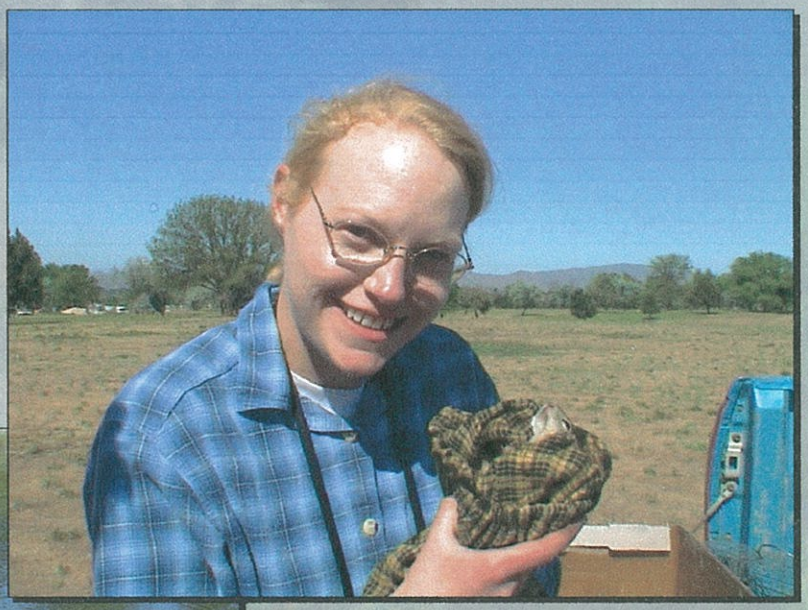
ANNUAL REPORT

1 October 2001 – 30 September 2002

Idaho Cooperative Fish and Wildlife Research Unit



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M.S. Wildlife Resources

Kajsa Stromberg
M.S. Fishery Resources

Cooperating Agencies

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Annual Report

1 October 2001- 30 September 2002

Idaho Cooperative
Fish and Wildlife Research Unit

U.S. Geological Survey
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P. O. Box 44-1141
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Moscow, ID 83844-1141

Unit Cooperators

U.S. Geological Survey
Idaho Department of Fish and Game
University of Idaho
Wildlife Management Institute
U.S. Fish and Wildlife Service

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Dennis Murray – Wildlife Resources
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Matt Powell - Fishery Resources
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John Ratti - Wildlife Resources
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Dennis Scarnecchia - Fishery Resources
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Peter Bloom	Ph.D. Wildlife Resources	J.M. Scott
Michael Colvin	M.S. Fishery Resources	C. M. Moffitt
Billy Connor	Ph.D. Fishery Resources	T.C. Bjornn/J.M. Scott
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LeeAnne Eareckson	M.S. Wildlife Resources	R.G. Wright
Derek Fryer	M.S. Fishery Resources	J L. Congleton
Kevin Gergely	Ph.D. Wildlife Resources	J.M. Scott
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Lorrie Haley	M.S. Fishery Resources	J.L. Congleton
Brett High	M.S. Fishery Resources	T.C. Bjornn/D. Bennett
Steve Intelmann	M.S. Fishery Resources	C.M. Moffitt
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Stephen Mosher	M.S. Wildlife Resources	J. M. Scott
Dave Robertson	M.S. Fishery Resources	J. L. Congleton
Scott Patterson	M.S. Fishery Resources	J. L. Congleton
Anna Pidgorna	M.S. Environmental Science	J. M. Scott

Amy Pinson	M.S. Fishery Resources	J.Congleton/C. Peery
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David Stannish	M.S. Environmental Science	J. M. Scott/ Dale Goble
Brad Stumph	M.S. Wildlife Resources	J. M. Scott
Leona Svancara	Ph.D. Wildlife Res/Geography	J. M. Scott
Tom Welker	Ph.D. Fishery Resources	J.L. Congleton
Jim Wilder	M.S. Wildlife Resources	R.G. Wright
Don Zaroban	Ph.D. Fishery Resources	J. M. Scott/G. LaBar

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Introduction

Unit History

The Cooperative Wildlife Research Unit Program began in 1935, when five Wildlife Units were established at land grant universities. Additional Units have been added since that time. In 1961 the Cooperative Fishery Research Unit Program was initiated. Beginning in 1984, Wildlife and Fishery Units were combined into Cooperative Fish and Wildlife Research Units. At the present time, there are 41 Cooperative Research Units. In 1994 the Cooperative Research Units were moved into the National Biological Service under the Division of Cooperative Research. In 1996 the National Biological Service and Cooperative Research Units were moved into the United States Geological Survey under the Biological Resources Division.

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. The Unit is staffed, supported, and coordinated by the USGS/Biological Resources Division, Idaho Department of Fish and Game, University of Idaho, Wildlife Management Institute and the U.S. Fish and Wildlife Service.

Program Direction

The Unit works toward: (1) conducting research on fish and wildlife problems of state, regional, and national interest, (2) training graduate students for careers in the fish and wildlife professions, and (3) providing technical assistance to state and federal managers and researchers. The Unit emphasizes research to (1) helping find solutions to problems affecting anadromous fish passage in the Snake River basin; (2) evaluating methods of establishing new animal populations or augmenting existing populations; (3) improving estimators of animal abundance; (4) evaluating effectiveness of existing reserve and management areas in the Pacific Northwest; (5) study the basic biology of aquatic and terrestrial animals; (6) evaluating effectiveness of efforts to recover populations of endangered species and (7) evaluating factors that regulate carrying capacity in fresh water and terrestrial habitats.

Unit Research, Expertise, and Interests

Unit personnel maintain close working and professional relationships with University faculty, Idaho Department of Fish and Game and U.S. Fish and Wildlife Service personnel. Research studies are conducted primarily within Idaho, although some work is done in adjoining states, as well as Hawaii, Federated States of Micronesia, Alaska and European counties.

Unit research is supported by State contributions and by contracts from the USGS/Biological Resources Division, the 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 advisors for graduate students, and participate in a variety of professional activities.

J. Michael Scott - Unit Leader and Professor of Wildlife Resources – Recent research activities include studies on: reserve identification, selection, and design in North America; 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 transfer of information at the science policy interface. Areas of interest include animal ecology, and conservation biology. Specialty course: FW-504 Advanced Topics in Conservation Biology.

