populations and identified two genetic complexes. In 2002, a captive population was established at Zoo Boise from individuals originating from the Rolling Hills and Clay Peak populations, which belong to the two different genetic complexes.

Plucked hair was used as the source for DNA in this study. Samples were obtained from 30 progeny (F1) of the Zoo population in 2003 and from the Scotch Pines (n = 10) and Sweet (n = 13) SIDGS populations in 2004. As in the previous study, eight microsatellite loci were analyzed for each sample by the Polymerase Chain Reaction (PCR). Genetic diversity was quantified using expected heterozygosity and allelic richness for each population. Genetic divergence and gene flow among populations were quantified with F_{ST} statistics and assignment tests, respectively. Following calculation of divergence measures, groups of similar populations were tested for significant divergence from other groups, using hierarchical analysis of molecular variance (AMOVA).

Microsatellite genotypes of all F1 samples were compared to genotypes of founding individuals. Because the founding males from Clay Peak contained alleles not present in the Rolling Hills founders, offspring were confidently assigned to Clay Peak fathers by a process of elimination. Assignment of all possible mothers was also completed by a process of elimination.

2004 SIDGS Samples Populations on the periphery of SIDGS range exhibited lower than average levels of genetic diversity, and the most peripheral populations were also highly differentiated from other populations. The populations of SIDGS sampled in this study were grouped most parsimoniously into two genetic complexes, one consisting of the Rolling Hills

and Henley Basin populations, and one consisting of all other populations. However, the Squaw Butte and Sweet populations may represent a third, moderately differentiated group.

2003 Zoo Progeny Samples Assignment of progeny to likely parents indicated very unequal contribution of founding individuals to the F1 generation. A total of 21 of the 30 offspring were attributed to two Clay Peak males, and the remaining 9 offspring were attributed to Rolling Hills males. Founding females (all from Rolling Hills) were too genetically similar to determine maternal relationships with confidence.

The low microsatellite diversity observed in SIDGS, particularly in peripheral populations, may warrant supplementation through translocations or possibly captive breeding to increase current levels. Patterns of population divergence reported here, including the identification of at least two genetic complexes, may aid managers in selecting appropriate source populations for augmenting populations of low diversity. However, more complete analyses of mitochondrial DNA are suggested before final recommendations are made.

LAMB PRODUCTION IN CALIFORNIA BIGHORN SHEEP

Principal Investigator:	Janet Rachlow, Ph.D.
Student Investigator:	Regan Berkley
Funding Agency:	Idaho Department of Fish and Game
Completion Date:	30 June 2005

Objectives:
The goal of this research was to investigate potential causes for the decline of bighorn sheep (*Ovis canadensis*) in Owyhee County. Specific objectives included to:
- Evaluate survival of adult females and production and survival of lambs.
- Assess dates and causes of mortality.
- Examine differences in habitat use and selection, and forage quality and quantity across three subpopulations experiencing differing levels of lamb recruitment.

Results:
Historical records indicate that bighorn sheep were once widespread in southwestern Idaho, but that their numbers began to decline following the mining boom of the late 19th century. Our study investigated potential causes of the population decline. Mortality-sensing radio collars were used to evaluate survival, reproduction, and causes of death for adult females. We monitored the survival of lambs of the collared ewes throughout the summer to obtain an index of juvenile mortality and potential recruitment. We also collected data on behavior and habitat during April – August in 2002, 2003, and 2004. These data were compared to data collected during a study completed prior to the start of the population decline. This earlier study, conducted by researchers from IDFG and the Bureau of Land Management, used methods similar to ours to collect behavior and habitat use data on 39 radio-collared sheep in a portion of our study area. We collected fecal samples monthly during the summers of 2003 and 2004 in each of the three drainages within the study area. These samples were analyzed for fecal nitrogen content, which will be used as an index of diet quality. Finally, we used GIS technology to assess both the availability and spatial arrangement of habitat features. These data allowed us to

examine the relationships among survival, nutrition, and the use, availability, and arrangement of security and nutrition resources across the study area.

The total number of collared-animal deaths observed during this project was 23, seven of which were positively attributed to cougar predation, and several others showed evidence of a predator presence, but cause of death could not be conclusively determined. Researchers on the earlier study noted only one predation-related mortality. Therefore, predation levels, and presumably predation risk, may have been higher on the recent study. However, comparison of behavior and habitat use data in Shoofly and Little Jacks between the two study periods revealed few differences. Sheep group sizes and alert behavior were consistent between the two time periods. There is limited evidence that sheep on the current study are using more rugged terrain than sheep on the pre-decline study.

Analyses comparing survival rates across the study area suggested that although ewe survival appeared to be consistent across the three drainages in the study area, lamb survival did not; lamb survival in Shoofly Creek was significantly higher than that in Little Jacks Creek. Sheep in the Big Jacks drainage exhibited lamb survival intermediate to that observed in Shoofly and Little Jacks. This trend was consistent among all three years of data collection, and suggested that predation risk might vary across the study area. Specifically, apparent predation risk was higher in Little Jacks than in Shoofly Creek. Finer-scale analyses of current-study data suggested that use of rugged terrain and group size differ between the two creeks. Sheep in Little Jacks formed larger groups and made more use of rugged terrain than did Shoofly sheep.

