

*My Copy for May '08 Report*

**Idaho Cooperative Fish and Wildlife  
Research Unit**

**Annual Report**

**Fiscal Year 2006**



# ANNUAL REPORT

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**1 October 2005 — 30 September 2006**

*1 October 2006 — 30 September 2007*

## **IDAHO COOPERATIVE FISH AND WILDLIFE RESEARCH UNIT**

6<sup>TH</sup> AND LINE STREETS  
DEPARTMENT OF FISH AND WILDLIFE SERVICE  
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IDAHO DEPARTMENT OF FISH AND GAME  
UNIVERSITY OF IDAHO  
WILDLIFE MANAGEMENT INSTITUTE  
U.S. FISH AND WILDLIFE SERVICE**

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## ***Introduction***

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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 was established in 1937. 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 program was moved into the National Biological Survey established by a Secretarial Order under the FY 1994 Interior Appropriations Act. 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 the fish and wildlife resources of Idaho, the Pacific Northwest, and the nation. Special areas of focus include studies of anadromous fish passage in the Snake River basin, development and evaluation of methods to enhance fish health of hatchery reared fish, evaluating 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, develop methods to



prevent species from becoming threatened or endangered, and evaluate factors that regulate carrying capacity in fresh water and terrestrial habitats.

### **Unit Scientists, 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.

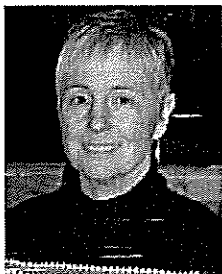
Unit research is supported by state contributions and by contracts from the U.S.G.S.-Biological Resources Division, U.S. Fish and Wildlife Service, U.S. Army Corps of Engineers, U.S. Forest Service, Bonneville Power Administration, Northwest Power Planning Council, and other federal, state, and private 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. JLC provided guest lectures in various classes; and workshops.



**Christine M. Moffitt, Ph.D.** – Assistant Unit Leader and Professor of Fishery Resources. Recent research activities include: 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; studies of the efficacy, risks, approval and regulation of aquaculture chemicals, sustainable aquaculture, and fisheries history. Specialty Courses: FISH 510, Advanced Fisheries Management; FISH/WLF 501, Graduate Seminar, and guest lectures in various classes.



## **Idaho Cooperative Fish and Wildlife Research Unit**

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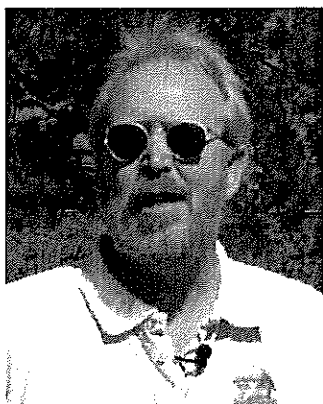
Washington, DC 20036

## Department of Fish and Wildlife Faculty & Emeriti and Other Faculty Cooperators with Unit Projects in FY 2006

*\* Indicates Unit Project in 2006*

Ernest Ables, Emeritus Professor  
Cort Anderson, Research Assistant  
Professor  
David H. Bennett, Emeritus Professor  
Ernest Brannon, Emeritus Professor  
Kenneth Cain, Assistant Professor  
Brian Dennis, Professor  
Michael Falter, Emeritus Professor  
\*E. O. (Oz) Garton, Professor  
\*Dale Goble, Professor of Law  
\*Brian Kennedy, Assistant Professor  
George LaBar, Emeritus Professor  
\*Kirk Lohman, Affiliate Associate  
Professor  
James Peek, Emeritus Professor

\*Christopher Peery, Research Assistant  
Professor  
\*Madison "Matt" Powell, Adjunct  
Assistant Professor  
\*Wayne Melquist, Ph.D. – Wildlife  
Resources  
\*Janet Rachlow, Assistant Professor  
\*John Ratti, Emeritus Professor  
\*Kerry Paul Reese, Professor and  
Department Head  
\*Dennis Scarnecchia, Professor  
\*Kerri Vierling, Assistant Professor  
Lee Vierling, Assistant Professor  
\*Lisette P. Waits, Associate Professor  
\*R. Gerald Wright, Emeritus Professor



In Memorium  
Jeffrey H. Braatne  
Associate Professor  
1956-2006

Dr. Jeff Braatne passed away in October 2006. His research project with the Coop Unit: *his graduate students and associates are completing Baseline Monitoring of Floodplain Vegetation.* see page 53. A memorial fund for students has been established, contact CNR Dean's Office staff.

### Post-Doctoral Associates on Unit Projects

Aaron Haines, Ph.D., Wildlife Resources  
 Jon Horne, Ph.D., Wildlife Resources  
 Mazeika Sullivan, Ph.D. Fish and Wildlife Resources

### Graduate Students of Unit Staff

Student	Discipline	Adviser
Emmi Blades	M.S. Environmental Science	J.M. Scott — graduated 5/07
Peter Bloom	Ph.D. Wildlife Resources	J.M. Scott
Rolita Louise Bruce	M.S. Fishery Resources	C.M. Moffitt — graduated
John Cassinelli	M.S. Fishery Resources	C.M. Moffitt
Lubia Cajas Cano	M.S. Environmental Science	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
Jordan Nielson	M.S. Fishery Resources	C.M. Moffitt
Anna Pidgorna	Ph.D. Environmental Science	J.M. Scott — graduated 5/07
Amy Pinson	M.S. Fishery Resources	J.L. Congleton/C. 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

### Graduate Students on Unit Affiliated Projects

Student	Discipline	Adviser
Jen Adams	Ph.D. Wildlife Resources	L.P. Waits
Chris Anderson	M.S. Fishery Resources	C.A. Peery
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
Rita Dixon	Ph.D. Wildlife Resources	E.O. Garton
Trevor Fox	M.S. — Wildlife Resources	J. Ratti

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
Tim Kiser	M.S. Fishery Resources	B. Kennedy
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
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
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 Staff on Unit Affiliated Projects**

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

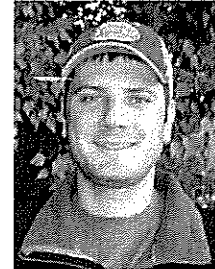
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Karla Makus  
Linda Kisha  
Cheryl Chambers

## *Current Research – Fisheries Resources*

### EFFECTS OF ARSENIC FROM MINE WASTES ON BULL TROUT

Principal Investigator: Brian Kennedy, Ph.D.  
Graduate Research Assistant: Tim Kiser  
Funding Agency: U.S. Fish & Wildlife Service  
Completion Date: 30 September 2008



#### Objectives:

- Determine the extent and spatial variability of Arsenic (As) contamination in sediments below the Lakeview Mine and throughout Gold Creek drainage.
- Determine the bioaccumulation factors that relate the concentration of As in sediment to As in benthic macro invertebrates and resident salmonids.
- Determine benthic macro invertebrate diversity and abundance relative to spatial variability of sediment As concentrations.
- Determine the seasonal use patterns of juvenile bull trout in Gold Creek and West Gold Creek and relate to sediment As loads and habitat variables (e.g. productivity).
- Determine the extent of As-related toxicity in juvenile bull trout residing in Gold Creek and West Gold Creek by analyzing tissue residues and conducting histological investigations.

#### Background:

Arsenic (As) is a contaminant of concern in the Inland Northwest. Arsenic can be found at relatively high concentrations in soils and sediment at mine sites in Washington and Idaho. Lakeview Mine is located on the southeast end of Lake Pend Oreille in northern Idaho. The mine and mine wastes are located in Chloride Gulch which flows into Gold creek, then into the lake. The Gold Creek drainage is the second most productive bull trout spawning and rearing area in the lake basin. This stream contains high numbers of juvenile bull trout with relatively low numbers of other salmonid species. Mine-related toxicity may be the cause, or a contributing factor, to the lack of use of Gold Creek above the confluence with West Gold Creek by juvenile bull trout. Furthermore, As may be adversely-affecting those juvenile bull trout that are present in the system, potentially reducing their long-term survival.

Progress: Funding began in Summer 2006 at which time a graduate student was brought on for field work. An intensive field effort in 2006 resulted in the collection of sediment, macroinvertebrate, and fish samples as well as extensive habitat measurements throughout the drainage. Efforts focused on five sites throughout the drainage that varied with respect to their distance to mine effects and presumed sediment As concentrations. The graduate student, Tim Kiser, has been working hard to process fish samples for histological analysis

## CURRENT PROJECTS – FISHERIES AND AQUATIC RESOURCES

and processing macroinvertebrate samples. Tim has also had a full load of classes in the past academic year. Plans for the 2007 summer field effort are underway.

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

GFK819

ongoing

Principal Investigator:

Christine M. Moffitt, Ph.D.

Student Investigators:

~~Rolita Louise Bruce~~

Jordan Nielson

Funding Agency:

U.S. Geological Survey,  
Special Scientific Support  
Project

Completion Date:

30 September 2007



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#### Objectives:

- Pursue water system treatments or barriers that can successfully filter out invading snails.
- Determine if there are chemical treatments that would be lethal to New Zealand mudsnails, and harm fish, that would be given to fish prior to stocking to eliminate survival of snails in the fish gut.
- 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 a New Zealand mudsnail project funded by the U.S. Fish and Wildlife Service, and thus provides a collaboration of FWS with Unit scientists and students. Graduate student L. Bruce was funded as a SCEP student through the FWS, region 1, and has now taken a job with the FWS in Washington. A new graduate student, Jordan Nielson, is moving forward with studies of hydrocyclone separation techniques.

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 are 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 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 remove all live snails from the gut, depurating fish, before planting so that fish 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 continue 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.

#### **ASSESSING THE POTENTIAL FOR ENVIRONMENTALLY FRIENDLY AQUACULTURE IN GUATEMALA.**

Major Professor:	Christine M. Moffitt, Ph.D.
Funding Agency:	Ford Foundation and Environmental Science
Student Investigator	Lubia Cajas Cano
Completion Date:	30 August 2009

*ongoing*



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#### **Objectives:**

- Identify potential social opportunities and obstacles that may affect aquaculture development in Guatemala.
- Identify the likely habitats and determine a suite of suitable species for aquaculture development for Guatemala.
- Provide a set of guidelines and management practices that will help regulators and decision makers to consider and minimize the negative footprints of aquaculture production so as to protect the environment for future generations.