Jim Congleton - Assistant Unit Leader and Associate Professor of Fishery Resources - Recent research activities include studies on the: Effects of stress, tissue injury, and infection on components of natural disease resistance; stress response of chinook salmon smolts collected and transported from Snake River dams; natural defenses against IHN virus. Areas of interest include mechanisms of disease resistance in fish and stress physiology. Specialty courses: F511 - Fish Physiology, F514 - Fish Population Ecology.

Christine Moffitt - Assistant Unit Leader and Associate Professor of Fishery Resources - Research emphasis includes aquaculture chemical efficacy and approval studies, understanding host-parasite relationships, & investigations of interactions between cultured & wild fish, & fisheries history. Specialty Course: Advanced Fisheries Management.

R. Gerald Wright - Research Scientist and Professor of Wildlife Resources -Recent research activities include studies on: Wildlife management in national parks and protected areas; modeling of ecological problems; ungulate ecology and habitat use; natural resource data management and geographic information systems. Specialty courses include Human Dimensions of Wildlife Management.

Ongoing Projects - Fisheries Resources

David H. Bennett - Principal Investigator

- Reduction of Northern Pikeminnows in Lake Cascade

James L. Congleton - Principal Investigator

- Evaluation of physiological condition of migrating juvenile salmon and effects of multiple-dam bypass.
- Evaluation of the physiological condition of transported juvenile salmon
- Effects of sedimentation on the survival of white sturgeon embryos

George LaBar - Principal Investigator

- Yellowstone Cutthroat Conservation Plan

Kirk Lohman - Principal Investigator

- Macroinvertebrate assemblages in mountain streams in burned and unburned watersheds on the Payette National Forest, Idaho

Chris Peery - Principal Investigator

- Evaluation of adult salmon, steelhead, and lamprey migration past dams and through reservoirs in the Lower Columbia River and into tributaries
- Research lamprey at Walla Walla

Matt Powell - Principal Investigator

- Hybridization in Westslope Cutthroat Trout

J. Michael Scott - Principal Investigator

- Spatial distribution of phenotypic diversity in westslope cutthroat trout
- Distribution and abundance of the fishes of Idaho

REDUCTION OF PIKEMINNOWS IN LAKE CASCADE

Principal Investigator: D. H. Bennett
Student Investigator: Kajsa Stromberg
Funding Agency: Idaho Dept of Fish & Game
Completion Date: 6/30/03

Objectives:

1. To monitor migration and spawning behavior of northern pikeminnow.
2. To quantify dietary habits of northern pikeminnow and estimate yellow perch consumption
3. To determine the level of northern pikeminnow abundance at which the desired population of yellow perch can be maintained.

Progress:

Fieldwork was completed during the spring, summer and fall of 2002. During the spring and early summer, radio telemetry was used to monitor the migration and spawning behavior of northern pikeminnow in Cascade Reservoir. Radio transmitters were surgically implanted into 23 adult northern pikeminnow and 20 survived for the entire tracking period. Radio tagged fish were tracked throughout the reservoir and into the tributaries by boat, truck and air during the migration and spawning period from late May through mid-July. Locations were recorded and are being analyzed using Geographic Information Systems (GIS).

To quantify dietary habits of northern pikeminnow and estimate yellow perch consumption, stomach samples were collected from adult northern pikeminnow from July through October. Fish were obtained using gillnets. Approximately 100 stomach samples were collected from representative areas of the reservoir. These samples were preserved in 10% formalin and are being processed to identify and weigh each dietary item. The Wisconsin Bioenergetics Model 3.0 will be used to estimate the total consumption of yellow perch by northern pikeminnow in Cascade Reservoir.

To determine the level of northern pikeminnow abundance at which desired populations of yellow perch can be maintained, the Fisheries Analyses and Simulation Tools (FAST) 2.0 software package will be used. FAST requires fish population parameters like population abundance and estimates of fecundity, which were obtained from previous research. Mortality is the key population parameter to estimating desired yellow perch abundance.

EVALUATION OF PHYSIOLOGICAL CONDITION OF MIGRATING JUVENILE SALMON AND EFFECTS OF MULTIPLE-DAM BYPASS

Principal Investigator: J. L. Congleton
Student Investigator: T. Welker, D. Fryer, and L. Haley
Funding Agency: U.S. Army Corps of Engineers
Completion Date: 12/31/03

Objectives: 1) Sample spring chinook smolts of wild and hatchery origin to determine changes in energy reserves and other physiological indices during downstream migration to, and through, the Snake-Columbia River Federal Hydropower System, 2) Determine the cumulative effects of exposure to fish-bypass systems at multiple dams on stress indices, energy stores, and "tissue damage" enzymes, 3) Determine if significant differences exist between wild and hatchery fish chinook salmon such that they might have different survivorship following exposure to multiple by pass systems.

Progress: In the five years 1998 through 2001, PIT-tagged yearling chinook salmon *Oncorhynchus tshawytscha* reared at three hatcheries in the Snake River Basin (Dworshak, Rapid River, and McCall) were sampled prior to release, and from bypass systems at selected hydroelectric dams on the Snake and Columbia Rivers. Carcass and gut water, lipid, protein, and ash masses were determined so that the rate of use of energy reserves could be estimated as the fish migrated through, the hydropower system. Plasma triglyceride, cholesterol, and total protein concentrations and alkaline phosphatase activity were measured as indices of nutritional status.

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

Plasma triglyceride, cholesterol, and total protein concentrations and alkaline phosphatase activities decreased significantly as the fish migrated downstream, indicating that the energetic deficit in migrating fish was in part due to a low rate of food intake. The data did not suggest that increasing food availability in lake May and early June might improve the energy status of late-migrating fish.

White-muscle activities of citrate synthase (an indicator of aerobic capacity) also declined significantly as the fish migrated from Lower Granite Dam to Bonneville Dam. These results suggest that an energetic deficit-induced breakdown of body proteins lowers the activities of key metabolic enzymes. Lowered enzyme activities may reduce the performance capabilities of migrating fish for swimming, osmoregulation , and other vital functions. Significance decreases in swimming ability were in fact observed in 2001 and 2002 (thesis work of D. Fryer), and decreases in osmoregulatory ability were observed in 1999, 2000, and 2001 (thesis work of L. Haley).