Our habitat analyses suggested that sheep in Shoofly creek are feeding at sites characterized by significantly different features than those found at either Little Jacks or Big Jacks feeding sites. While Shoofly sheep consistently fed at sites characterized by cliffs and shrubs, Little Jacks fed at sites that were characterized by a greater proportion of grasses and loose rock. In Big Jacks Creek, sheep fed at sites dominated by cliffs, but with very little grass. Analyses of fecal nitrogen levels indicated that diet quality was highest in Shoofly sheep, moderate in Little Jacks, and relatively low in Big Jacks sheep. Analyses of availability suggest that there were no differences in the availability of habitat features across the three drainages.

Analyses of spatial structure indicated that Shoofly Creek was characterized by smaller patches of cliff and grass than either Little or Big Jacks Creek. In addition, habitat patches were better interspersed with one another in Shoofly Creek than in Little or Big Jacks. Conversely, Little and Big Jacks Creeks were characterized by larger, more continuous swaths of cliffs and grass than Shoofly Creek. These data suggested that the relatively high lamb survival in Shoofly Creek might be related to interactions between habitat arrangement and predation. In Shoofly Creek, small grassy patches of forage were often located very close to patches of rugged "escape terrain." In contrast, grassy patches in Big and Little Jacks Creeks were often quite far from the nearest patch of rugged terrain. Because of this, sheep in Big and Little Jacks Creeks may have to make trade-offs between forage quality or quantity and security, whereas sheep in Shoofly Creek were consistently able to forage in patches that were relatively close to rugged terrain.

PYGMY RABBIT SURVEY

Principal Investigators: Janet Rachlow, Ph.D., Jim Witham, Ph.D.
Funding Agency: Idaho Department of Fish and Game
Completion Date: 30 June 2005

Objectives:
The goal of this work was to evaluate pygmy rabbit (*Brachylagus idahoensis*) habitat and presence in the BLM Shoshone Field Office Area. Specific objectives included:
- Conduct surveys to document presence of pygmy rabbits.
- Examine potential locations during winter when snow was present to confirm activity at potential pygmy rabbit burrows.
- Collect tissue samples to be included in a statewide assessment of genetic diversity.
- Evaluate feasibility of identifying pygmy rabbit presence during winter aerial surveys.

Results:
We used a Geographic Information System (GIS) to build a broad scale habitat model to assist in identifying areas of potential habitat for rabbits across Idaho (Rachlow and Svancara *in press*). We used this model to map potential habitat within the Shoshone FOA into 4 categories that ranked habitat from higher to lower priority for survey efforts. We surveyed a total of 111 sites in the Shoshone Field Office Area (FOA) for presence of pygmy rabbits during June – September of 2003. We identified potential evidence of pygmy rabbits at 12 of the random sampling sites. However, follow-up autumn and winter surveys revealed that 10 supported cottontail rabbits (*Sylvilagus nuttallii*), but not pygmy rabbits. Two (Mormon and Magic Reservoir sites) supported populations of pygmy rabbits. We documented distribution of rabbit activity during winter at each site.

We live-trapped and released 40 pygmy rabbits at 3 sites in the Shoshone FOA. We trapped 15 pygmy rabbits at the Mormon Reservoir site and 13 rabbits at the Magic Reservoir site during July – August of 2005. We also captured 12 rabbits from the Johnson Hill area during June – August, 2005, 10 of which were captured on private land that bordered BLM-owned parcels.

We conducted a pilot study during 2005 to test whether pygmy rabbit tracks in snow could be detected during aerial surveys. We were able to distinguish potential pygmy rabbit tracks from the air, and conducted ground surveys to confirm species identification. This work resulted in detection of 4 new areas occupied by pygmy rabbits and provided an expansion of one known population in the Shoshone FOA. Additional aerial surveys were conducted during February – March of 2006. This technique may enable biologists to more completely define pygmy rabbit distribution, especially in areas that are remote and/or difficult to access.

MOUNTAIN QUAIL HABITAT STUDY

Principal Investigator: Kerry P. Reese, Ph.D.
Funding Agency: Idaho Department of Fish and Game
Completion Date: 30 June 2005
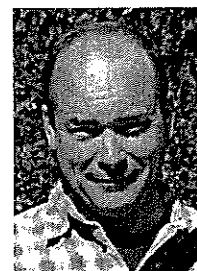

Objectives:
- Identify the distribution and abundance of potentially suitable mountain quail habitat within the Craig Mountain WMA
- Identify potential sites for release of translocated mountain quail
- Use Habitat Suitability protocols to evaluate mountain quail habitats
- Identify logistical constraints and limitations for travel and access during future data future data collection efforts.
- Qualitatively assess the overall feasibility of conducting a comprehensive investigation of translocated mountain quail ecology in the WMA.

Results:
Habitat surveys were conducted and completed at both Craig Mountain Wildlife Management Area and Asotin Creek Wildlife Management Area during summer 2004. Habitat suitability Index (HIS) values (Brennan 1991) were calculated for 379 points in 45 routes in 2004. Route HIS values ranged from 0.06 to 0.99. Many sites appeared suitable for mountain quail. These values were used to prioritize sites for release of translocated mountain quail in 2005. A final report was produced for both Idaho Department of Fish and Game and the Washington Department of Fish and Wildlife. The final report is "Martens, A. 2004. 2004 Mountain Quail habitat surveys Craig Mountain and Asotin Creek Wildlife Management Areas. Idaho Department of Fish and Game and Washington Department of Fish and Wildlife, unpublished report, 13 pages.