**Progress:** This project has just begun as Lubia Cajas Cano has remained at the University of Idaho following completion of her Master's degree in August. The goals of the project are being developed. She was provided initial funding through the Ford Foundation, and we will seek additional support from a variety of sources such as the World Wildlife Fund, and Department of Agriculture, and others interested in developing environmentally and socially responsible aquaculture production for Guatemala. The vision of the project is to



10/1/06 to 9/30/07

## CURRENT PROJECTS – FISHERIES AND AQUATIC RESOURCES

develop a set of guidelines and model approaches that can be used to evaluate the aquatic resources of Guatemala and other developing countries and their potential for aquaculture.

ongoing

### EFFECTS OF WATER TEMPERATURE ON GROWTH AND PHYSIOLOGY OF REDBAND TROUT

Completed GFK7/2  
12/07

Principal Investigator: Christine M. Moffitt, Ph.D.  
Student Investigator: John Cassinelli  
Technical 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:

Redband trout (*Oncorhynchus mykiss gairdneri*) in the Columbia River Basin occupy a range of habitat from high elevation mountain streams with high flows and cool temperatures to low elevation desert streams with little flow and warm summer temperatures. We have begun a laboratory study to evaluate the physiology and growth of selected wild populations exposed to simulated desert or montane daily water temperatures to test whether redband trout from a desert stream have evolved to survive and flourish in higher water temperatures. In 2006, sexually mature male and female redband trout were collected in March and April from two desert streams (Shoofly and Jump Creeks), one montane stream (Keithly Creek), and one hatchery source (Hayspur Hatchery, Idaho Department of Fish and Game). These wild stocks were chosen because there were no records that these drainages had been stocked with hatchery rainbow trout. Eggs and milt were collected from fish in the field, placed into separate plastic bags, and charged with oxygen. These gametes were transported on ice to the University of Idaho fisheries wet laboratory by commercial airplane, and on arrival, gametes from each location were combined into single parent crosses using a matrix mating process to maximize variation. Fertilized eggs were water hardened in 100 ppm iodophor, and transferred to Heath incubators and reared to hatching. After hatching, the alvins of each stock were enumerated and transferred to troughs and fed a commercial starter trout diet. Stocks were roughly standardized to the same size and degree-days by manipulating the water temperatures (~930).

Tests were designed to test fish from each stock in simulated desert or simulated montane temperatures. Equal sized groups of fish from each stocks were placed into circular rearing tanks (2 tanks per stock, per temperature treatment) in the fisheries wet lab. Water provided to each tank was single pass dechlorinated well water, heated or cooled to the appropriate test temperature. Temperatures cycled each day to simulate a desert (18 – 26°C) or montane (9 – 16°C) environment. Fish were exposed to these daily cycles for 35 d. Water temperatures were recorded throughout the trial with Hobo data loggers at 15 minute intervals. Fish were monitored daily, and fish from each tank were removed and sampled before, during and at the end of the 35 d trials. Metrics evaluated included fish length and weight to evaluate growth, survival, and feed efficiency. Blood was sampled and plasma separated for analysis of plasma cortisol. We removed livers and muscle samples from fish for analysis of heat shock proteins (hsp-70). Whole fish were analyzed for proximate analyses.

Little mortality occurred in any of the test groups. The Hayspur stock of fish showed rapid growth and highest feed efficiencies. Among the wild fish stocks, Jump Creek fish had higher daily growth and higher feed efficiency followed by Keithly and Shoofly. Hayspur fish grew more than 0.8 mm per day, with the highest growth in the desert temperature regime. For all three wild stocks, growth rates were generally higher in the montane regime than the desert regime. Feed efficiency for Hayspur, Jump and Keithly stocks was higher for montane regime, but fish from Shoofly Creek were most inefficient in both water temperatures. Heat shock protein 70 (hsp70) levels were higher in fish from the desert treatments in both muscle and liver tissues. Within the muscle, levels of hsp 70 varied more among treatments for the two desert stocks (Figure 8). This was also true for liver tissue, but there was also a large separation of hsp 70 levels between treatments for the Keithly stock. Blood cortisol did not differ among treatments and groups, and levels for all groups were low (<30ng/mL for all tanks).

Work planned for 2007 will include repeating the laboratory trials with similar wild stocks collected from the field locations, and adding an additional montane stock. We may also pursue locating an additional desert stock, as there is some indication of hatchery genetic introgression in the Jump Creek stock.

*ongoing*  
**FILTRATION STRATEGIES TO REMOVE NEW ZEALAND MUD SNAILS AT FISH HATCHERIES**

*GCK819*

Principal Investigator: Christine M. Moffitt, Ph.D.  
Collaborating Investigator: Barnaby J. Watten, Ph.D.  
Student Investigators: Jordan Nielson  
Undergraduate Interns: Katie Teater, Shawn Howard  
Funding Agency: U.S. Fish and Wildlife Service  
Completion Date: 30 September 2007



**Objectives:**

- Pursue water filtration systems or barriers that can successfully filter out invading snails.
- Determine if CO<sub>2</sub> treatments can be lethal to NZMS, and feasible for killing snails in a fish culture operation.

**Progress:** This project is linked to a project funded by the USGS Science Support Partnership Program. The project provides a collaboration of USFWS, Unit scientists and students, and USGS Leetown Science Center Scientists. A new graduate student, Jordan Nielson, joined the project in May 2006, and we began active collaborations with Dr. Barnaby J. Watten of the Leetown Science Center.

Infestations of NZMS at fish hatcheries limit or restrict the options for stocking hatchery-reared fish because of the risks of spreading snails to uninfested locations. Development of reliable and environmentally friendly methods that remove NZMS from source waters would be helpful to hatchery managers by creating an environment for snail-free fish production and/or transportation. We are evaluating a two-step control method for the piped spring water supply of the Hagerman National Fish Hatchery in Idaho (USA). We are testing the efficacy of hydrocyclonic separation of NZMS, followed by carbonation of the hydrocyclone waste (snail) stream. Our analysis of NZMS particle size distributions, combined with proprietary simulation tools (Krebs Engineering, Tucson Arizona), suggest that hydrocyclonic separation of NZMS will be complete. Testing of hydrocyclonic separation will be completed during the summer of 2007. Recent tests have demonstrated that aquatic species are generally intolerant to forced increases in dissolved carbon dioxide concentrations (DC) given its effect on water, blood, and hemolymph pH. These species are also sensitive to elevated total dissolved gas pressures. The gas bubble trauma that develops following exposure can, as with elevated DC exposure, cause mortality. We are exploiting this sensitivity in NZMS under both atmospheric and hyperbaric pressure conditions. Testing of NZMS at 100 kPa CO<sub>2</sub> and 15°C has been completed for the reproductive stage of snails (>2.5mm). A probit model of survival predicts the 100% lethal time of exposure at 9.6 h for 15°C. Testing is continuing at 8°C and 20°C for representatives of at least three sizes of snails to determine NZMS sensitivity under elevated DC conditions. Preliminary results indicate an inverse relationship between temperature during elevated DC exposure and survival. To determine whether altered pH of test water affects survival, we are evaluating the effects of a range of pH from 2 to 12. When water is saturated with CO<sub>2</sub> the pH can drop to approximately 5. Our results

indicate that these pH shifts have little effect on the survival of NZMS. If successful, we propose that CO<sub>2</sub> can be used to disinfect tanks, and as a treatment method to kill snails in a waste stream from a hydrocyclone. The hydrocyclone will be tested in intake waters of Hagerman National Fish Hatchery in 2007.

10/1/06 to 9/30/07 completed  
**INFRASTRUCTURE TO COMPLETE FDA REGISTRATION OF ERYTHROMYCIN** GFK934

Principal Investigator: Christine M. Moffitt, Ph.D.  
Funding Agency: DOE – BPA (LSRCP)  
Completion Date: 30 September 2007

9/30/07

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Objectives:

- Keep an active dialog with Food and Drug Administration (FDA) to resolve any outstanding issues during their review of submission, and 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 form more than 10 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, and Human Safety from Resistant Microorganisms 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. Outstanding issues of environmental safety were addressed with submission of a risk assessment document following the CVM guidance as an Environmental Impact Assessment, Phase I, using Guidance Document 89. This document was reviewed and the CVM determined that a further Environmental Assessment Phase II needed to be completed. This document is in preparation with assistance of a consultant. Bimeda Animal Health is preparing to submit data to support a manufacturing claim for this drug. The passage of the MUMS legislation for Minor Use Minor Species drug approval requirements led to this decision by Bimeda, as this legislative act allows a longer exclusivity arrangement and other advantages for drug companies to sponsor products with minor use. We hope to complete the requirements for this approval in the coming year.

**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
Completion Date:	28 February 2007

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**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 priced and scaled for the lower Elwha River, estuary and shallow nearshore areas.
- Develop Geographical Information Systems tools that will organize the Tribe's current and expanding spatial data (GIS) collection into appropriate themes, scales, 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 by the Tribe.

**Progress:**

Initial training of Tribal researchers was conducted on uses of acoustic telemetry to assess residence times and habitat use by juvenile coho salmon in the Elwha River estuary and nearshore. Funds were also used to purchase habitat survey equipment and for training in use of habitat survey equipment. A comprehensive website to house and serve critical ecological, social and cultural information on the Elwha River and Lower Elwha Klamath Tribe is underway. A full-scale telemetry evaluation with juvenile salmon was conducted spring 2006. A workshop on mapping riparian vegetation was also conducted in March 2006. An extensive website containing ongoing research, socio-economic analysis of dam removal and archival databases is currently being developed.

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

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

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**Objectives:**

- Deploy a set of two acoustic transmitting devices and hydrophones 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-series 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.
- Use a randomized block design with and without modified entrance dates in place 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 currently being conducted.

**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

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**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  $\pm 15\%$  of the true value 95% of the time.
- Evaluate effectiveness of instream PIT tag interrogators to determine tributary exit rates for adult fall Chinook salmon marked in the Deschutes River for escapement estimation program.

Progress:

## CURRENT PROJECTS – FISHERIES AND AQUATIC RESOURCES

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

### **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



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#### **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.

### **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: June 2007

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#### **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 will be completed in June 2007.



**EVALUATE FACTORS LIMITING MIGRATION SUCCESS AND SPAWNING  
DISTRIBUTION OF ADULT PACIFIC LAMPREY IN THE SNAKE RIVER**

Project Investigator: Dr. Chris Peery  
Student Investigator: Brian McIlraith  
Funding Agency: USFWS  
Closing Date: 31 October 2008

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**Objectives:**

- Evaluate passage of adult lamprey at McNary and four lower Snake River dams and identify areas and factors affecting passage success using radio telemetry.
- Determine final fates, distribution and preferred spawning habitat of adult lamprey migrating in the Snake River upstream from Lower Granite Dam.