In all years, fish reared at Dworshak National Fish Hatchery were smaller than fish reared at McCall and Rapid River hatcheries less robust, with smaller lipid and protein reserves. Marine survival rates for wild fish those and from the three hatcheries will be compared in future years and tested for correlations with physiological condition during the smolt migration.

EVALUATION OF THE PHYSIOLOGICAL CONDITION OF TRANSPORTED JUVENILE SALMON

Principal Investigator: J. L. Congleton
Student Investigator: T. Welker
Funding Agency: U.S. Army Corps of Engineers
Completion Date: 03/31/03

Objective: In recent years, the National Marine Fisheries Service has reported marked intra-seasonal changes in survival rated of PIT-tagged juvenile chinook salmon transported daily by barge from Lower Granite Dam (the first dam encountered by migrating smolts) to below Bonneville Dam (the last dam in the Snake-Columbia River Hydropower System). Our studies have also shown marked intra-seasonal changes in stress indices and other physiological indices in transported fish. This study was undertaken to determine if seasonal changes in stress indices, smoltification, or other indicators of physiological condition are correlated with survival rates, suggesting a possible cause-and-effect relationship.

Progress: Seasonal maxima in stress indices (cortisol and glucose) in juvenile chinook salmon were consistently correlated with seasonal peak loading densities of steelhead in the fish-transport barges. These stress responses are believed to be due to behavioral interactions between the chinook salmon and larger, more aggressive juvenile steelhead. We did not, however, find significant correlations between smolt-to-adult return rates for daily transport groups of chinook salmon and daily loading densities of steelhead in 1998, 1999, or 2000. These results suggest that co-transport with steelhead has little or no effect on post-transport survival of chinook salmon.

Mean gill Na^+,K^+-ATPase activities, an indicator of smoltification, were higher in wild chinook salmon than in hatchery fish throughout the migration season (1994, 1995, 1996, 2001), indicating that wild fish were more advanced in the parr-smolt transformation and possible better prepared in enter seawater. Gill Na^+,K^+-ATPase activities in hatchery and wild fish were higher in 2002, an average-flow year, than in 2001, a low-flow year.

EFFECTS OF SEDIMENTATION ON THE SURVIVAL OF WHITE STURGEON EMBRYOS

Principal Investigator: J. L. Congleton
Student Investigator: T. Kock
Funding Agency: Kootenai Tribe of Idaho
Completion Date: 5/31/03

Objective: While many factors have been implicated in the failure of white sturgeon recruitment in the Kootenai River, North Idaho, the potential effects of sedimentation on embryo survival are of particular interest. The combined effects of diking and decreased peak spring flows have resulted in deposition of fine sediments throughout the reach used by white sturgeon for spawning, Moreover, high spring flows during the sturgeon spawning season result in extensive movement of sediment, raising the possibility that sturgeon egg which are demersal, might be covered by fine sand. The objective of this laboratory study was to determine the effects of sediment cover on the survival and development of white sturgeon empryos.

Progress: An embyro incubation unit (EIU) was developed to study the effects of sediment cover on the survival and development of white sturgeon embryos in the laboratory. Embryo survival rates were found to be insensitive to changes in the size of ventilation holes in the base of the EIU, or to changes in above-substrate flow velocity. In comparison to the survival of embryos incubated in the absence of sediment (80-85% survival), the survival of embryos incubated under a 5-mm layer of fine sand (obtained from the sturgeon spawning reach of the Kootenai River) was reduced to 44% after 4d, and to 18-20% after 0 to 4d. No effect of sediment cover on embryo or larval size was observed. These results indicate that even a relatively thin layer of fine sediment can greatly reduce the survival of white sturgeon embryos.

YELLOWSTONE CUTTHROAT CONSERVATION PLAN

Principal Investigator:	George LaBar
Student Investigator:	Scott Host
Funding Agency:	Idaho Dept of Fish & Game
Completion Date:	5/16/03

Objective: To determine if a barrier is effective at reducing introgression between Yellowstone cutthroat and rainbow trout in tributaries of the South Fork Snake River, Idaho.

Progress: Spawning adult rainbow and Yellowstone cutthroat trout were captured at an artificial barrier in tributaries of the South Fork Snake River, Idaho. Rainbow trout were removed and Yellowstone cutthroat were physically released above the barrier. Tissue (fin) samples were collected from upstream spawning adults and age 0 fry immigrating back to the South Fork Snake River. Three nuclear DNA gene regions were amplified using PCR. The resulting allele frequencies were compared between the total spawning adults and age 0 fry. The data collected indicates significant differences in allele frequencies between the two populations to suggest a barrier is effective at reducing introgression between the two species in tributaries of the South Fork Snake River, Idaho.

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

Principal Investigator:	Kirk Lohman
Student Investigator:	Katherine Strickler
Funding Agency:	USDA-Forest Service
Completion Date:	9/30/05

Objectives:

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

1. 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 subbasin;

2. 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 subbasin; and
3. To relate variation in benthic invertebrate metrics among different watersheds or years to stream habitat variables.

Progress:

Contract objectives were completed in 2002, with aquatic invertebrate samples collected in July and August 2002 from 12 streams in the South Fork of the Salmon River and Big Creek watersheds. All samples have been identified and enumerated to the level of genus. Preliminary analyses of pre- and post-fire invertebrate samples from the Big Creek subbasin indicate that relative abundance of true fly larvae (order Diptera) has increased in most streams following the 2000 fires, while relative abundance of mayfly larvae (order Ephemeroptera) has decreased. Further analyses of benthic invertebrate community composition and densities are in progress. A report will be completed by March 31, 2003.

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

Principal Investigator:	C. Peery
Student Investigators:	Brett High (completed 12/02)
	Tom Goniea (completed 12/02)
	Eric Johnson
	Amy Pinson
Funding Agency:	U.S. Army Corps of Engineers
Completion Date:	12/31/02

Objective(s)

1. Evaluating the degree and effects of fallback fish at dams
2. An Evaluation of locations for a new fishway at Bonneville Dam
3. Identifying sources of delay and loss in the system and effects of environmental variables on passage
4. Evaluating the effects of barging smolts around dams on the homing and straying of returning adult migrants
5. Evaluating the energy use of adult salmonids during their upstream migrations
6. Evaluate reproductive successes and swimming performance of Pacific Lampery and factors which affect their passage at dams.