JARBRIDGE GREATER SAGE-GROUSE ECOLOGY PROJECT

Principal Investigator: Kerry P. Reese, Ph.D.
Student Investigator: Jay Shepherd
Funding Agency: Idaho Department of Fish and Game
Completion Date: 30 June 2005

Objectives:
The general effects of shrubsteppe fragmentation on greater sage-grouse (*Centrocercus urophasianus*) have been implicated as a cause in range-wide declines, yet have not been studied and are not well understood. Research that has been conducted on greater sage-grouse use of fragmented habitat has not quantified levels of fragmentation. The purpose of this study is to provide land management and wildlife agencies that have jurisdiction over shrubsteppe habitat or greater sage-grouse with a more complete understanding of the effects of natural and man-caused shrubsteppe fragmentation. The objectives are:

- To determine if the landscape metrics for home ranges with various levels of fragmentation explain movement patterns, productivity, and other measures of general habitat use of greater sage-grouse.
- To develop a model that uses vegetation patch characteristics (cover type, size, interspersion, and juxtaposition) and topography (aspect and evaluation), to explain observed nesting and brood-rearing habitat use patterns using remotely sensed vegetation data
- To test this model in an area with known nest and brood-rearing success.

Results:
Graduate student Jay Shepherd has a draft dissertation that will be completed by May 2006.

DETERMINATION OF RECOVERY PLAN POPULATIONS GOALS

Principal Investigator: J. Michael Scott, Ph.D.
Student Investigator: David Stanish
Funding Agency: U.S. Geological Survey
Completion Date: 30 May 2005

Objectives:
- Determine which biological variables are correlated with recovery goals.
- Evaluate relationships between population goals and listed threats
- Assess relationship between recovery goals and ecological role of species

Results:
The purpose of this study was to determine how endangered species recovery teams define recovery. I analyzed 425 recovery plans completed by December 31, 2004, for animal species, subspecies, and distinct population segments. Remarkably, thirty-one percent of the plans provided no reclassification criteria and forty-five percent provided no delisting criteria. Recovery teams pointed primarily to a lack of available information (22% of 425) and the likelihood that the animal was to remain on the list indefinitely (16%). Where defined, recovery was most often described in terms of stability (72% of 235) or of meeting some qualitative threshold (80%), rather than meeting a quantifiable population size goal (35%). Despite the 1988 amendments to the Endangered Species Act mandating "objective measurable criteria," the use of quantitative population size metrics has not appreciably increased in the more recent recovery plans.

DEVELOPMENT OF UNMANNED AIRBORNE VEHICLE FOR MONITORING WILDLIFE

Principal Investigators:	J. Michael Scott, Ph.D., Pete Zager, Ph.D.
Funding Agencies:	U.S. Geological Survey, Idaho Dept. of Fish and Game
Completion Date:	31 December 2004

Objectives:
To determine the feasibility of using drones to survey wildlife at 3 levels of complexity:
- Large-bodied mammals in a simple environments (e.g., pronghorn in shrubsteppe)
- Large-bodied mammals in complex environments (e.g., Elk, bighorn in mountainous terrain with tall trees)
- Specialized applications (e.g., predator tracks in snow, elks in grasslands)

Results:
We co-hosted two symposia with the Florida Cooperative Research Unit on the use of unmanned aircraft for wildlife and fisheries research and managements. The first was held in Gainesville Florida. Fifty people attended to present and listen to twenty papers on the use of unmanned aircraft in fisheries, agriculture and wildlife. Results of a graduate project to monitor manatees and birds were presented and several presentations on ongoing efforts to develop aircraft more suited to wildlife biologists needs. A presentation about legal issues regarding access to airspace was very instructive.

The second symposium was held at the National Meeting of the Wildlife Society attended by 150 people. A group of papers covering topics similar to those heard in Gainesville was presented. A very productive discussion on future efforts was followed by a demonstration of state of the art unmanned aircraft suitable for wildlife research.

BIOLOGICAL DATA INVESTIGATION IN THE UPPER COLUMBIA RIVER BASIN

Principal Investigator:	R. Gerry Wright, Ph.D.
Research Associates:	Lisa Garrett, Tom Rodhouse
Funding Agency:	National Park Service
Completion Date:	1 May 2005

Objectives:
- Complete the compilation of historic data for all species of vascular plants and vertebrates believed to occur in Northern Semi-Arid Lands Network parks from a variety of sources, including park data bases, museum records of voucher specimens, and previous studies, Input this data into the appropriate NPS databases.
- Complete field surveys for the 8 inventories in the network parks with the goal of documenting 90% of all species estimated to occur in each park. Greater emphasis will be placed on inventories of species of special concern to the parks.
- Gather inventory information using a study design that will allow information to be incorporated into a long-term monitor program.

- Develop distribution maps in Geographical Information System format for each species in each park in the Network.

Results:
Inventories for vertebrates and vascular plants were completed for all eight parks in the Upper Columbia River Basin network. Species lists and associated abundance, status, and nativity information were certified by external and internal reviewers. Certified lists were used to populate national level databases of species occurrences. Species range limits were documented in multiple parks.

COORDINATION OF MONITORING PROGRAM FOR THE NORTHERN SEMI-ARID NETWORK AND COMPLETION OF PHASE I REPORT FOR MONITORING

Principal Investigator: R. Gerald Wright, Ph.D.
Government Technical Rep.:   Lisa Garrett
Funding Agency   National Park Service
Completion Date: 1 March 2005

Objectives:
The goal of this project is to coordinate the monitoring program for the Northern Semi-Arid Network for fiscal year 2003 and to cooperatively write Phase I of the monitoring plan for the Northern Semi-Arid Network.