**Progress:** Fifty adult lamprey were collected at two dams on the lower Snake River, outfitted with radio transmitters and released upstream of Lower Granite Dam, the last dam fish must pass prior to reaching historical spawning areas in the upper Snake River. There fish were monitored through the winter and early spring using combination of fixed-receiver sites and mobile tracking by boat and truck. To date (about end of battery life of transmitters) 30 fish had been documented in areas that represent potential spawning habitat in the Clearwater and Salmon rivers. Future efforts include tracking transplanted adult lamprey, released into headwater streams, to evaluate this method to boost spawning populations, monitor fir juveniles in these same streams, and tagging a second batch of migrant fish in the coming fall.

**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



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**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:**

## CURRENT PROJECTS – FISHERIES AND AQUATIC RESOURCES

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.

### **LOWER METHOD FISHERIES POPULATION GENETIC ANALYSIS**

Principal Investigator:	Madison Powell, PhD
Student Investigator:	Dana Weigel
Key Technical Staff:	Joyce Faler
Funding Agency:	U. S. Bureau of Reclamation Pacific Northwest Region
Completion Date:	1 December 2008



**Project Objectives:** The purpose of this investigation is to provide fisheries population genetic data to: 1) assess the effects of parentage and hatchery fish on naturally spawned endangered fish in the Methow basin; and 2) compare population genetics and life history information across steelhead and Chinook salmon populations in Beaver, Libby and Gold creeks. These data will be analyzed to quantify the effects of passage barrier removal on salmon and steelhead population parameters (such as growth, survival, etc), life history strategies, and the effects of hatchery fish on naturally spawned populations in the basin.

#### **Results Report:**

Tissue samples were collected by project cooperators from juvenile steelhead rearing in Beaver, Libby and Gold creeks during 2004 and 2005. In addition, tissue samples from migrating adult and juvenile steelhead were collected in upstream-downstream weir during 2005. These samples were delivered to the University of Idaho, Aquaculture Research Institute lab. DNA was extracted from these samples and they are currently being analyzed with 13 standardized microsatellite markers.

Photo 1. Upstream-downstream weir located on Beaver Creek, tributary to the Methow River near Twisp, WA. Migrating steelhead and other non-target fish for a barrier removal study are collected at the weir.



## ***Completed Projects – Fisheries Resources***

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

Principal Investigator:	James L. Congleton, Ph.D.
Student Investigators:	Lorrie Haley, Tom Welker, Derek Fryer
Funding Agency:	U.S. Army Corps of Engineers
Completion Date:	December 2005

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#### **Objectives:**

- Sample spring Chinook salmon smolts 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 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.

#### **Results:**

Juvenile Chinook salmon reared at three hatcheries in the Snake River Basin (Dworshak, Rapid River, and McCall) were sampled from dam juvenile-fish bypasses as they entered and left the Snake-Columbia River hydropower system in the years 2000-2003. Body lipid and protein masses were determined and the use of these energy reserves by the fish was estimated. Lipid reserves were depleted to about 0.8% body mass in fish exiting the hydropower system in all years. Protein reserves (on a length-standardized basis) decreased as migration duration increased, and were reduced during hydropower system passage by 12% in 2000 (a high-flow year) to 22% in 2001 (a low-flow year). 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) declined as the fish migrated from Lower Granite Dam to Bonneville Dam, indicating that the activities of key metabolic enzymes were reduced by the energy deficit-induced breakdown of body proteins. 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

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work of D. Fryer), and decreases in osmoregulatory ability were observed in 1999, 2000, and 2001 (thesis work of L. Haley). Changes were also observed in lipid oxidative stress indices and vitamin E reserves (dissertation work of T. Welker).

Available lipid reserves are normally depleted during smoltification and downstream migration of juvenile salmon; substantial use of protein reserves is, however, potentially deleterious. In this study, the post-hydropower system survival of fish leaving the hydropower system (adjusted for inter-annual changes in the marine environment) was inversely correlated with body protein content.

Sampling of stress indices in barge-transported Chinook salmon supported the hypothesis that the major stressor was confinement with larger and more aggressive juvenile steelhead. However, no correlation was found between the smolt-to-adult survival rates of transported Chinook salmon and densities of co-transported steelhead.

In some years, exposure of hatchery-reared Chinook salmon to dam bypass systems was negatively correlated with the quantity of lipid and protein reserves, 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. Similar correlations between exposure to dam bypass systems and nutritional/condition indices were not observed for wild fish, and no relationship was apparent between bypass exposure and body length of wild fish.

To date, the findings of this project have been reported in ten peer-reviewed publications. Several additional manuscripts are in preparation.

**MACROINVERTEBRATE ASSEMBLAGES IN MOUNTAIN STREAMS IN BURNED AND UNBURNED WATERSHEDS OF THE PAYETTE NATIONAL FOREST, IDAHO**

**Principal Investigator:** Dr. K. Lohman  
**Student Investigator:** Katherine Strickler  
**Funding Agency:** USDA Forest Service  
**Completion Date:** 8/31/2006

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**Objectives:** The overall goal of the study is to characterize the effects of prescribed and wildland fire on aquatic invertebrate communities. Specific objectives include:

- To compare benthic invertebrate density, diversity, and community composition in watersheds treated with prescribed fire and reference watersheds in the South Fork of the Salmon River sub-basin.
- To compare benthic invertebrate density, diversity, and community composition in samples collected before and after wildland fire in streams in the Big Creek watershed, Middle Fork of the Salmon River sub-basin.
- To relate variation in benthic invertebrate metrics among different watersheds or years to stream habitat variables.

A final report has been completed

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

**Principal Investigator:** Dr. C.M. Moffitt  
**Student Investigator:** Louise Bruce  
**Funding Agency:** USFWS  
**Completion Date:** 30 September 2006



**Objectives:**

- Determine an ozone dose and associated contact time lethal to New Zealand mudsnails for hatchery water treatment.
- Determine the range of time the New Zealand mudsnail is viable within the GI tract of a typical salmonid to estimate an appropriate fish depuration time before transport.
- Explore the potential of other practical hatchery control measures.

Results:

Several fish hatcheries in the western United States have become infested with New Zealand mudsnails, *Potamopyrgus antipodarum*. This infestation has caused some facilities to discontinue transporting and stocking fish for release to other locations because of potential risks of introducing snails to new locations. Laboratory studies were conducted to determine if ozone could be used to kill snails, and to determine factors affecting snail transit and survival through the gastrointestinal tract of trout. Ozone was not effective in killing snails, and this objective was dropped from the study.

Laboratory trials were conducted to determine mudsnail transit and survival through the gastrointestinal tract of trout. Rainbow trout were force-fed a quantity of New Zealand mudsnails to compare the survival and transit time given different feeding regimes. We tested different numbers of snails in a meal, the effect of feeding fish with commercial feeds after consumption of snails, the effect of fish size, and the effect of snail size. At 3, 6, 12, 24, and 48 h after feeding, fish were examined for the presence and survival of adult snails in each region of the gastrointestinal tract. Adult snails that were recovered were also examined for the expulsion of live neonates. We modeled this response using a stochastic model of ordinal data. Models were developed to compare the transit and survival with variable number of snails in a meal; variable fish feeding; different sizes of fish; and different sized snails. Gut evacuation was faster for fish fed a larger snail meal, fish not fed a commercial feed after consumption of snails, smaller fish and fish fed smaller snails. Fish that were fed a commercial feed retained a majority of snails in the stomach, while only voiding dead snails in the fecal material. One live neonate was expelled from an adult snail in the fecal material at 24 h. Increasing the length of time snails are retained in the gastrointestinal tract decreases the probability of survival of snails in the fecal material of fish. If infested hatcheries are to stock fish without risk, they need to feed fish for 96 h and then, depurate fish for more than 48 h. Infested hatcheries need to also incorporate a waste removal system in raceways that will rapidly remove and divert fish fecal material to a treatment tank.

Additional laboratory trials were conducted to determine the amount of snails that rainbow trout and steelhead would consume if placed into tanks with snails and either starved or fed a commercial trout diet. Two trials were conducted where starved fish and fish fed commercial feed at a rate of 0.9 % body weight were exposed to approximately 2,000 New Zealand mudsnails for 48 h. After each trial, a final snail weight and snail count in the gastrointestinal tract of fish was obtained. Starved and fed rainbow trout and steelhead volitionally consumed snails, with rainbow trout consuming a significantly greater amount when compared to steelhead. Fed fish consumed a greater amount of snails when compared to starved fish. Fish depurated on an infested water source will increase the probability of transporting infested fish. A depuration strategy will require a New Zealand mudsnail-free water source if fish are to be rid of snails.

Graduate student L. Bruce completed her thesis project, was funded as a SCEP student through the FWS, region 1, and has now taken a job with the FWS in Washington.

## 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



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### Objectives:

- Provide an overview of the components involved to estimate the environmental and social footprints of animal protein production
- Provide estimates for trout and beef production in Idaho.

### Results:

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 was 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.

In 2003, United States had the third highest beef consumption in the world, after Argentina, which consumed 54.7, Australia 46.1, and the United States 41.9 kg/per capita. However, United States has more population therefore it is the country with largest beef consumption worldwide. In the United States, seafood and finfish consumption has increased significantly, according to FAO and USDA statistics, but if we separate finfish consumption from seafood, the consumption ranges from 2 to 4 kg per capita. According to FAO, the consumption of freshwater fish in the world has increased from 1961 to 2003 from 1.5 to 4.6 kg. During this time in U.S. consumption of fish increased from 1.5 to 3.1 kg per capita.

The research focused on beef and rainbow trout production in Idaho. 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 were collected and compared for the fish and beef production systems. In 2000, Idaho livestock operations used 132 million Liters per day. It was calculated that 106 million L per day were coming from ground water and 26 million Liters per day from surface water. We calculated that a kg of boneless beef produced in Idaho required approximately 12,000 to



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14,000 Liters, when all components of the production of animals, feed, other operations were considered.

The quantity of water used for aquaculture in the United States per day in 2003 was 14 billion Liters per day, and Idaho used close to 53 % of the water supplies for aquaculture (7.5 billion Liters per day), from this total, 97 % was surface water. However, aquaculture activity utilizes the water but it is not consumptive water and close to 99% of the water running in trout farms is returned to the public waters and can be use for other. In Idaho using a 1.2 feed conversion ratio we calculated that a typical diet demands 7,962 Liters per kg of trout filet produced

### 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



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#### 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.