In 2002, we conducted the sixth field season in a basin-wide research study investigating migration of adult salmon, steelhead, and Pacific lamprey in the Columbia and Snake rivers. Over 3,500 adult fish were outfitted with radio transmitters at Bonneville Dame and monitored as they migrated upstream using a network of fixed-site radio receivers and by mobile tracking from boats and trucks for a variety of study objectives.

- Data collected from these studies will be used to determine factors affecting passage, survival, and reproductive successes for adult salmonids and lamprey migrating through the lower Columbia and Snake rivers.

- As part of this project, we conducted a second year of monitoring the depth and temperatures of fish as they migrated upstream in the system to evaluate effects of dissolved gas and temperatures on fish behavior and survival. Fish used for this part of the study were tagged at Bonneville. At Bonneville, we also conducted a second year investigating swimming performance of Pacific lamprey and factors that affect their passage at dams.

- In the Snake River drainage, we conducted an evaluation on the use of cool water released from Dworshak reservoir on adult migration behavior in the lower Snake River during summer, and a test of structural modifications in the fishway to improve passage at Lower Granite Dam, as well as the continuation of passage and survival evaluations conducted in the lower Columbia River.

- Currently, we are in the final stages of monitoring the 2002 steelhead run and are processing the 2002 Chinook salmon data. Our results will be used in association with efforts to recover and conserve ESA listed salmonid populations in the Interior Pacific Northwest. Funding for this project is provided by the U.S. Army Corps of Engineers, Portland and Walla Walla Districts.

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

Principal Investigator:	C. Peery
Funding Agency:	U.S. Corps of Engineers
Completion Date:	9/30/03

Objectives(s)

1. Evaluate fallback of adult salmon and steelhead at Columbia and Snake River dams.
2. Evaluate delay of adult salmon and steelhead at Columbia and Snake River dams.
3. Evaluate homing and the incidence of straying of adult salmon and steelhead migrating to natal streams in the Columbia River basin.
4. Determine temperature and dissolved gas exposure of adult salmon and steelhead migrants and evaluate its effects on survival.
5. Assist other researchers in the evaluation of steelhead kelt passage downstream through the Columbia and Snake rivers.
6. Assess the effects of passage through the Columbia and Snake rivers hydrosystem on the survival and reproductive fitness of adult salmon and steelhead.
7. Assist in evaluation of adult salmon and steelhead behavior and passage in fishways with adult PIT tag detection systems and efficiency of the detectors.

In 2002, we conducted the sixth field season in a basin-wide research study investigating migration of adult salmon, steelhead, and Pacific lamprey in the Columbia and Snake rivers. Over 3,500 adult fish were outfitted with radio transmitters at Bonneville Dame and monitored as they migrated upstream using a network of fixed-site radio receivers and by mobile tracking from boats and trucks for a variety of study objectives.

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HYBRIDIZATION IN WESTSLOPE CUTTROAT TROUT

Principal Investigator:	Matt Powell
Student Investigator:	Mike Peterson
Funding Agency:	Idaho Dept of Fish & Game
Completion Date:	6/30/03

Objectives: Westslope cutthroat trout are currently under a second, court-ordered, status review by the U.S. Fish and Wildlife Service to determine whether the subspecies should be listed as threatened under the Endangered Species Act. Hybridization and introgression from stocking of non-native trout has been cited as the principal biological hazard to the persistence of the subspecies and was referred to by the court as the primary reason for the decision to order a second status review. The Idaho Department of Fish and Game and the University of Idaho have been investigating hybridization and introgression in westslope cutthroat trout populations throughout Idaho. The research has focused on populations of westslope cutthroat trout in the Middle Fork of the Salmon River drainage thus far. The two primary objectives of this study are (1) to assess whether past stocking of hatchery trout in high mountain lakes within the drainage has led to hybridization and introgression, and (2) to determine whether natural hybridization and introgression between sympatric westslope cutthroat trout and native rainbow trout occurs within the drainage.

Progress: We have extracted whole genomic DNA (includes mitochondrial and nuclear DNA) from 1,247 samples that were collected during the summer of 2002. We then preformed Polyrmerase Chain Reaction (PCR) amplification on 1 mitochondrial DNA locus (gene region), 3 nuclear DNA loci and 4 microsatellite DNA loci on the extracted samples. After the amplification of the DNA was completed we digested the PCR product with a restriction enzyme (cuts the DNA at a specific site and is used to identify genetic differences at the gene region your looking at) to identify the hybrids. We have identified that hybridization has occurred and we are in the process of determining whether that hybridization is from native or introduced Rainbow Trout. We are currently analyzing the data with a genetics program called GENEPOP to determine the genetic population structure of Westslope Cutthroat in the Middle Fork of the Salmon River. We are also writing a manuscript for publication.

SPATIAL DISTRIBUTION OF PHENOTYPIC DIVERSITY IN A WESTSLOPE CUTTHROAT TROUT

Principal Investigator:	J. M. Scott
Student Investigator	Kathy McGrath
Funding Agency:	USDA-FS
Completion Date:	12/31/02

Results: Contract requirements were completed during 2002 and the final report was delivered to the U.S. Forest Service. The final report included a summary of accomplishments, two manuscripts in publication format, and all data and metadata corrected during the project. One manuscript focused on broad spatial scales and environmental gradients hypothesized to drive size diversification, and the other focused on finer spatial scales and the role of habitat complexity in generating size variation. Three trips to the field were conducted early in 2002 to collect otoliths of overwintering age 0 cutthroat trout and additional habitat complexity information. Two presentations were given, 1) at the Western division of the American Fisheries Society Annual Meeting in Spokane, WA, and 2) the Washington State University Seminar in Environmental Science and Environmental Engineering, Richland, WA. Awards received include a University of Idaho Graduate Student Association Travel Grant and the Sustainable Fisheries Foundation Annual Scholarship. Remaining work on this project includes lab work preparing and reading otolith microstructure for over-winter survival and life history characteristics, and completion of remaining manuscripts.