Results:
Internal reviews on monitoring program proposal completed. Reviewers comments incorporated into Phase II monitoring plan. Phase II monitoring plan was submitted to the National Park Office in Washington, D.C. in June.

PEER REVIEWS OF NATIONAL PARK SERVICE MONITORING PLANS

Principal Investigator   R. Gerald Wright, Ph.D.
Funding Agency: National Park Service
Completion Date: 1 September 2005

Objectives:
To obtain peer reviews from academic experts for the first 12 Phase III network monitoring plans produced under the NPS service-wide Inventory and Monitoring Program. There are 32 networks in this program.

Results:
Peer reviews from twelve external academic experts were obtained. Plans were revised based on comments from external and internal reviewers. The reviewers comments and the revised plans were sent to the national office.

LANDSCAPE ANALYSIS OF BLACK BEAR DISTRIBUTION PATTERNS
IN OLYMPIC NATIONAL PARK

Principal Investigator   R. Gerald Wright, Ph.D.
Student Investigator   Kim Sagar
Funding Agency: National Park Service
Completion Date: 30 September 2005

Objectives:
- Evaluate black bear distribution and habitat use in the Elwha River drainage of Olympic NP. This project was designed to gather baseline information on bear distribution prior to the removal of the two old Elwha River Dams that have blocked salmon movement for almost a century.
- Evaluate the feasibility of using GPS-based radio-collars in a mountainous, dense temperate rainforest environment.

Results:
This study has been completed. Kim defended her thesis on March 25, 2005.

During the course of the study we radio-collared and tracked for varying lengths of time 12 black bears, 10 male and 2 female. Bears were captured using snares in coveys and occasionally by direct darting. Females were difficult to catch. We identified 16 categories of tree canopy cover, GPS satellite view, and aspect evaluated the accuracy of GPS data and GPS data collection ability at each using stationary GPS collars placed in each location.

From these data we developed a weighing formula which was applied to every pixel in the park. These weights were applied to raw GPS bear relocation data. We developed seasonal and annual home range maps for each of the collared bears. We evaluated the distance of bears in the fall from the Elwha River (the time of expected salmon spawning activity) to provide a baseline to evaluate future distribution when the dams are removed.

EXPANSION OF MOOSE IN IDAHO

Principal Investigator: R. Gerald Wright, Ph.D.
Funding Agency: U.S. Geological Survey
Completion Date: 30 April 2006

Objectives:
- Gain an understanding of the causes and consequences of the expansion of moose population in Idaho.
- Evaluate the effect of the landscape on movements, survival, reproduction, and populations expansion.
- Contrast movement patterns and demographics of individuals in expanding and stable populations.

Results:
We used radio telemetry to locate moose for investigation of habitat use and to evaluate calf production and survival in the Moscow Mountain. Eleven female moose were fitted with radio collars during March-April 2004, and an additional 5 collars were deployed in April 2005. We located individuals from the ground during May through August ≥ 2 times per week, and recorded ≥ 30 locations per individual per year. Home ranges were estimated for April through September using the fixed-kernel analyses in program SPACE USE.

Resource Selection Functions (RSF) were defined by a "used versus available" design (Manly et al. 2002). We delineated the study area boundary using a composite 99% kernel home range that incorporated all animal locations. We examined habitat selection within the study area (2nd order selection) and within individual home ranges (3rd order selection). To characterize the available resources at the 2nd order of selection, 2,250 random locations were cast within the study area. Availability of resources within home ranges was characterized using 90 random locations within each animal's 99% kernel home range (3 random locations for each observed moose location). We used logistic regression analyses to construct RSF models. Variable selection was completed using an information theoretic approach (AIC), as well as both forward and backward stepwise logistic regression.

We examined the effect of temperature on habitat selection using hourly temperature data derived from a SNOTEL weather station on Moscow Mountain. to estimate temperature at the time of each animal relocation. Using a cumulative logit logistic regression, we evaluated the canopy closure category for each location relative to temperature and presence of a calf.

Sizes of home ranges were similar between 2004 and 2005, although placement differed moderately between years. Mean size of 99% fixed kernel home ranges was 3,542 ha. The large-extent (2nd order selection) RSF model for moose in the Moscow Mountain study area during diurnal periods indicated selection for areas dominated by western red cedar forest, but where timber and shrub cover were mixed. Moose in this area also selected home ranges that were closer to standing water in the form of residential and agricultural ponds and lakes, closer to secondary roads, at higher elevations, closer to riparian areas, and further from human developments than was available at random within the study area. Within the home range (3rd order selection), the RSF model indicated that moose selected for Douglas fir/grand fir and open seral shrub fields with little or no timber overstory. In addition, moose selected areas further from human developments, closer to primary roads, closer to standing water, further from secondary roads, on easterly slopes, and closer to riparian zones.

Temperature significantly affected habitat use by moose during summer. Moose used closed canopy forest types with increasing temperatures ($P = 0.0435$), and females that had produced viable offspring were more likely to be located in closed canopy forest types than female moose without calves ($P = 0.0033$). When temperatures were >30° C we rarely located moose in open habitats, but moose were located in both closed and open canopy types when temperatures were ≤ 25°C.

DIGITAL IMAGE LIBRARY: CHANNEL ISLANDS NATIONAL PARK

Principal Investigator: R. Gerald Wright, Ph.D.
Research Associate: Marilyn Ostergren
Funding Agency: National Park Service
Completion Date: 30 September 2005

Objectives:
- Compile a complete list of all photography and video archives at Channel Islands National Park.
- Document the characteristics of each of these items in the format of the NPS Natural Resources Bibliography.