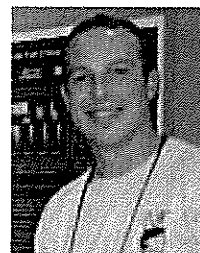
#### Results:

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 (NZMS) 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<sup>2</sup>. 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.

### **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.
Collaborating Investigators:	James L. Congleton, Ph.D. William P. Connor, Ph.D.
Student Investigators:	Jeffrey Yanke
Staff:	Boling Sun
Funding Agency:	US Fish and Wildlife Service RWO Cooperative Research Unit
Completion Date:	31 December 2005




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#### **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.

#### **Results:**

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

## COMPLETED PROJECTS – FISHERIES AND AQUATIC RESOURCES

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.

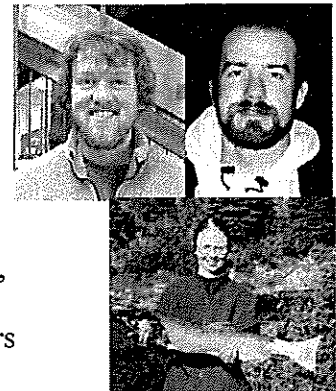
### **EVALUATION OF ADULT SALMON, STEELHEAD AND LAMPREY MIGRATION PAST DAMS AND THROUGH RESERVOIRS IN THE LOWER COLUMBIA RIVER AND INTO TRIBUTARIES**

Principal Investigator:  
Student Investigators:

Christopher Peery, Ph.D.  
Amy Pinson, Chris Anderson,  
David Griffith

Funding Agency:  
Completion Date:

U.S. Army Corps of Engineers  
30 September 2006



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#### **Objectives:**

- Evaluate the degree and effects of fish fallback at dams
- Identify sources of delay and loss in the system and effects of environmental variables on passage
- Evaluate homing and straying of returning adult migrants
- Evaluate 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.

**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 July 2006

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**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  $\pm 15$  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.

**Results:**

A total of six hundred 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.

**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

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**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.

**Results:** 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.

### **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

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**Objectives:**

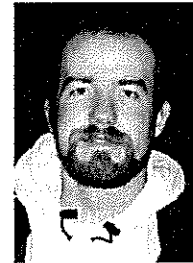
- Using radio-telemetry to determine movement patterns, including migration timing of migration, location and duration of holding, and time to reach spawning areas.

**Results:**

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 were monitored into the early spring of 2006. Data analysis and development of final reports are complete.

### **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



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**Objectives:**

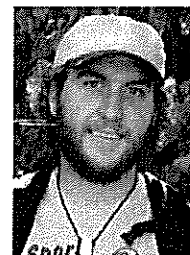
- Investigate macro and micro-scale temporal and spatial patterns of habitat use in the Columbia River Estuary by adult Chinook salmon migrants.
- Test newly developed marine and estuary seafloor and water column mapping technologies.
- Pilot application of NMEC standards within the Columbia River Estuary

**Results:**

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

### 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



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#### 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.

Results: Field sampling was conducted, fish were aged with otoliths and fin rays, and growth rates of fishes characterized with von Bertalanffy growth curves. A final report has been completed.

### DISTRIBUTION AND ABUNDANCE OF THE FISHES OF IDAHO

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



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#### 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

## COMPLETED PROJECTS – FISHERIES AND AQUATIC RESOURCES

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 refereed journal.

### Results:

Thousands of records of fish of Idaho have been compiled. A contract for publication of Idaho's Native Fish has been obtained. Species accounts are drafted for all families of Idaho fishes except Salmonidae. National Science Foundation funding received July 1, 2006 for preservation of Richard L. Wallace fish collection.

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



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

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### Objectives:

- Inventory Wood River sculpin occurrence across its range, with single-pass electrofishing at randomly selected stream reaches
- Develop a multivariate habitat association model to predict species occurrence using logistic regression
- Assess feasibility of using PIT tags to track individual Wood River sculpins using PIT tags implanted in shorthead sculpins, observe survival, tag retention, net avoidance behavior and detectability.
- Integrate findings through a modified aquatic Gap Analysis, 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.

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### Results:

I monitored 166 stream reaches in the Wood River basin. Graphic comparisons of habitat parameters with sculpin presence and relative abundance are being made as first step of model development. An initial model is anticipated by July 2007. Feasibility assessment for PIT tagging sculpins is completed and a manuscript drafted, and in review. Spatial data layers are compiled for Wood River basin. A GIS comparison of Wood River sculpin occurrence, physical habitat and land use will be initiated upon development of predictive model.



## ***Current Projects – Wildlife and Terrestrial Resources***

*Ongoing*

### **A METAPOPOPULATION APPROACH TO THE CONSERVATION OF THE WHITE-HEADED WOODPECKER IN THE INTERIOR WEST**

Principal Investigator: Oz Garton  
Student Investigator: Rita D. Dixon  
Completion Data: 31 December 2007



#### **Objectives:**

- Estimate the population size, survival rates, and stability of White-headed Woodpeckers in the Interior West,
- Investigate metapopulation structure and dynamics,
- Examine the effects of landscape heterogeneity on populations.

#### **Progress:**

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.

### **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 2007

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**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 ( $\lambda$ ) associated with these elasticities was  $1.083 \pm 0.008$  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.

**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 2007



**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.

ongoing

**USING THE METAPOPOPULATION 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 2007



**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**

*Ongoing*

Principal Investigator: ~~Wayne Melquist, Ph.D.~~ *J. Michael*  
Cooperating Investigators: Rex Sallabanks, Ph.D. and Colleen Moulton  
Funding Agency: Idaho Department of Fish and Game  
Completion Date: 30 June 2008

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**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.

**Background:**

Idaho's Important Bird Areas (IBA) Program was launched in 1996 as a partnership between Idaho Partners in Flight and the Idaho Audubon Council. An IBA Technical Committee was formed to encourage nominations and review materials for candidate IBAs. To date 57 sites have been identified by the committee as IBAs in Idaho. Phase two of the IBA process has begun and proponents were sought to work toward conservation and management of IBAs. These individuals and organizations are champions for bird conservation at particular sites and work cooperatively with each site's land manager or landowner. To some degree, additional site nominations are still being sought and missing information for accepted sites is being sequestered. Another important part of the phase two process that has been initiated is monitoring of birds at some of Idaho's IBAs, which is conducted by either biologists or volunteers. These efforts, intended to collect basic information about the IBAs, created an inventory of bird species present at each site, which will lead to further investigations. Waterbirds at Silver Creek Preserve have been monitored monthly, year-round, by volunteers, and year-round monitoring by volunteers at several more IBAs has been initiated. In addition, Colleen Moulton, the project's Wildlife Research Biologist is building an "Adopt-an-IBA" Program, which seeks to encourage more community participation in the IBA Program, particularly from local Audubon chapters. Project has been extended through June of 2008.

**FURTHER UNDERSTANDING AND KNOWLEDGE OF WILDLIFE IN IDAHO**

ongoing?

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 2007

**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 and has been continued through June 2007.

ongoing 9/07

**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: 31 August 2007



**Objectives:**

Completed 12/07

- 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 Global Positioning System 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 Lotek GPS collars that store data on board. We downloaded location data sets for 7 black bears during the summer of 2005 from collars that were dropped (n=5), from one animal that was recaptured, and from one bear that was harvested.

During January - March, 2006, we visited winter dens of 6 black bears to retrieve GPS data and to replace GPS collar batteries. During the summer, we trapped an additional 13 black bears and 1 grizzly bear, and fitted each with GPS collars. We also recaptured a grizzly bear previously collared in Canada and fitted a yearling black bear with a VHF collar. I

## CURRENT PROJECTS – WILDLIFE AND TERRESTRIAL RESOURCES

also surveyed relative shrub abundance, presence of fence, and presence of cut-banks along Highway 95.

We completed an assessment of how habitat variables affect GPS collar performance. Results of this work are currently in press in the *Journal of Applied Ecology* (Lewis et al. 2007). The M.S. student, Jesse Lewis, will be completing the project and his thesis during August 2007. We anticipate 3 additional publications addressing: 1) Habitat characteristics associated with highway crossings by black bears; 2) Habitat selection by black bears and the influence of highways and human development; and 3) Influence of location fix rate on evaluations of habitat selection: GPS and VHF technology.

### WINTER ECOLOGY OF VANCOUVER CANADA GEESE IN SOUTHEAST ALASKA

Principal Investigator:	John Ratti, Ph.D.
Student Investigators:	Trevor Fox
Funding Agency:	U.S.G.S. Alaska Science Center
Completion Date:	01 July 2007

?  
closed but  
report  
not  
completed

#### Objectives:

- Compare characteristics of shorelines that are used by Canada geese to intertidal areas that are not used. Use GIS coverages to develop a predictive model of the distribution of potential wintering areas in Southeast Alaska
- Evaluate how habitat area, snow cover, intertidal substrate, and plant community composition affect numbers of geese that use a wintering site.
- Determine how Canada geese are distributed among available habitats within a wintering site, and whether patterns of habitat use change with tide, weather, or date

#### Progress:

Thesis is in process. Project will be completed by 30 June 2007. Canada goose use of shoreline characteristics in Southeast Alaska was modeled using logistic regression. Shoreline characteristics were sampled within 500-m and 1000-m circular buffers placed around used and available locations. These buffers were used to develop 2 separate sets of models (small- and large-buffer model). Because geese are gregarious animals, spatial dependency was a concern in the analyses. To account for this, I included the number of geese within additional buffers up to 3000 m from location and used these as potential explanatory variables. At least one of these dependency variables appeared in 81.8% and 77.4% of candidate models of small-buffer and large-buffer models; respectively.