DISTRIBUTION AND ABUNDANCE OF THE FISHES OF IDAHO

Principal Investigator:	J. M. Scott/G. LaBar
Student Investigator:	D. Zarabon
Funding Agency:	Dept of Environmental Quality
Completion Date:	07/01/05

Objectives:

1) 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; make occurrence information available through the Idaho Digital Atlas, Idaho GAP, Orma J. Smith Museum of Natural History;

2) Create and field test a species occurrence prediction model for Wood River sculpin and shorthead sculpin to address bias associated with occurrence only data set and to delimit the range of the species, publish model and results in peer reviewed/refereed journal;

3) Compile records of fish introductions (native and alien species), geo-reference the introduction events, append results to existing IDFG fish stocking database, publish process and results in peer reviewed/refereed journal; and

4) Assess status of Wood River sculpin population and potential for conflicting fishery management goals in the Wood River drainage created by stocking native and alien salmonids for recreational purposes in waters containing Wood River sculpin (an endemic species listed as a species of special concern, publish results of status and management conflict assessment as separate articles in peer reviewed/refereed journal.

Progress: Dissertation project objectives were drafted and reviewed by primary advisors, comprehensive literature review was conducted for each objective, and project proposal written. I anticipate presentation of project proposal to the department during the graduate seminar in the fall 2003 semester.

Completed Projects - Fisheries Resources

David H. Bennett - Principal Investigator

- Effects of increased winter water levels in Lake Pend Oreille on kokanee survival, predation, food abundance, and aquatic macrophytes
- Effects of higher winter lake levels on the carrying capacity of Lake Pend Orielle, Idaho

Theodore Bjornn - Principal Investigator

- Juvenile Life History, downsteam migration rate, and survival of wild snake river fall chinook salmon

James L. Congleton - Principal Investigator

- Development of methods of control of infectious hematopoietic necrosis virus (IHN) in commercially reared salmonid fishes

C. Michael Falter – Principal Investigator

- Mid-Snake Sediment Study

George LaBar - Principal Investigator

- Bull trout genetics comparison in the North Clearwater River drainage

Christine M. Moffitt - Principal Investigator

- Susceptibility of bull trout, *Salvelinus confluentus*, to infection by Reinbacterium salmoninarum, causative agent of bacterial kidney disease

Dennis Scarnecchia - Principal Investigator

- Bull trout studies in the East and South Fork Salmon River

EFFECTS OF INCREASED WINTER WATER LEVELS IN LAKE PEND OREILLE ON KOKANEE SURVIVAL, PREDATION, FOOD ABUNDANCE, AND AQUATIC MACROPHYTES

Principal Investigator: D. H. Bennett
Student Investigators: Lance Clark
Dimitri Vidergar
Funding Agency: Idaho Dept of Fish and Game/Bonneville Power Adm
Completion Date: 12/31/01

Objectives: 1) To evaluate growth and survival of age 0 kokanee in Lake Pend Oreille; 2) To evaluate the spatial and temporal zooplankton abundance in Lake Pend Oreille during the growth season for kokanee; and 3) To evaluate the abundance of potential predators and assess their consumption of kokanee in Lake Pend Oreille.

Results: The initial stages of this project have been completed and have resulted in completion of two Master of Science theses and one Ph.D. dissertation:

Clarke, L. 1999. Juvenile kokanee diet and growth, and zooplankton community dynamics in Lake Pend Oreille, Idaho. M.S. thesis. University of Idaho, Moscow.

Vidergar, D. T. 2000. Population estimates, food habits, and estimates of consumption of selected predatory fishes in Lake Pend Oreille, Idaho. M.S. thesis. University of Idaho, Moscow.

Chipps, S.R. 1997. *Mysis relicta* in Lake Pend Oreille: Seasonal energy requirements and implications for mysid-cladoceran interactions. Ph.D. dissertation. University of Idaho, Moscow.

In addition, studies have been conducted to test the hypothesis that emerging kokanee *Oncorhynchus nerka* need food immediately or mortality will ensue. Dietary studies of emerging kokanee showed strong selection for copepods, especially *Cyclops bicuspidatus thomasi* although *Bosmina longirostris*, a reported important dietary zooplankton, was present in zooplankton samples. *Mysis relicta*, opossum shrimp, appeared in stomachs of age 0 kokanee in net pen studies showed no differences in kokanee growth and survival between kokanee maintained at ambient food levels and those considered high for the lake. Initial findings are that food is not limiting survival of recently emerging kokanee in Lake Pend Oreille.

EFFECTS OF HIGHER WINTER LAKE LEVELS ON THE CARRYING CAPACITY OF LAKE PEND ORIEILLE, IDAHO

Principal Investigator: D. H. Bennett
Student Investigators: Chris Karchesky
Funding Agency: Idaho Department of Fish and Game
Completion Date: 12/31/01

Objectives: 1) Assess changes in fish community structure with an emphasis on selected warmwater species following a 3-year period of reduced winter draw down in the Pend Oreille River, Idaho; and 2) Evaluate the winter movement and habitat selection of largemouth bass in relation to winter draw down in the Pend Oreille River, Idaho.

Results: We collected over 8,000 fish representing 19 species during 1999 and 2000, and found that fish community structure was significantly different among sampling years although only catch rates of black crappie *Pomoxis nigromaculatus*, mountain whitefish *Prosopium williamsoni* and suckers *Catostomus spp.* were significantly different between pre- and post-high winter water years. Population structure of largemouth bass *Micropterus salmoides*, black crappie, and pumpkinseed *Lepomis gibbosus* revealed significant differences between sampling years with an increased abundance of larger and older fish following 3-years of higher winter water levels. The increase in average fish size and age structure was attributed to improved winter survival during high winter water years, spring water temperatures prior to and during the spawning season were significant along with winter water temperatures in February, spring refill timing and quality of the growing season. The data suggested that draw down interacts with spring and winter conditions that ultimately determine the year-class strength for warmwater fishes.

Movement and habitat selection were characterized for 20 adult largemouth bass (> 300 mm total length) were captured in the Pend Oreille River, surgically implanted with radio transmitters, and monitored biweekly from September 1999 to June 2000. In the fall, largemouth bass exhibited a shift from backwater habitat to shoreline areas along the main river channel in response to lowering water levels and movement into over-wintering areas occurred in early November when water temperatures decreased below 10° c and drawdown was near completion. Two primary over-winter areas (combined area 102.1 ha) contained 95 % of the radio-tagged largemouth bass from November to mid-March. Aquatic vegetation in 1-3 m of depth was associated with 90.2 % of the winter locations of largemouth bass, and was the most selected winter habitat

JUVENILE LIFE HISTORY, DOWNSTREAM MIGRATION RATE, AND SURVIVAL OF WILD SNAKE RIVER FALL CHINOOK SALMON

Principal Investigator:	T. Bjornn & J. M. Scott
Student Investigator	William P. Connor
Funding Agency:	Army Corp of Engineers
Completion Date:	12/31/01

Objectives: Snake River fall chinook salmon *Oncorhynchus tshawytscha* were listed for protection under the Endangered Species Act in 1992. In 1990s, there was little information on life history, downstream migration rate, or survival of young fall chinook salmon in the former and current spawning and rearing areas. There was also little information on the efficacy of summer flow augmentation, which was intended to improve downstream migration rate and survival of fall chinook salmon smolts in the lower Snake River.