Results:
A list of all photographs and video material and Channel Islands National Park was placed in Access databases and characteristics, e.g. date, location, photographs documented each photo.

HABITAT USE AND MOOSE BROWSING EFFECTS IN ROCKY MOUNTAIN NATIONAL PARK

Principal Investigator: R. Gerald Wright, Ph.D.
Student Investigators: Jason Dungan, Brad
                               Stumph
Funding Agency: National Park Service
Completion Date: 31 July 2005

Objectives:
- To compile baseline data on moose distribution and a minimum population estimate of moose in the park.
- To develop a habitat classification of areas used by moose in the park that will characterize the structure and composition of the plant communities within those habitats.
- To analyze browse condition and availability and nut nutrient content.
- To ascertain food habits.
- To develop a nutritional based ecological carrying capacity model for moose in the park.

Results:
Brad Stumph M.S. thesis completed and defended on March 11, 2005. All field work completed, Jason expects to defend September 2005.

We have characterized the nutritional status of all six willow species growing in the western portion of the park, and examined this along an elevational gradient from the valley floor to the highest elevations that willow occur in. We calculated the available biomass of each of the willow types within communities in three elevation zones. This data will be incorporated into a carrying capacity model which s the subject of Jason's thesis.

We have conducted three years of field work examining forage consumption of moose by visually observing bytes by time and by species. We have conducted a total of 36 24-hour foraging surveys of male moose by following them and closely observing their foraging activities. We have estimated that there are about 100 moose in the western portion of the park. We did not radio-collar any moose, but did attempt in one summer to mark animals using paint balls. This proved to be unsuccessful due to the short duration of the marks and the occasional behavioral aberrations the impact caused which made it difficult to subsequently follow that moose closely.

HONORS AND AWARDS

J. L. Congleton
   Promotion to Full Professor at University of Idaho

Louise Bruce
   Studies to control New Zealand mudsnails. March 2005. Center for Research on Invasive
      Species and Small Popoulations Scholarship Recipient. Research award $9,000.

Chris James
   The Henry P. Adams Scholarship College of Natural Resources for research focused on
      management of resources at urban and wildland interface.
   Ted Bjornn Graduate Scholarship, Idaho Chapter AFS awarded to fisheries and aquatic science
      students at the University of Idaho who contribute to the fisheries profession and the
      American Fisheries Society.
   The Kelly Creek Fly-casters Scholarship awarded to a fisheries graduate student in the state of
      Idaho with career plans for conserving fisheries resources.

Christine M. Moffitt
   Who's Who in Medicine and Healthcare
   Who's Who in America
   Who's Who of American Women

TECHNICAL ASSISTANCE

J. L. Congleton
   Reviewed manuscripts for two journals and a book chapter.

Chris James
   Presentations to the Idaho Department of Fish and Game and the Nature Conservancy
      December 2004. Progress in research on New Zealand Mudsnails in Silver Creek Idaho.
      Boise, ID.
   Update on July 2005. 2005.

Christine M. Moffitt
   2005-20007 Co-Leader, Task Force on Resistant Microbial Populations. Joint Subcommittee
      for Aquaculture 2005-2006.
   CREES Department of Agriculture SBIR Aquaculture Program Panel Leader, Phase I and
      Phase II Proposals.
   SBIR Phase II reviewer
   Journal Outreach Co-Editor, Journal of Aquatic Animal Health
   CREES Department of Agriculture SBIR Aquaculture Program panel member; one of 6
      panelists. Primary reviewer for six proposals, secondary for six proposals.
   2004-2005. Chair, Technical Advisory Board for Silver Creek Watershed, The Nature
      Conservancy, Hailey, Idaho.
   Potlatch Corporation Community Advisory Board. Acting Chair 2004-2005.
   2004-2006. United States - Israel Bi-national Agricultural Research and Development Fund
      Review Board. Proposal reviewer.

J. Michael Scott
  2005 Member, Ivory Billed Woodpecker Recovery Team
  Member, Hawaii Forest Bird Recovery Team
  Member, The Nature Conservancy Senior Science Council
  Member, Doris Duke Charitable Foundation, Science Advisory Board
  Member, National Wildlife Foundation Wildlife Scholarship Advisory Board, Biosciences and
     Biological Conservation
  Briefing Endangered Species Staff, U.S. Fish and Wildlife Service, Arlington, Virginia, on
     results of Endangered Species Act at Thirty project

FISHERIES PAPERS/POSTERS PRESENTED

Anlauf, K., C. Moffitt, and M. Colvin, 2005. The influence of landscape, stream, and
    microhabitat parameters on tubificid habitat and population abundances. Idaho Chapter
    American Fisheries Society. Boise.

Bruce, L., and C. M. Moffitt, 2005. Survival of New Zealand mudsnails in the gastrointestinal
    tract of rainbow trout. Western Fish Disease Workshop. June 2005. Boise.

Bruce, R. Louise and Christine M. Moffitt, September 2005. Exploring the feasibility of control
    methods for the New Zealand mudnsnail (*Potamopyrgus antipodarum*) at fish hatcheries.
    135th Annual Meeting of the American Fisheries Society; Anchorage, Alaska.

Cajas, L., and C. Moffitt, 2005 Comparison of the environmental, social, and economic factors in
    trout and beef production in Idaho. Forestry 510, May.