A portion of sampling data was withheld for model validation. This data was scored using the Score option in PROC LOGISTIC (SAS version 9.1). The discriminatory capacity of models was evaluated by looking at the area under the curve (AUC) of relative operating characteristic (ROC) curves. All AUC values were above 0.7, which indicates reasonable discriminatory capacity. •Analysis of wintering-site data is on-going.

ongoing 9/10/07

### MOUNTAIN QUAIL TRANSLOCATIONS

Principal Investigator: Kerry Reese, Ph.D.  
Student Investigator: John Stephenson  
Funding Agency: Idaho Department of Fish and Game  
Completion Date: 31 December 2007



#### Objectives:

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

#### Progress:

On 17 March 2006, we translocated 177 mountain quail (*Oreortyx pictus*) into Asotin Creek Wildlife Area (AC) in eastern Washington and into Craig Mountain Wildlife Management Area (CM) in northern Idaho. Fifty and 49 birds were radioed at CM and AC, respectively, and monitored throughout the season. Translocated mountain quail moved up to 24.4 km from release sites at AC and up to 33.6 km at CM. Nests ( $n = 12$ ) were located a mean distance of 1.2 km (range 0.3 – 2.2 km) from release sites at AC and 8.4 km (range 3.3 to 15.8 km) at CM. At AC, 40 of 49 (82%) radioed mountain quail died during the season and 8 (16%) radioed birds were still alive at the end of the 5 month study period (17 Mar – 12 Aug). At CM, 42 of 50 (84%) radioed mountain quail died and 5 birds (10%) were still alive at the end of the study period. Mean clutch size for 12 nests was 7.8 eggs. Five of 8 nests at AC hatched from 15 June to 13 July (mean 30 June). Two of 4 nests at CM hatched on 3 July and 5 July (mean 4 July).

Nest success was 63% (5/8) for AC, 50% (2/4) for CM, and 58% (7/12) for areas combined. Six nests were incubated by males, 4 by females, 1 was started by a female and finished by a male, and 1 nest was not incubated. Brood success was 57% (4/7) with an average of 4.0 chicks per brood at 28 days after hatching. Of the 12 nests located, 6 (50%) were located in Douglas fir, 4 (33%) in ponderosa pine, 1 (8%) in talus/garland, and 1 (8%) in a rose/snowberry plant association. All nests were in or near edge habitat. The data collected in 2005 and 2006 will be analyzed further and incorporated into a Master's thesis which is expected to be completed in December 2007.

**SOCIAL, LEGAL, AND ECONOMIC DIMENSIONS OF INVASIVE SPECIES AND  
THREATENED/ENDANGERED SPECIES**

Principal Investigator: Cort Anderson, Ph.D./Mike Scott, Ph.D.  
Funding Agency: Center for Research on Invasive Species & Small  
Populations (CRISSP)  
Date of Completion: 31 May 2008

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**Objectives:**

- Work with an interdisciplinary team to research questions on the social, legal, and economic dynamics of invasive species and threatened/endangered species management.
- Research the listing policy for threatened/endangered species and develop landscape management frameworks to effectively evaluate the conservation planning process.

**Progress:**

Developed a database for all threatened/endangered species with recovery plans (i.e., 1,075 species) to evaluate the recovery process used in the implementation of the Endangered Species Act. Developed the dynamic human footprint concept to measure conservation success at the landscape level.

**ESTABLISHING NEW PATHWAYS TO RECOVERY OF THREATENED AND  
ENDANGERED SPECIES**

Principal Investigator: J. Michael Scott Ph.D., U.S.G.S.  
Cooperating Investigators: Donald Pitts, U.S. Army Corp. of Engineers;  
Dr. Barry Noon, Colorado State University  
Student Investigator: Gina Wilson  
Agency Funding: U.S. Department of Defense (DoD)  
Completion Date: 30 September 2007

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**Objectives:**

- Assess the recovery status of threatened and endangered species on military lands
- Compare their status with that of populations and endangered species not found on military lands
- Identify those species that could be future success stories in relatively short time periods
- Develop realistic time frames for evaluating the recovery status of a listed species
- Apply the insights derived from the modeling exercises to real existing data sets that occupy a wide range of ecological conditions.



The work to be conducted will estimate meaningful time frames to evaluate a species recovery status based on the unique ecological and life history attributes of each listed species and recovery actions taken. We have assembled a multidisciplinary team of researchers who together have more than a hundred years of experience with threatened and endangered species these investigators will compile a database of recovery status for T and E species on military lands and those found elsewhere. Successful management of threatened and endangered species on Army installations will be identified by conducting a literature survey, and polling endangered species and natural resource managers on the installations. Management systems both planned and those innate to the unique situation of Army installations will be compared to those directly off the installations and within the region, thereby gaining insight into management priorities region-wide. The rate of recovery of a listed species, even under the most optimal conditions for its population growth, will ultimately be limited by the demographic characteristics of its life history. That is, a species' maximum rate of population growth will be constrained by its demographic potential which is a function of its age-specific rates of survival and reproduction. Demographic attributes such as age at first reproduction, average number of young produced, and survival of young to reproductive age will determine the maximum possible time period over which a listed species can possibly experience "recovery."

Progress:

Recovery status of U.S. DoD installations has been assessed. Initial findings suggest threatened and endangered species on DoD lands have no conservation advantage over threatened and endangered species on other U.S. lands. DoD success stories have been identified; low hanging fruit - species that could be moved along the recovery gradient in a very short amount of time have been also identified. Initial modeling efforts have identified factors that have influenced time to recovery for delisted and downlisted species. Initial answers for recovery time have been identified and further analysis is being done. A sampling framework for recovery plans and Integrated Natural Resource Management Plans (INRMPs) is being created. Databases that include management actions in recovery plans and INRMPs, conservation status, and recovery status of threatened and endangered species have been assembled. Literature on demographic and life history information for selected threatened and endangered species on DoD lands, e.g. brown pelican, least tern, peregrine falcon, bald eagle has been gathered. Initial work has analyzed time frames for recovery of species on DoD lands that are downlisted and delisted. We have developed algorithms for determining factors that influence time to recovery.

*emailed  
with  
5/20*

**A RISK ASSESSMENT FRAMEWORK FOR DEFINING SCIENTIFICALLY-  
DEFENSIBLE RECOVERY GOALS FOR LISTED SPECIES**

Principal Investigators:	J. Michael Scott, Oz Garton Scott Mills, University of Montana
Post Doctoral Researcher:	Jon Horne
Student Investigator:	Katherine Strickler
Funding Agency:	Department of Defense
Completion Date:	31 Dec 2008

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**Objectives:**

- Develop and test tools that can be used to better manage listed species on Department of Defense (DoD) installations by estimating management effects and extinction risk under a range of life history attributes, available data, and training, testing, and management actions.

**Progress:**

Military land managers increasingly are faced with the challenge of balancing threatened and endangered species (TES) conservation with military testing and training activities, which must not impede species' recovery. This challenge is often complicated by incomplete information on species' populations and demography that precludes conducting quantitative, complex viability analyses to assess the effects of military and conservation activities on the health of these populations. Military land managers are uniquely situated to enhance local populations of TES and, if provided the tools to conduct thorough viability analyses, can facilitate more robust TES populations and alleviate current training restrictions.

Full funding for the project has been obtained and personnel have been hired. Threats posed by military training activities were documented through literature searches and discussions with military personnel and installation Biologists. Searches of gray and refereed literature have been conducted and information obtained on demographic response of threatened and endangered species to disturbances associated with military training activities. A graduate seminar was jointly conducted with University of Montana and University of Wyoming on Life History Typologies. A second seminar on Spatially explicit modeling of meta populations is planned for the spring semester. Possible mitigation factors have been identified and literature documenting demographic response of threatened and endangered species gathered to mitigation activities obtained. Models to assess response of threatened and endangered species to training activities and mitigation actions are being developed.

**THE NATIONAL WILDLIFE REFUGE SYSTEM: PROVIDING A CONSERVATION  
ADVANTAGE TO THREATENED AND ENDANGERED SPECIES IN THE  
UNITED STATES**

Principal Investigator:  
Student Investigator:  
Funding Agencies:  
Completion Date:

J. Michael Scott, Ph.D.  
Emmi Blades  
U.S.G. S. /Environmental Science  
May 2007



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**Objectives:**

- Define and compare the conservation advantage of listed species for which refuges have been established, listed species found on the refuge system but for which refuges have not been established, and listed species not found on the refuge system.
- Assess the levels of population viability that can be maintained on refuges established for listed species by examining habitats and home range sizes of listed species for which refuges have been established.

**Progress:**

Conservation advantage has been defined and compared. Sixty-one national wildlife refuges have been identified as established to protect threatened and endangered species. One-hundred and twenty-seven species for which refuge have been established have been identified and refuge sizes established for listed species determined. Home-range sizes for listed species for which refuges have been established have been identified and were used to determine the levels of population viability that could be maintained. Dispersal abilities were assessed and refuge habitats analyzed to assess the ability of species for which refuges have been established to evade effects of climate change and human development.

*Completed  
Masters 5/2007*

*Ongoing*

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

Principal Investigator:

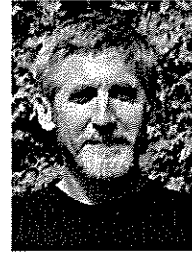
J. Michael Scott, Ph.D.

Student Investigator:

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 to determine several questions:

- 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 remains.
- 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 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. 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. However, no live or fresh mortalities were found in any state other than California after approximately 24 months 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. Interestingly, female red-tailed hawks did not disperse significantly further than males ( $P=0.90$ ). 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 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.

#### CONSERVATION RELIANT SPECIES

Principal Investigators:	J. Michael Scott and Dale Goble
Funding Agency:	Idaho Department of Fish and Game U.S. Geological Survey
Completion Date:	June 2006

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ongoing  
9/2007

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#### Objectives:

Test the assumption that imperiled and endangered species will no longer require specific management intervention after down listing or delisting.

Results: Study of delisted and down listed threatened and endangered species found that several require continuing species specific management intervention if recovered status is to be sustained. Traditional concept of once a species is delisted that existing statutes would be sufficient to protect it may not be true for fifty percent of listed species. Three papers were published in peer reviewed journals

*Completed  
7/20/06  
J. Michael Scott*

### ENDANGERED SPECIES ACT AT THIRTY: THIRTY YEAR RETROSPECTIVE

Principal Investigators: J. Michael Scott, Dale Goble and Frank Davis  
Funding Agency: US Fish and Wildlife Service  
State Government and several nonprofit groups  
Completion Date: September 2006

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#### Objectives:

- Determine if implementation of the Endangered Species Act falls short of the statute's intent, if the listing process is broken, if recovery happens overnight, if conservation opportunities are being lost, if decision making can be improved with better information.
- Determine if successful conservation institutions and relationships are emerging.
- Determine if there is an expanded role for the States, or are private landowners carrying much of the conservation burden?
- Should the ESA be the last rather than the first conservation bulkhead?