1. Analyze data collected on wild Snake River fall chinook salmon from 1992 to 2000.

Results:

- Development through the early life stages (fry, parr, and smolt) proceeded in direct accordance with the water temperatures of present-day spawning and rearing areas. Wild fall chinook salmon emerged, reared along the shorelines, and began seaward migration earliest in the warmest spawning and rearing area, and latest in the coolest area. The historical spawning and rearing area, which was eliminated by dam construction, was warmer than present-day areas. Therefore, it produced young fall chinook salmon that developed on an earlier time schedule than observed in the spawning and rearing areas currently available for production.
- Downstream migration rate of wild fall chinook salmon was influenced by several variables. Larger juveniles migrated downstream faster than smaller juveniles. Fish that were initially captured, tagged, and released at warmer temperatures typically migrated downstream faster than those released at cooler temperatures. Fish that passed downstream during periods of higher flow usually migrated faster than fish that experienced lower flow levels. Downstream migration rate also increased as the distance traveled in free-flowing river increased.
- Survival of wild fall chinook salmon during early seaward migration was influenced by both flow and water temperature. Survival increased as flow during downstream passage increased. Smolts that migrated downstream when temperatures were relatively cool survived better than those that migrated when temperatures were relatively warm.
- Developed modeling techniques to estimate the effects of summer flow augmentation on downstream migration rate and survival of wild juvenile fall chinook salmon. Model runs suggested that the increases in flow caused by summer flow augmentation increased downstream migration rate. Model runs also indicated that increases in flow and decreases in water temperature caused by summer flow augmentation increased smolt survival during early seaward migration.

DEVELOPMENT OF METHODS OF CONTROL OF INFECTIOUS HEMATOPOIETIC NECROSIS (IHN) VIRUS IN COMMERCIALLY REARED SALMONID FISHES

Principal Investigator: J. L. Congleton
Funding Agency: Western Regional Aquaculture Consortium
Completion Date: 12/31/02

Objectives: 1) Develop model challenge protocols that mimic the etiology of mixed IHNV/*Flexibacter psychrophilus* infections; 2) Determine effects of IHNV and *F. psychrophilus* on the immune response of rainbow trout; and 3) Determine histopathological changes in various tissues from fish exposed to mixed IHNV/*F. psychrophilus* infections.

Results: Work on this project focused on objectives 2 and 3. Development of an ELISA (enzyme-linked immunosorbence assay) method for measurement of the humoral immune response against Flexibacter was successful. Methods were also developed for dual staining of IHN virus and Flexibacter antigens in tissue sections. These methods are currently being applied to the study of histopathological changes in rainbow trout with mixed IHNV/Flexibacter infections.

SEDIMENT CHARACTERIZATION BELOW WASTE LOADINGS IN THE MID-SNAKE RIVER, SOUTH-CENTRAL

Principal Investigator: C. Mike Falter
Student Investigator: Dustin Hinson
Funding Agency: U.S. Fish & Wildlife Service
Completion Date: 9/30/02

Results: In 2000-01, sediments, benthic macroinvertebrates (BMI), and aquatic macrophytes (AM) were sampled downstream of a subset of existing aquaculture and agriculture discharges to the middle Snake River from Twin Falls, Idaho (RK 984.6) to Upper Salmon Falls Dam (RK 935.5). Control samples were collected upstream of the aquaculture and agriculture discharges for comparison. Results indicate that the dominant particle sampled upstream and downstream of all sampled discharges (3 aquaculture and 3 agriculture) in 2001 was sand (43-95%), followed by silt (4-48 %) and clay (0.5-5.0 %), respectively. In 2001, sand content was generally greater in agriculture deposition zones than aquaculture deposition zones. Overall, 2001 sediment nutrient levels (P and N) were greater downstream of aquaculture discharges than below agriculture discharges. Sediment P averaged 758.7 _g×g-1 upstream of agriculture discharges and 688.1 _g×g-1 downstream of agriculture discharges. Sediment P averaged 734.9 _g×g-1 upstream of aquaculture discharges and1473.9 _g×g-1 downstream of aquaculture discharges in 2001. Sediment P was significantly greater ($p < 0.05$) in deposition zone sediments than control zone sediments throughout the five sampling months for all three aquaculture study sites. Sediment organic matter content averaged 1.11 % upstream of agriculture discharges and 0.91 % downstream of agriculture discharges. Sediment organic matter content averaged 1.57 % upstream of aquaculture discharges and 1.78 % downstream of aquaculture discharges. Sediment lead, chromium, cadmium, and nickel concentrations exceeded threshold effects levels at some point during the 2001 study, while probable effects levels were exceeded by cadmium and nickel. Dominant BMI sampled from the middle Snake River in 2001 were pollution-tolerant taxa, including Potamopyrgus antipodarum, Oligochaeta, Chironomidae, and Hyalella azteca (Amphipoda). BMI density, biomass, and richness were generally greater downstream of aquaculture discharges than below agriculture discharges in 2001. The density of Potamopyrgus antipodarum was greater downstream of aquaculture discharges than below agriculture discharges. Aquatic macrophytes were dominated by Potamogeton crispus, Ceratophyllum demersum, and Elodea canadensis, all taxa considered tolerant of organic pollution and eutrophic conditions. AM densities found during the 2001 middle Snake River sampling effort were greater than the 200 g×m-2 nuisance level (nuisance level per EPA 2002) downstream of all three aquaculture study sites and one agriculture study site. Plant biomass averaged 5.9 g×m-2 upstream of agriculture discharges and 6.2 g×m-2 downstream of agriculture discharges. Plant biomass averaged 33.5 g×m-2 upstream of aquaculture discharges and 73.1 g×m-2 downstream of aquaculture discharges.