Colvin, M., K. Anlauf, C. Moffitt, and K. Johnson, 2005. The ecology of *Myxobolus cerebralis*
    in the Pahsimeroi River drainage, Idaho. Idaho Chapter American Fisheries Society, Boise,
    Idaho.

James, C. and C. M. Moffitt, 2005. New Zealand Mudsnails in Silver Creek Drainage. Idaho
    Chapter American Fisheries Society, Boise. February.

James, C. and C. M. Moffitt, 2005. Winter temperatures and distribution of New Zealand
    mudsnails in Silver Creek and Hagerman Idaho. New Zealand mudsnails in Western U.S.
    Conference. August 16-17. Bozeman, MT.

Moffitt, C. M., 2005. Risk characterization of erythromycin effluents from salmon hatcheries.
    Western Fish Disease Workshop, Boise.

Moffitt, C. M., and M. Colvin, 2005. Profile of the microflora in the hatchery water, the trout and
    New Zealand mudsnails at Hagerman State Fish Hatchery. Western Fish Disease Workshop,
    Boise.

Pinson, A., C. Peery, and J. Congleton. Changes in body composition and energetic costs of the
    spawning migration for spring-summer Chinook salmon of the South Fork Salmon River
    population. Annual Meeting of the Ecological Society of America. August 2-5, 2005,
    Montreal, Canada.

Yanke, J., C. Moffitt, J. Congleton, and W. Connor, 2005. Survival growth and physiology of
    Snake River fall Chinook salmon following chronic temperature stress and application of
    passive integrated transponder (PIT) tags. Idaho Chapter American Fisheries Society, Boise,
    ID.

WILDLIFE PAPERS/POSTERS PRESENTED

Burkepile, N. A., K. P. Reese, and J. W. Connelly, 2005. Problems encountered in studying age-
    related reproductive success: a greater sage-grouse examples. 10th International Grouse
    Symposium, Luchon, France, September.

Dungan, J. and R. G. Wright, 2005. Moose foraging behavior and its relation to carrying capacity in Rocky Mountain NP. Paper to be presented at the annual ALCES meeting, Whitefish, Montana, June 2005.

Garton, E.O., J. W. Connelly, and K. P. Reese, 2005. Estimating the potential for sustainable harvests of greater sage-grouse using a model incorporating density dependent responses to harvest. 10th International Grouse Symposium, Luchon, France, September.

Gokhelashvili, R., A. Gavashelishvili, A. Javakhishvili, D. Tarkhnishvili, L. Azniashvili, K. P. Reese, and C. Anderson, 2005. Caucasian black grouse research, monitoring and conservation management in Georgia. 10th International Grouse Symposium, Luchon, France, September 2004.

Kilpatrick, D., L. Hanauska-Brown, K.P. Reese, and T. Hemker, 2005. An overview of trumpeter swan translocation project in southeastern Idaho during 2001-2005. The Trumpeter Swan Society Meeting, Council Bluffs, Iowa, October 2004.

Stumph, B. and R. G. Wright, 2004. Sexual segregation in moose in willow communities at different elevation zones in Rocky Mountain National Park. Paper presented at annual ALCES meeting, Tordum, New Foundland, June 2004.

Waits, Lisette: Jen Adams - Annual Meeting of Cooperative Red Wolf Breeding Group,

Waits, Lisette: Tacoma, WA, July 2005 (invited) A multifaceted molecular approach to red wolf *(Canis rufus)* conservation and management

Waits, Lisette: Jen Adams - Wildlife Society Meeting, Madison, WI, September 2005, Evaluating the use of fecal DNA genotyping and GIS to locate hybrid individuals in the red wolf *(Canis rufus)* population

Waits, Lisette: Jen Adams - Hamline University Biology Department, St. Paul, MN, September 2005 (invited), The role of conservation genetics in the recovery of the endangered red wolf *(Canis rufus)*

Waits, Lisette: Jen Adams Wildlife Science Center, Forest Lake, MN, October 2005 (invited), The role of conservation genetics in the recovery of the endangered red wolf *(Canis rufus)*

Waits, Lisette, Utah State University, February 2005 (invited), Achieving science driven recovery planning for endangered species

INVITED PRESENTATIONS

Bruce, R. Louise and Christine M. Moffitt, November 2005. Exploring the feasibility of control methods for the New Zealand mudsnail *(Potamopyrgus antipodarum)* at fish hatcheries. USFWS Hatchery Management Workshop; Richland, Washington. Invited presentation

J. L. Congleton. "Delayed effects of hydrosystem passage on smolt viability." Invited presentation to Independent Scientific Advisory Board at Flow Survival Symposium, Northwest Power and Conservation Council, Portland, OR, November 9-10, 2004.

Moffitt, C. M., and L. R. Bruce, 2005. Survival of New Zealand Mudsnails in the gastrointestinal tract of rainbow trout. New Zealand mudsnails in Western US. Conference, Bozeman, Montana August 16-17

Moffitt, C. M., 2005. Erythromycin to control bacterial kidney disease in salmon. Risk and Use Characterization for Idaho, Oregon and Washington. INAD Workshop, Bozeman, Montana, 1-4 August.

Moffitt, C. M., L.R. Bruce, and C. James, 2005. Progress, objectives and rationale of control strategies for New Zealand mudsnails in hatcheries and in Silver Creek, Idaho. New Zealand Musnails and Aquatic Nuisance Species Biologist Workshop, Denver, Colorado, April.