#### Results:

Completed thirty year retrospective of actions taken to implement the Endangered Species Act. Findings suggest that administrative not legislative changes would be sufficient to accomplish most suggested "improvements" to the Act. Largest barriers to greater success of the Act is lack of funding, long delays in implementing management actions e.g. Habitat Conservation Plans and implement recovery actions at scales that are ecologically and biologically relevant.

Two books and seven articles have been published reporting the results of this project. Six workshops on issues identified as ones in which biologically and legally defensible consensus solutions were completed. The workshops were hosted by groups as diverse as National Cattlemen's Beef Association and Defenders of Wildlife.

*ongoing*

**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 2007



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**Objectives:**

- 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.
- 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:**

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.

**REPRESENTATION, REDUNDANCY, AND RESILIENCE: 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: 26 April 2007



**Objectives:**

- To assess the occurrences of waterfowl species on each of the 545 National Wildlife Refuges during all-seasons and during breeding in order to measure representation and redundancy.
- To assess the occurrences of waterfowl species on each of the 545 National Wildlife Refuges within the four North American migratory bird flyways during all-seasons and during breeding in order to measure representation and redundancy.
- To assess the occurrences of waterfowl species on each of the 545 National Wildlife Refuges within the 20 climatic zones during all-seasons and during breeding in order to measure representation and redundancy.
- To assess the resilience of waterfowl species on National Wildlife Refuge lands.

**Progress:**

By combining and editing several GIS data sources we produced a digital dataset of 538 National Wildlife Refuges. We completed the search for bird checklists for National Wildlife Refuges. We managed to acquire some form of bird list for 82% of refuges. We finalized the methods for assessing the resilience of waterfowl species on the National Wildlife Refuge System. Resilience includes three assessments: the range of the waterfowl species in the U.S. captured by the National Wildlife Refuge System; the number of cities and interstate highways in the vicinity of refuges; the projected changes to the breeding ranges of waterfowl in the National Wildlife Refuge System as a result of Global Climate Change. Initial results showed that waterfowl species occurred on at least 45% of refuges in their respective ranges. In the all-season part of the analysis waterfowl species had representation in all the National Wildlife Refuges.

*Completed Phd  
4/2007*



*Completed project 7/31/07**Emailed 5/20/08***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: July 2007



What will the National Park Service (NPS) system look like on its 100<sup>th</sup> and 200<sup>th</sup> 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 was 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 quantified 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 for the 243 park units in the coterminous US with "significant natural resources." These parks represent 1.47% of the coterminous US, average 48,100 ha in area (median 2,400ha) and range from 4ha to over 1.3 million ha. Although the majority of parks consist of only 1 subunit, 49% represent 2 or more subunits with the greatest number in Appalachian Trail (405 subunits) and National Capitol Parks-East (347 subunits). In general, NPS units protect areas of high elevations, steep slopes, low soil productivity. In addition, they are not distributed equally through ecological space. Eight ecoregions lack even one park with significant natural resources and eight more ecoregions are only represented once. These ecoregions are predominately in the Midwest. Based on estimated minimum park sizes put forth by Gurd et al. (2001) and Wiersma et al. (2004), only 12 parks are large enough to preserve the historic number of mammals.

We assessed the resiliency of these parks based on the size and context of surrounding lands, a crucial factor in the effectiveness of parks as conservation areas and the ability of the NPS to manage for their "unimpaired" mission. We 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. At the national level, the proportion of converted (urban or agriculture) to natural land cover within 10km of park boundaries is significantly different than the proportion within the parks themselves. In addition, although 51% of parks are less than 1 km from other protected areas, the proportion of protected to converted lands within 10km is quite small, with the exception of the southwest where the amount of protected lands equal or surpass the amount converted. These results, along with the fact that the average human

## CURRENT PROJECTS – WILDLIFE AND TERRESTRIAL RESOURCES

population size in counties adjacent to NPS units has increased faster than the national average, indicate that, at the national level, park units occur in a fairly unfriendly matrix. We are currently assessing the potential impacts of climate change on these parks.

### USE OF ADVOCACY IN PEER REVIEWED ARTICLES IN THE NATURAL RESOURCE SCIENCES <sup>2</sup>

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

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#### 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:

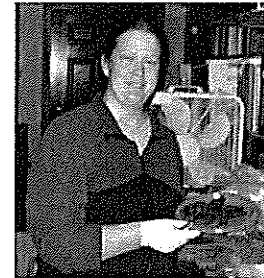
We concluded a graduate seminar on Advocacy in Science in three semesters. Fifty articles from each of six natural resource journals; Ecological Applications, Journal of Wildlife Management, North American, Journal of Fisheries, Management, Forestry Science, Conservation Biology and Journal of Range 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 co-hosted 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 were featured at the symposium. An overview of our results was presented.

*ongoing*

### **EVALUATING AND CURBING HYBRIDIZATION FOR THE RED WOLF POPULATION**

Principal Investigator: Lisette Waits, Ph.D.  
Post Doctoral researcher: Jen Adams  
Funding Agency: U US Fish and Wildlife Service  
Completion Date: September 2009



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#### **Objectives:**

- Reconstruct the pedigree of the wild red wolf population and evaluate hybridization events
- Determine the genetic identity of puppies, captured animals and fecal samples
- Evaluate the genetic consequences of red wolves dispersing from the recovery zone using computer modeling
- Optimize and evaluate fecal DNA sampling and analysis methods

#### **Methods:**

Objectives one and two are being accomplished by extracting DNA, amplifying 8-18 microsatellite loci and analyzing the data on an ABI fluorescent detection system. To determine parentage, program CERVUS, exclusion and likelihood based models are being used. To determine the genetic identity of the samples, log-likelihood assignment test analysis methods and program described in Miller et al 2003 is being used. A computer model is being constructed to evaluate the long-term genetic impacts of two management options: a) active removal of red wolves that disperse from the recovery zone vs b) no active removal of red wolves dispersing from the recovery area. We are collecting fresh fecal samples and storing them using 5 different preservation methods (freezing, Ethanol, lysis buffer, DETs buffer and a Guanine buffer. Samples will be stored for 1 year but extracted at 4 different time points to evaluate which preservation method works best for long-term and short-term storage. The usefulness of new PCR preamplification methods for improving the success rates for DNA amplification from fecal samples is also being tested.

This project supports a PhD student and partial funding for a post doc.

**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 Dec 2007

2  
ongoing

← 1, 2004

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**Objectives:**

- 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:**

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. 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 and are to be completed in summer of 2007. The remaining parks in the network will be mapped throughout 2007.

**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

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**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 vouchered 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

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**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

## CURRENT PROJECTS – WILDLIFE AND TERRESTRIAL RESOURCES

plans and protocols and those where the vital signs are monitored by a given park or another federal or state agency and from 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.

The Phase III report has been peer reviewed and final edits are in progress as of April, 2007. Final product will be complete in 2007.

### **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

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#### 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 Inventory & Monitoring Network was established in Moscow in 2003. The program 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.

## 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 2007 ← 2006 DEC

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### 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 dominant 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, 2007.

## ***Completed Projects – Wildlife and Terrestrial Resources***

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### **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: 30 September 2006



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#### **Objectives:**

- Baseline studies of floodplain vegetation along the Elwha River, WA

#### **Results:**

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 t transects are 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



### 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

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#### Objectives:

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

#### Results:

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.

### 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

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#### Objectives:

- 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.

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

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management strategies based on focal species allow for adequate protection of other terrestrial vertebrates known to regularly breed in the state.

A preliminary draft WAS 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 was completed. A manuscript based on a qualitative analysis of Idaho's focal species selections is in preparation for submission to the peer-reviewed journal, Northwest Science.

Reserve selection algorithms (e.g., SITES, MARXAN, RESNET) were 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 were 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

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#### 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.

#### Results:

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.

## ECOLOGY OF THE NIGHTINGALE REED WARBLER ON SAIPAN IN MICRONESIA

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



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### Objectives

- Provide management relevant information on the ecology of the Nightingale Reed-Warbler on Saipan:
- Describe the home range and movements of adult reed-warblers
- Describe eggs, nests, and nestlings
- Describe 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.

Nightingale Reed-Warblers (*Acrocephalus lusciniia lusciniia*) 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 gymnorhiza*) 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. gymnorhiza* [ $n = 3$ ], *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  $4.3\text{m} \pm 1.3$  (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.

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The reproductive biology of the endangered Nightingale Reed-Warbler (*Acrocephalus luscini*) 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. Thesis was defended and project is completed.

### SONGBIRD DIVERSITY AND ABUNDANCE SURVEYS IN THE COEUR D'ALENE BASIN

Principal Investigator:	J. Michael Scott
Government Technical Rep.:	Dan Audet, US Fish & Wildlife Service
Funding Agency:	U.S. Geological Survey
Completion date:	10/1/05

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Goals: The goal of this effort was to provide information on avian productivity and survivorship within the Coeur d'Alene Basin.

In September 2002, The U.S. Environmental Protection Agency (EPA) issued its interim Record of Decision (ROD) to clean up mining contamination in the Bunker Hill Mining and Metallurgical Complex Superfund Site Operable Unit 3. The ROD established a long-term monitoring program which included a status and trends assessment of biological resource conditions in the basin. Included in this assessment was an evaluation of songbird diversity and abundance intended to evaluate improvements in biological resources within the Coeur d'Alene Basin.

Nine mist nests were established in a twenty acre study area following protocol of the Monitoring Avian Productivity and Survivorship (MAPS). Birds were captured in mist nets and banded from May to August 2005. Information on species, age, sex, molt, and reproduction was recorded for each bird and reported to director of MSPS and the US Fish & Wildlife Service banding office. Final Report has been completed.

## RED WOLF MICROSATELLITE GENETICS AND HABITAT USE PROGRAM

Principal Investigator	Dr. Lisette Waits
Student Investigator:	Jennifer Adams
Funding Agency:	USFWS
Completion Date:	09/30/06

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### Objectives:

- Modify existing non-invasive genetic tests (mtDNA) to use nuclear DNA microsatellite markers
- Improve existing maximum likelihood genetic test by including data from 14 red wolf founders
- Combine data from non-invasive genetic sampling with GIS technology to determine both red wolf home range size and habitat usage.