BULL TROUT GENETICS COMPARISON IN THE NORTH CLEARWATER RIVER DRAINAGE

Principal Investigator:	George LaBar
Student Investigator:	Danielle Schiff
Funding Agency:	Idaho Dept of Fish & Game
Completion Date:	12/31/01

Results: Since bull trout *Salvelinus confluentus* have been listed as a federally threatened species state and federal agencies have been required to identify critical habitat areas across their distribution. This study was designed to document their spatial and temporal distribution in the North Fork Clearwater River drainage, Idaho. Radio transmitters were implanted in 119 bull trout from April 2000 – October 2001 in Dworshak Reservoir. Their overall migration pattern is emigrating from Dworshak Reservoir on the descending limb of hydrograph following high flows, generally late May. Then they migrate through the mainstem rivers and reach spawning areas in mid-August through early September. Spawning occurs from late August through the end of September. There are two different return migration patterns. The first pattern is where individuals following spawning will quickly return to the reservoir for overwintering, spending a few days in the mainstem river. The second pattern is where individuals after spawning will migrate to the mainstem river and remain there feeding on kokanee for several weeks before proceeding to the reservoir for overwintering. Overwintering occurs throughout the reservoir with a concentration of individuals in the mid-reach of the reservoir. It is uncertain if this is the historic downstream distribution for these fish or if they move into this area because of prey availability. Bull trout were not documented being entrained through Dworshak Dam during this study. This population's length-at-age structure is smaller than other populations across their distribution. This may be a result of the loss of anadromous species, mainly steelhead trout, since the construction of Dworshak Dam.

SUSCEPTIBILITY OF BULL TROUT, *SALVELINUS CONFLUENTUS,* TO *RENIBACTERIUM SALMONINARUM*, CAUSATIVE AGENT OF BACTERIAL KIDNEY DISEASE

Principal Investigator:	Christine M. Moffitt
Student Investigator:	Darin T. Jones
Funding Agency:	U.S. Fish and Wildlife Service & USGS
Completion Date:	6/30/02

Objectives: 1) Determine the susceptibility of bull trout to bacterial kidney disease (BKD), caused by *Renibacterium salmoninarum*; 2) Compare the susceptibility of bull trout to BKD with that of other salmonid species, for which there are more data; and 3) to provide information and analysis about the risks of infections of *R. salmoninarum* to managers involved with bull trout recovery.

Results:
We evaluated the susceptibility of juvenile bull trout (*Salvelinus confluentus*) to challenge with *Renibacterium salmoninarum*, causative agent of bacterial kidney disease, at 9 and 15°C with three approaches: 1) estimating the median lethal dose (LD_{50}), 2) comparing the survival of challenged fish relative to related salmonid species, and 3) assessing the ability of fish surviving challenge to maintain swimming at 5- 6 body lengths for up to 30 min.

In general, we found bull trout were more resistant to infection than other related salmonid species. For determination of LD_{50}, groups of juvenile bull trout were challenged with one of several levels of *R. salmoninarum* and observed for up to 60 d. The slopes of probit curves fit to survival data were tested between and within trials held at each temperature and were found to be similar. Intercepts of the probit curves were different between temperatures with a higher magnitude of challenge estimated for median mortality at the colder water temperatures (5.60×10^7 cells/g at 15°C vs 5.61×10^8 cells/g at 9 °C).

In separate experiments, we evaluated the susceptibility of juvenile bull trout to *R. salmoninarum* relative to that of lake trout *(S. namaycush)*, arctic char (*S. alpinus*), chinook salmon (*Oncorhynchus tshawytscha*), and rainbow trout (*O. mykiss*) at 9 and 15°C. Survival distributions and endpoint survival were compared between species within each temperature. Bull trout and lake trout exhibited similar patterns of mortality while arctic char were the most susceptible char species. Rainbow trout and chinook salmon were more susceptible than the chars, with chinook salmon most affected by the bacterium. We used enzyme linked immunosorbent assay (ELISA) to determine the amount of soluble antigen in kidney tissue of fish surviving bacterial challenge. Whereas kidneys of unchallenged control fish were nearly all below detection, the majority of challenged fish had OD values between 0.2 and 0.999. Even though the majority of challenged fish had elevated ELISA values, only five fish surviving challenge exhibited clinical signs of kidney disease.

Groups of fish surviving challenge were tested for swimming endurance at 5-6 body lengths/s also at 9°C or 15°C, to determine if bacterial infection affected prolonged swimming ability and blood plasma parameters. Bull trout with clinical signs of bacterial kidney disease were less able to maintain continuous swimming than were fish that were not challenged with the bacterium. No significant differences were detected between the time to fatigue of the clinically healthy bull trout challenged with different bacterial concentrations. Bull trout and lake trout fatigued significantly faster in trials than did arctic char or rainbow trout. More than 60% of challenged and control rainbow trout did not exhibit exhaustion after 30 min of swimming. Arctic char had higher hematocrit than either bull trout or lake trout. Hematocrit of clinically diseased fish and some non-clinically diseased fish within higher bacterial challenge groups was significantly lower than that of unchallenged controls. Plasma samples from Arctic char challenged with *R. salmoninarum* exhibited significantly lower sodium and chloride concentrations, and significantly higher glucose levels when compared to control fish not challenged.

We conclude from these studies that associations of bull trout with species of fish infected with *R. salmoninarum* are not likely to affect populations of bull trout, since challenged bull trout with sub clinical infections appeared to function similarly to fish not challenged with live bacteria. However, further studies of swimming stamina that would involve repeated testing of individual fish are recommended.

We have prepared one manuscript based on this research for submission to the *Journal of Aquatic Animal Health*, and plan to submit it within the next month. We have one other manuscript in preparation.

BULL TROUT STUDIES IN THE EAST AND SOUTH FORK SALMON RIVER

Principal Investigator: D. Scarnecchia
Student Investigator: David Hogen
Funding Agency: Idaho Department of Fish and Game
Completion Date: 6/30/01

Objective: To determine spatial and temporal distribution of bull trout in the upper East Fork, South Fork Salmon River and its tributaries.