J.M. Scott, "Endangered Species Act at 30: Renewing the Conservation Promise." Practical Paths Workshop. October 2004 Idaho Association of Commerce and Industry, Boise, Idaho

J.M. Scott, "America's Conservation Landscape 2076; Where, What, Who"

J.M. Scott, Natural Areas Association Conference. Chicago, IL., October 2004.

J.M. Scott, "Ecological Content and Context of America's National Wildlife Refuge Systems." National Wildlife Refuge Association. New Hampshire, October 2004.

J.M. Scott, "Endangered Species Act at 30: Renewing the Conservation Commitment." Presentation made to director and staff of the Idaho Office of Species Conservation. Boise, Idaho, October 2004.

J.M. Scott, "America's Future Landscape: Where will it be, what will it contain, who will make it happen". National Congress of Natural Areas Protection in Mexico, Monterrey, Mexico, November 2004.

J.M. Scott, Environmental Science 101 University of Idaho, May 25, 2005. "The Endangered Species Act at 30: Renewing The Conservation Promise"

J.M. Scott, U.S. Department of Defense Symposium "Endangered Species on Military and Adjacent Lands," June 7, 2005, Baltimore, Maryland. "The Endangered Species Act at 30: Conserving Biodiversity In Human dominated Landscapes"

J.M. Scott, "America's Conservation Landscape 2076: Where, What, Who?" USDA Forest Service Centennial Forum, November 2004, Missoula, Montana.

J.M. Scott, "Endangered Species Act at 30: Renewing the Conservation Commitment." National HCP, SHA, CCAA Workshop, November 2004, Cleveland, Ohio

J.M. Scott, U.S. House and Senate Staffers. "The Endangered Species Act At 30: Renewing The Conservation Commitment," December 2004, Washington D.C.

J.M. Scott, "Endangered Species Act at 30: Lessons and Prospects," U.S. Fish and Wildlife Service, Regional Office, Portland, Oregon, December 2004.

J.M. Scott, panel, Idaho Sage-grouse Science Panel. Idaho Department of Fish and Game. February 2005, Boise, Idaho

J.M. Scott, "Conservation Landscape 2076: Where, What, Who?" Kootenai County, Coeur d'Alene Chamber Series, Coeur d'Alene, Idaho, February 2005.

J.M. Scott, Chaired Panel on "Advocacy in Science" All Hands Meeting, Sarasota, FL, February 2005.

J.M. Scott, "America's Conservation Landscape 2076: Where, What, Who?" George Wright Society, Philadelphia, PA, March 2005.

J.M. Scott, Ornithology, University of Idaho Department of Fish and Wildlife, "Endangered Species Act at 30; Renewing The Conservation Commitment," April, 2005.

J.M. Scott, Environmental Science Landscape Ecology Course: "America's Conservation Landscape 2076; What, Where, Who?" April 2005.

J.M. Scott, Remote Sensing Class, Department of Forestry University of Idaho, "Using Remotely Derived Data Sets To Map America's Conservation Landscape: A Hierarchical Approach," April 2005.

J.M. Scott, "The Endangered Species Act at 30: Renewing the Conservation Promise," Congressional Course, Harvard University, March 2005.

J.M. Scott, "The Endangered Species Act at 30: Renewing the Conservation Promise." Environmental Law Institute and the American Bar Association, Washington D.C., April 7 2005.

J.M. Scott. "Research Careers with the U.S. Geological Survey," The Nature Conservancy post doctoral fellows program, Providence, RI, April 2005.

J.M. Scott. Environmental Science 101 "Endangered Species Act @30: Renewing The Conservation Promise," May 25 2005, University of Idaho.

REPORTS

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Holden, Z. A., P. Morgan, and R. G. Wright. 2006. Ponderosa pine snag densities following multiple fires in the Gila Wilderness, New Mexico. Forest Ecology and Management 221:140-146.

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Kock, T. and J. L. Congleton. 2004. Effects of sedimentation and water velocity on white sturgeon embryo survival. Final Report to Kootenai Tribe of Idaho. 57 pp. (October 2005).

Moffitt, C. M. 2005. Evaluating the safety of administration of erythromycin feed additive for salmonids on bacteria of human health concern, qualitative risk assessment: Hazard identification and characterization release assessment; exposure assessment; consequence assessment;and overall risk estimate. 4 Books.

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Wright, Gerry: Stumph, B. 2005. Moose-willow foraging ecology in Rocky Mountain National Park. MS Thesis, University of Idaho.

PEER REVIEWED PUBLICATIONS

Adams, J., L. Waits, (submitted) Genetic monitoring of the endangered red wolf *(Canis rufus)* population using fecal DNA genotyping. *Conservation Genetics,*

Beck, J.L., K.P. Reese, P. Zager, and P.E. Heekin. 2005. Simultaneous multiple clutches and female breeding success in mountain quail. Condor 107:889-897.

Jones, D. and C. M. Moffitt. 2004. Swimming endurance of bull trout, lake trout, arctic char, and rainbow trout following challenge with *Renibacterium salmoninarum.* Journal of Aquatic Animal Health 16: 10-22.

Karl, J. W., J.M. Scott and E. Strand, 2005. An assessment of Idaho's Wildlife Management Areas for the Protection of Wildlife. Natural Areas Journal 25:36-45.

Moffitt, C. M., A. H. Haukenes, and C. J. Williams. 2004. Evaluating and understanding fish health risks and their consequences in propagated and free-ranging fish populations. American Fisheries Society Symposium 44:529-537.