### Results:

Objective 1: We used the 2000 scat dataset to optimize the use of microsatellite markers in collected fecal samples. Using probability of identity calculations, we determined that 6 microsatellite loci are necessary to distinguish between individuals in the wild red wolf population. Because oftentimes loci fail to amplify in fecal samples, we decided to optimize 8 loci. We were able to obtain reliable data at 110 of those scats for an amplification success rate of 53%. The haplotypes found in 107 of the scats were matched to 15 known individuals, the highest number of detections for one individual being 21 and the lowest being 1. The haplotypes found in the other 3 scats did not match any individuals in the known dataset and so represent three previously unknown individuals. This documents the ability of this method to identify new, never before captured individuals. This work is published in *Conservation Genetics* (Adams et al 2007).

This method was also applied to 271 scats collected in 2003 and we evaluated the efficiency of different sampling approaches. We have obtained genotype data on 111 scats for an amplification success rate of 41%. Thirty-two individuals were detected, six of which were hybrids. The total number of detections per individual ranged from 1 to 23. Placement of fecal sample locations on a map of the recovery implementation area revealed three hybrids were located in the middle of the red wolf range and three were located on the periphery of the red wolf range. Four of the six individuals were subsequently captured and removed from the population. This method provides a valuable tool to locate hybrid individuals in the red wolf recovery implementation area thereby reducing hybridization between red wolves and coyotes. This work is currently in press (Adams et al in press) with *Molecular Ecology*.

Objective 2 The principal threat to the persistence of the endangered red wolf (*Canis rufus*) in the wild is hybridization with the coyote (*Canis latrans*). To facilitate identification and removal of hybrids, we developed assignment tests, which use genotype data to estimate identity as coyote, 1/4, 1/2, 3/4 or full red wolf. The tests use genotypes from the red

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wolves that founded the surviving population and the resulting pedigree, rather than a contemporary red wolf sample. The tests are evaluated by analyzing both captive red wolves at 18 microsatellite loci, and data simulated under a highly parameterized, biologically reasonable model. The accuracy of assignment rates are generally high, with over 95% of known red wolves identified correctly. This work was published in 2003 (Miller et al 2003).

Objective 3: Field data were collected from September 2004 to December 2004. Telemetry locations were gathered for eight red wolves from three packs. The total number of telemetry locations per individual ranged from 24 to 34. Scat samples were collected once a month from within the territories of the three packs, and GPS coordinates were recorded. A total of 138 wolf scats were collected with the number of scats per pack ranging from 38 to 51. Fecal DNA sampling provided a promising method for evaluating space use. Manuscript is in preparation for Journal of Wildlife Management.

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

Principal Investigator:	R. Gerald Wright, Ph.D.
Government Technical Rep.:	Jerald Weaver
Funding Agency:	National Park Service
Completion Date:	30 September 2006

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#### 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.

#### Results:

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

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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.

10/1/06 to 9/30/07

## *Awards, Publications, Service and Other Activities*

### HONORS AND AWARDS

#### *J. Michael Scott*

- Department of Interior Distinguished Service Award
- American Ornithologists Union Conservation Award

#### *John Cassinelli, MS Student*

- Trout Unlimited Graduate Scholarship.
- DeVlieg Award for graduate research.

#### *Lubia Canas Cano, PhD Student*

- Dissertation Support, Regional Program of Graduate Fellowships for Latin American Students. Ford Foundation, New York. 2006 -2008.

### PEER REVIEWED PUBLICATIONS

Adams, J, L. Waits, and B. Kelly. 2003. Using fecal DNA sampling and GIS to monitor hybridization between red wolves (*Canis rufus*) and coyotes (*Canis latrans*) Molecular Ecology 12:2175-2186

Adams, J., J. Leonard, and L.P. Waits. 2003. Genetic evidence for introgression of domestic dog mitochondrial DNA into the wild coyote population. Molecular Ecology 12:541-546.

Adams, J. R., C. Lucash, L. Schutte, and L. P. Waits (in press) Locating hybrid individuals in the red wolf (*Canis rufus*) experimental population area using a spatially targeted sampling strategy and faecal DNA genotyping. Molecular Ecology

Adams, J. R. and L. P. Waits. 2007. An efficient method for screening faecal DNA genotypes and detecting new individuals and hybrids in the red wolf (*Canis rufus*) experimental population area. Conservation Genetics 8:123-131

Bishop, Chad J., James W. Unsworth and Edward O. Garton. 2005. Mule deer survival among 3 adjacent populations in Southwest Idaho. Journal of Wildlife Management 69:311-321

Congleton, J. L. and T. Wagner. 2006. Blood-chemistry indicators of nutritional status in juvenile salmonids. Journal of Fish Biology 69:473-490.



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- Congleton, J. L. 2006. Stability of some commonly measured blood-chemistry variables in juvenile salmonids exposed to a lethal dose of the anesthetic MS-222. *Aquaculture Research* 37:1146-1149.
- Goble, D.D., and J.M. Scott 2006. Recovery management agreement offer alternatives to continuing ESA listings. *Fisheries* 31:35.
- Horne, Jon S. and Edward O. Garton. 2006. Selecting the best home range model: an information theoretic approach. *Ecology* 87:1146-1152
- Horne, Jon S. and Edward O. Garton. 2006. Likelihood cross-validation vs. least squares cross-validation for choosing the smoothing parameter in kernel home range analysis. *Journal of Wildlife Management* 70:641-648.
- Jones, D.T., C.M. Moffitt, and K. Kenneth Peters 2006. Survival and disease expression in *Renibacterium salmoninarum*- challenged bull trout at two water temperatures compared with other char and Pacific salmon. *North American Journal of Fisheries Management*.
- Kissling, Michelle L. and Edward O. Garton. 2006. Estimating detection probabilities from point count surveys: a combination of distance and double observer sampling. *Auk* 123:735-752.
- Kock, T., J. L. Congleton, and P. Anders. 2006. Effects of sediment cover on survival and development of white sturgeon embryos. *North American Journal of Fisheries Management* 26:134-141.
- Kristan, W.B. and J.M. Scott 2006. Hierarchical models for avian ecologists. *Condor* 108: 1 – 4
- Lewis, J.S, J.L. Rachlow, E.O. Garton, L.A. Vierling. (in press) Effects of habitat on GPS collar performance: addressing location error. *Journal of Applied Ecology* — ?
- Meretsky, V. J., R.L. Fischman, J.R. Karr, D.M. Ashe, J.M. Scott, R.F. Noss, & R.L. Schroeder. 2005. New directions in conservation for the National Wildlife Refuge System. *Bioscience* 56:135-143.
- Miller, C.R., J. R. Adams, and L. P. Waits. 2003. Pedigree based assignment tests for reversing coyote (*Canis latrans*) introgression into the wild red wolf (*Canis rufus*) population. *Molecular Ecology* 12:3287-3301
- Moffitt, C.M. 2006. Environmental, economic and social aspects of animal protein production and the opportunities for aquaculture. *Fisheries* 30(9) 36-37.

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- Moffitt, C. M., and S. M. A. Mobin. 2006. Profile of microflora of the posterior intestine of Chinook salmon before, during and following administration of rations with and without erythromycin. *North American Journal of Aquaculture*. 68:176-185.
- Scott J.M. & D.D. Goble 2005. A database for the ESA. *Bioscience* 55:299
- Scott J.M. & D.D. Goble 2006. Ongoing threats to endemic species. *Science* 312:526.
- Scott, J.M., T. Loveland, K. Gergely, J. Strithold & N. Straus. 2005. National Wildlife Refuge System: Ecological context and integrity. *Natural Resources Journal*. 44: 1041-1066
- Scott, J.M. and J. Rachlow 2006. Science policy and scientists. *Frontiers in Ecology* 4: 68-69
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- Svancara, L.K., R. Brannon J.M. Scott., C.R. Groves, R.F. Noss and R.L. Pressey 2006. Response from Svancara and colleagues. *Bioscience* 56:93-94.
- Svancara, L.K., R. Brannon, J.M. Scott, C.R. Groves, R.F. Noss, & R.L. Pressley. 2005. Policy driven versus evidence based conservation: a review of political targets and biological needs. *Bioscience* 55:989-995
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- 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* 17:386-391
- Williams, C.J. and C.M. Moffitt. 2006. Erratum Estimation of pathogen prevalence in pooled samples using maximum likelihood methods and open source software *Journal of Aquatic Animal Health* 18:149-155

**BOOKS AND BOOK CHAPTERS**

- Davis, F.W., Goble, D.D., and J.M.Scott. 2006. Introduction pages 3-15. *in* Scott, J.M., D.D. Goble and F.W. Davis 2006. The Endangered Species Act at Thirty: conserving biodiversity in human dominated landscapes. Island Press. Covelo, CA
- Davis, F.W. D.D. Goble and J.M. Scott 2006. Conserving biodiversity in human dominated landscapes pages 288-290 *in*. Scott, J.M., D.D. Goble, and F.W. Davis 2006. The Endangered Species Act at Thirty: renewing the conservation promise. Island Press. Covelo CA
- Davis, F.W., D.D. Goble, and J.M. Scott. 2006. Renewing the conservation commitment pages 296-306 *in* Goble, D.D. J.M. Scott and F.W. Davis 2006. The Endangered Species Act at Thirty: renewing the conservation promise. Island Press. Covelo CA
- Davison, R.P., A. Falucci, L. Maiorano, and J.M. Scott. 2006. The National Wildlife Refuge System pages 90-100 *in* Goble, D. D., J.M. Scott and F.W. Davis (Editors).The Endangered Species Act at Thirty: renewing the conservation promise. Island Press. Covelo CA
- Garton, Edward O., John T. Ratti, and John H. Giudice. 2005. Research and Experimental Design. Chapter 3 *In* Braun, Clait (ed.). Techniques For Wildlife Investigations and Management. The Wildlife Society, Bethesda, MD.
- Goble, D.D., J.M. Scott, and F.W. Davis (Editors) 2006. The Endangered Species Act at Thirty: Renewing the conservation promise. Island Press, Covelo, CA
- Goble, D.D., J.M. Scott and F.W. Davis 2006. Preface pages x-xiii. *in* Scott, J.M. D. D.Goble and F.W. Davis 2006. The Endangered Species Act at Thirty: conserving biodiversity in human dominated landscapes. Island Press Covelo, CA
- Mills, L.S., J.M. Scott, K.M. Strickler, and S. A. Temple. 2005. Ecology and management of small populations. Techniques for Wildlife Investigations and Management, 6<sup>th</sup> edition, pages 611 – 713 *in* C.E. Braun editor, The Wildlife Society, Bethesda MD.
- Scott, J. M., Goble, D.D., and F.W. Davis (Editors) 2006. The Endangered Species Act at Thirty: Conserving biodiversity in human dominated landscapes. Island Press, Covelo, CA
- Scott, J.M. D.D. Goble L. Svancara and A. Pidgorna. 2006. By the Numbers. pages 16-35 *in* Goble, D.D. J.M. Scott and F.W. Davis 2006. The Endangered Species Act at Thirty: renewing the conservation promise. Island Press Covelo CA

## PUBLICATIONS, AWARDS AND OTHER ACTIVITIES

Svancara, L.K., J.M. Scott, D.D. Goble, F.W. Davis, A. Pidgorna, and D. Brewer. 2006. Endangered Species timeline pages 24-35 *in* Scott, J.M., Goble, D. D., and F.W. Davis(editors). The Endangered Species Act at Thirty: conserving biodiversity in human dominated landscapes. Island Press, Covelo, CA

## TECHNICAL AND SEMI-TECHNICAL REPORTS

Moffitt, C. M. 2005. Environmental Impact Assessment, Phase I, Erythromycin thiocyanate to control bacterial kidney disease in salmonids. Using Guidance Document 89. International cooperation on harmonization of technical requirements for registration of veterinary medicinal products. VICH CL6. Answers to decision tree questions, and detailed profile of use patterns for seven years. Estimated unadjusted worst-case scenario effluents, mitigation procedures and structures at participating hatcheries in Idaho, Oregon, and Washington. October 31, 2005.