Rachlow, J.L. and L.K. Svancara. (*in press*) A modeling approach for surveying for rare mammals: prioritizing habitat for pygmy rabbit surveys. Journal of Mammalogy.

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Scott, J.M. and J. Schipper, 2005. Gap analysis: a spatial tool for conservation Planning. Pager 518-519 in Principles of Conservation Biology(3rd edition). M.J. Groom, G.K. Meffe, C.R. Carroll and contributors. Sinauer Sunderland Massachusetts

Scott, J.M. and D.D. Goble, 2005. A database for the ESA. Bioscience 55:299.

Scott, J.M., T. Loveland, K. Gergely, J. Strittholt and N. Staus, 2005. Natural Resources Journal 44: 1041-1066.

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Svancara, L.K. G. Servheen, W. Melquist, D. Davis and J.M. Scott, 2004. Habitat restoration across large areas: assessing wildlife responses in the Clearwater Basin, Idaho. Western Journal of Forestry Applications 19: 123-132

Waits, L. P. and D. Paetkau (in press, invited review) New non-invasive genetic sampling tools for wildife biologists: a review of applications and recommendations for accurate data collection. Journal of Wildlife Management.

Williams, C. J., and C. M. Moffitt. 2005. Estimation of prevalence of pathogens in pooled samples using maximum likelihood methods and open source software. Journal of Aquatic Animal Health.

Zabel, R., T. Wagner, J. L. Congleton, S. G. Smith, and J. G. Williams. 2005. Survival and selection of migrating salmon from capture-recapture models with individual traits. Ecological Applications 15 (4):1427-1439.

BOOKS AND BOOK CHAPTERS

Mills, L.S., J.M. Scott, K.M. Stickler and S. Temple, 2005. Ecology and management of small populations. Pages in C.E. Braun editor Techniques for Wildlife Investigations. Braun , C.E. editor 691-713.

Waits, L. P. (in press) Microsatellite DNA genotyping identifies killer bear and cubs in ed. F. Allendorf and G. Luikart Conservation genetics textbook (this is a case study example box in the textbook)

NON-PEER REVIEWED PUBLICATIONS

Moffitt, C. M. 2005. Environmental, economic and social aspects of animal protein production and the opportunities for aquaculture. Fisheries 30(9):36-38.

THESES AND DISSERTATIONS
J. L. Congleton
Pinson, A. Energy reserves and survival of adult summer chinook salmon migrating through the Snake-Columbia River hydropower system. M.S. thesis. May, 2005.

Christine M. Moffitt
Yanke, Jeffrey, A. 2005. Effects of passive integrated transponder (PIT) tags and elevated water temperatures on survival, growth and physiology of Snake River fall Chinook salmon subyearing (Oncorhynchus tshawytscha). MS. Thesis, Fisheries Resources. Advisor. Christine M. Moffitt
Colvin, M. 2005. Ecology of Myxobolus cerebralis in the Pahsimeroi River drainage, Idaho. Master's Thesis, Fisheries Resources. Advisor. Christine M. Moffitt
Anlauf, K. J. 2005. Understanding the ecology of whirling disease through modeling of the Tubificid host. Master's Thesis. Fishery Resources. Advisor. Christine M. Moffitt

Wright, Gerry
Sagar, K. 2005. Black bear distribution patterns in a temperate forest environment, Olympic National Park. M.S. Thesis, University of Idaho, Moscow.

OUTREACH EDUCATION
J. L. Congleton
Initiated and maintain the Environmental News Bulletin Board in the College of Natural Resources.

Christine M. Moffitt
2005 University of Idaho Hoist Program, Helping Orient Indian Students to Sciences- Mentor for 6-week summer intern.

VOLUNTEER ACTIVITIES AND PROFESSIONAL SOCIETY
Louise Bruce
American Fisheries Society – Palouse Unit Vice-President, August 2005 – Present

John Cassinelli
Member, Palouse Unit of the Idaho Chapter of American Fisheries Society
St. Joe River redd surveys, August 2005
Free fishing day volunteer, assisted kids while fishing at a community pond in Eagle, Idaho

Chris James
Member and president of the Palouse Unit of the Idaho Chapter of the American Fisheries Society. Activities included Kids Free Fishing Day, Bull Trout Redd Surveys, Paradise Creek Clean-up, fly fishing lessons to local youth, handmade a fishing rod for auction at the Palouse Units Annual Wild Game Feed fundraiser.

Christine M. Moffitt
Faculty Advisor to the Palouse Unit of the Idaho Chapter of the American Fisheries Society
Member at large, University of Idaho Athena Board

Member Steering Committee "Challenges for Diadromous fishers in a Dynamic Global
   Environment." 2005 to 2007
President Elect, Fisheries History Section, 2004-2006
Chair, Award of Excellence Committee, 2002-2005
Multimedia Presentations for American Fisheries Society, 2005. Plenary Awards Presentation
   and Posters, American Fisheries Society. Business meeting Awards Presentations and
   Posters, American Fisheries Society 135th Annual meeting, Anchorage, AK. September

J. Michael Scott
Member, Board of Directors, American Institute of Biological Sciences
Chair, Awards Committee of the Natural Areas Association
Chair, LaRoe Award subcommittee Society for Conservation Biology
Member, Publications Committee, Society for Conservation Biology
Co-chair, Frank Church Wilderness Area, Symposium Committee, University of Idaho, College
   of Natural Resources
Member, Policy Committee, American Institute of Biological Sciences