Moffitt, C. M. 2006. Report to Governing Board, American Fisheries Society. Enhancement of AFS Value Committee. 21 August 2006. 8 pages.

## THESES AND DISSERTATIONS

Adams, J. R. 2006. A multi-faceted molecular approach to Red Wolf (*Canis rufus*) conservation and management. PhD Thesis, College of Natural Resources.

Bruce, R. L. 2006. Examination of a Fish Depuration Strategy to Control New Zealand Mudsnails (*Potamopygrus antipodarum*) at Fish Hatcheries. Master's Thesis. Fishery Resources.

Cajas Cano, Lubia. 2006. Environmental and social footprints of beef and trout production for human consumption: using Idaho as an example. Masters Thesis. Environmental Science.

Moser, S. M. 2006. Ecology of the endangered nightingale reed-warbler (*Acrocephalus luscini*) on Saipan, Micronexia. Master's Thesis, Wildlife Resources.

Stanish, D. 2006. Defining recovery: an analysis of endangered species recovery criteria through 2004. Master's Thesis. Wildlife Resources.

Yanke, J. A. 2006. Effects of passive integrated transponder (PIT) tags and elevated water temperatures on survival, growth, and physiology of Snake River fall Chinook salmon subyearlings (*Oncorhynchus tshawytscha*). Masters Thesis. Fishery Resources.

**POSTERS AND PAPERS PRESENTED AT PROFESSIONAL MEETINGS**

- Bruce, L., and C. M. Moffitt. 2006. Summary of laboratory trials to model survival and passage of New Zealand mudsnails in the gastrointestinal tract of rainbow trout. New Zealand Mudsnails Control workshop. Hagerman, May 2006.
- Bruce, R. L., and C. M. Moffitt. 2005. Survival and Passage of New Zealand mudsnails in the GI tract of rainbow trout. Northwest Fish Culture Conference, December 2006. Boise, Idaho.
- Bruce, R. L. and C. M. Moffitt. 2006. Survival and passage of New Zealand mudsnails in the gastrointestinal tract of rainbow trout. Idaho Chapter American Fisheries Society, Boise February.
- Cajas Cano, L. and C. M. Moffitt. Environmental and Social Costs of Beef and Fish Production for Human Consumption: Can we Export Information from Idaho to Guatemala?. Idaho Aquaculture Association, 17th Annual Meeting, Twin Falls, Idaho. June 2006.
- Cajas Cano, L. and C. M. Moffitt. 2005. Environmental and Social Footprints of Beef and Fish Production for Animal Protein. Northwest Fish Culture Conference. Boise, Idaho, December 2005.
- James, C. and C. Moffitt. 2006. New Zealand mudsnails in Silver Creek, Idaho. Presentation to the Idaho Nature Conservancy's Citizen's Advisory Group, Hailey, Idaho, March, 2006.
- James, C. and C. M. Moffitt. 2006. Seasonal population dynamics of New Zealand mudsnails in Silver Creek and Riley Creek Drainage, Idaho. Idaho Chapter American Fisheries Society, Boise February.
- Lewis, J.S., J.L. Rachlow, E.O. Garton, L.A. Vierling. 2006. Effects of habitat on GPS collar performance: addressing location error. The Wildlife Society. Anchorage, Alaska.
- Lewis, J.S., J.L. Rachlow, and J. Horne. 2006. Bears and highways: identifying crossing habitat characteristics using the Brownian bridge. Idaho Chapter of The Wildlife Society. Boise, Idaho.
- Moffitt, C. M. 2006. A model framework for evaluating risks of invasive species and diseases in hatchery and wild fish - examples from salmonids 136<sup>th</sup> Annual Meeting, American Fisheries Society, Lake Placid, New York. September 10-14 2006.

## PUBLICATIONS, AWARDS AND OTHER ACTIVITIES

- Moffitt, C. M. 2006. Understanding the risks of invasive New Zealand mudsnails to free ranging fish communities and to aquaculture. 5<sup>th</sup> International Fish Health Conference, 1-5 September 2006. San Francisco, CA.
- Moffitt, C. M. 2006. Progress toward drug approval for oral erythromycin. Annual Drug Approval Workshop. La Crosse, Wisconsin, 1-2 August, 2006.
- Moffitt, C. M. 2006. Control of New Zealand mudsnails in hatcheries: conceptual model of components to consider and options for potential collaborations. New Zealand mudsnail control workshop, Hagerman, Idaho. May 2006.
- Moffitt, C. M. 2006. Assessment of risks to the environment and humans from aquaculture drugs. Presentation to Idaho Aquaculture Association, Twin Falls, June 2006.
- Moffitt, C. M. 2005. Environmental assessment of erythromycin to control bacterial kidney disease in salmon hatcheries. Northwest Fish Culture Conference, December Boise, Idaho.
- Moffitt, C. M., 2006. Do Aquaculture Drug Treatments Pose a Serious Risk to Humans and the Environment – a case study. Idaho Chapter of the American Fisheries Society. Idaho Falls, 15-17 February, 2006.
- Scott, J. M. 2006. American Law Institute and American Bar Association: “Endangered Species Act at Thirty: renewing the conservation promise” Seattle, Washington; January 19, 2006
- Scott, J. M. and D. Goble. 2006. National Marine Fisheries Service: “Conservation Reliant Species; Novel Occurrence or the future of endangered species”. Seattle Washington
- Scott, J. M. 2006. Society for Conservation Biology Meeting: Invited paper, “Advocacy in science: perceptions and occurrence” San Jose, California; May, 2006
- Scott, J. M. 2006. Region Three National Wildlife Refuge Conference: Plenary Address. La Crosse, WI, February, 2006
- Garton, E.O., J.S. Horne. 2006. Analysis of Home Range, Resource Selection, and Space Use. The Wildlife Society, Anchorage, Alaska.

## TECHNICAL ASSISTANCE, OUTREACH AND PROFESSIONAL SOCIETY ACTIVITIES

### *Louise Bruce*

American Fisheries Society – Palouse Unit Vice-President, August 2005 – Present

PUBLICATIONS, AWARDS, AND OTHER ACTIVITIES

*John Cassinelli*

St. Joe River redd surveys, August 2005, Palouse Unit AFS.

Free fishing day volunteer, assisted kids while fishing at a community pond in Eagle, Idaho.

~~*J. L. Congleton*~~

~~Initiated and maintain the Environmental News Bulletin Board in the College of Natural Resources.~~

*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, President 2006-2008.

Multimedia Presentations for American Fisheries Society, 2006. Plenary Awards

Presentation and Posters, American Fisheries Society. Business meeting Awards

Presentations and Posters, American Fisheries Society 136th Annual meeting, Lake Placid, New York. September

Summer 2006 Hosted two student interns, Sean Howard (CRISSP Intern Program) and Katie Teater (REU2 Intern Program) who helped with graduate student pilot studies of CO2 toxicity to New Zealand. They presented the results of the pilot studies to the coordinators and other interns of the CRISSP program. Master's Student Jordan Nielson provided supervision.

2005-2007 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

2004-2006. Chair, Technical Advisory Board for Silver Creek Watershed, The Nature Conservancy, Hailey, Idaho.

Potlatch Corporation Community Advisory Board. Acting Chair 2004-2006.

2005-6. United States - Israel Bi-national Agricultural Research and Development Fund Review Board. Proposal reviewer.

Workshop Organizer: Control of NZMS in Hatcheries. Workshop for Interested Partners. Sponsored by USFWS, and U of Idaho Coop Research Unit. 4-5 May 2006.

Organizer, AFS Enhancement of Value Retreat, 8 September, Lake Placid. American Fisheries Society Governing Board Retreat Leader.

## PUBLICATIONS, AWARDS AND OTHER ACTIVITIES

2005-2006- Renewal of CNR Laboratory Infrastructure- Wrote proposal that led to securing university funds for \$300,000 renovations of the CNR wetlab. Project will begin 2007.

2006-7. Chair, Limnology Search Committee, Dept Fish and Wildlife Resources.

*J. Michael Scott*

Member Publications Committee Society for Conservation Biology

Chair LaRoe Award Committee for Society for Conservation Biology

Member Honorary Member ship Committee of the Cooper Ornithological Society

Committee Member Annual Meeting of the Society for Conservation Biology, San Jose, California; May 2006

Co-chair of Invited Symposium on Advocacy at the Society for Conservation Biology; San Jose CA June 2006

Member, Weiser, Idaho Sheep Council Joe Hinson Invited discussant

Senior Member of the Science Council of the Nature Conservancy; Attended both meetings of the Council in 2006.

Chair of 2006 Awards Committee, Natural Areas Association

American Institute of Biological Sciences: Served on Publications Committee; Served on Finance Committee; Member of the Board of Directors;

Attended Diversity Opportunities Luncheon in Washington DC

Co-chair, Frank Church Wilderness Area, Symposium Committee, University of Idaho, College of Natural Resources

Member, Policy Committee, American Institute of Biological Sciences

Member Editorial Board, BioSciences Journal

Member Diversity Committee, AIBS.

2006 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