Results: This study investigated the spatial and temporal distribution of bull trout in the upper East Fork South Salmon River (EFSFSR) and its tributaries in 1999 and 2000. The objectives of this study were to determine if the bull trout were resident or migratory, investigate if environmental parameters affect bull trout locations, and delineate spawning, migration corridors, and overwintering habitat. Radio transmitters were implanted in sixty-five bull trout (>385 mm FL) in the EFSFSR to study these objectives. Bull trout group movement by year was determined to exhibit non-random movement (nonparametric runs test, $p = 0.01$). All radio-tagged fish were migratory. Streamflow was determined to be a significant environmental factor in predicting bull trout location (autoregression, $p = 0.0001$). Bull trout spawned in Quartz, Profile, Tamarack, and Sugar Creeks and their tributaries from August 28 to September 15. An adfluvial population of bull trout was identified in the Glory Hole near Stibnite, Idaho. Fluvial bull trout overwintering habitat included both the lower SFSR (Sheep Creek confluence downstream to mouth) and Salmon River (Elkhorn Creek confluence upstream to Big Mallard Creek confluence).

Completion report was written and accepted by funding agency.

Ongoing Projects - Wildlife Resources

E. O. Garton - Principal Investigator

- Beach buffer effectiveness project
- Deer and elk interaction
- Elk Ecology Program
- Population Dynamics of Elk
- Pronghorn antelope population inventory methods

Wayne Melquist - Principal Investigator

- Population status and habitat use of Clearwater wolverine

Dennis Murray - Principal Investigator

- Direct responses of snowshoe hares to pre-commercial thinning
- Assessing snowshoe hare population estimation methods and habitat relationships in Northern Idaho

Janet Rachlow - Principal Investigator

- Evaluation of census techniques for pygmy rabbits
- Conservation genetics of Idaho ground squirrel *(Spermophilus brunneus)*
- Lamb production in California bighorn sheep

Kerry P. Reese - Principal Investigator

- Ecology and demographics of mountain quail
- Population dynamics of sage grouse in Little Lost/Cow, Idaho
- Jarbridge sage grouse ecology project
- Translocation of trumpeter swans
- Mule deer analysis

J. Michael Scott - Principal Investigator

- Development of guidelines for comprehensive conservation
- Development of unmanned airborne vehicle for monitoring wildife
- Gap analysis of the Ukraine
- Breeding ecology and philopatry in red-shouldered and red-tailed hawks
- Ecology of the endangered nightingale reed warbler
- Determinants of recovery plan population goals
- Decision making for comprehensive conservation planning
- Endangered Species Act at 30: Science, Policy and Law

Lisette Waits - Principal Investigator

- Using DNA to monitor grizzly bear population trends
- Red wolf genetics

Gerry Wright - Principal Investigator

- Biological data investigation
- Landscape analysis of black bear
- Managing resource data
- McCarthy bear project
- Understanding the range
- Habitat use
- Expansion of moose in Idaho

BEACH BUFFER EFFECTIVENESS PROJECT

Principal Investigator: E. O. Garton
Student Investigator: Michelle Kissling
Funding Agency: U.S. Fish and Wildlife Service
Completion Date: 6/30/03

Objectives: 1) Design an approach for determining the effectiveness of beach buffers for perching and movement; 2) Evaluate the adequacy of the beach buffers for maintaining quality of habitat.

Progress: Preliminary analysis has revealed that more fieldwork on influence of observers will be necessary to reduce variability and produce more meaningful results. A proposal describing field methods is currently being refined. Methods will include an assessment of edge effects of migratory and resident birds, including bald eagles. This approach has been, and continues to be, peer-reviewed. Field research will be conducted to investigate avian composition, abundance, and distribution in maritime-influenced forests in the Tongass National Forest. The evaluation of the beach buffers has not yet been addressed, and will be a result of Objective 1 efforts.

DEER AND ELK INTERACTION

Principal Investigator: E. O. Garton
Student Investigator: Jeff Manning
Funding Agency: Idaho Dept. of Fish & Game
Completion Date: 6/30/03

Objectives:

- Estimate the effects of competition and other fators on population growth rates of Rocky Mountain elk, white-tailed deer, and mule deer
- Develop a multi-ungulate system model that includes all three species, the estimated strength of competitive effects, other factors, and interactions.

Progress: Completed extensive literature searches and preparing a proposal that describes data sources and methods of analyses. Elk and deer population data collected over the past 30 years by the Idaho Department of Fish and Game are currently being compiled in a database. As part of developing a database of environmental variables that may predict changes in population growth rates. Exploring available methods of modeling snow depths and vegetation succession through time. Exploratory analyses of this data is underway.

ELK ECOLOGY PROGRAM

Principal Investigator: E. O. Garton
Student Investigator: Deborah Montgomery
Funding Agency: Idaho Dept. of Fish & Game
Completion Date: 6/30/03

Objectives:

Project 1: Estimating Survival Rates with Demographic and Environmental Factors for Elk in Idaho

1. Compare various survival analysis techniques and identify which one(s) are the most appropriate method(s) to use with particular datasets.
2. Using the best method(s), explore how demographic and environmental factors affect an elk's chance of survival for 4 elk populations from previous studies in 4 different locations in Idaho.
3. Evaluate the appropriate temporal and spatial resolution and extent for the chosen demographic and environmental factors.

Project 2: Elk calf growth and aging

1. Develop a model that will be able to estimate exact date of birth for elk calves using morphological variables.

Progress:
Project 1:

First, a literature review is being conducted on survival analysis techniques and elk survival. Second, we have begun organizing and editing the for the available information 4 different radio collared populations of elk from the Coeur d' Alene, Lochsa River and Sand Creek areas. Also, we have been exploring various survival analysis methods. Currently, we have implemented the Kaplan-Meier survival estimation technique on a small subsample of our dataset. We have also started locating information regarding various demographic and environmental covariates that we would like to include in the survival analysis. Additionally, we have mapped the GPS locations in ArcView of the elk in the 4 different populations.

Project 2:

Currently, a literature review is being conducted on elk calf growth and development. Various researchers who have worked with ungulate development have been contacted for advice and insight. Also, we have conducted univariate data analysis with two different datasets containing elk calf body measurement and known ages from captive elk calves. Additionally, we have conducted preliminary model development using multiple linear regression and polytomous, polylogous logistic regression methods.

POPULATION DYNAMICS OF ELK

Principal Investigator: E. O. Garton/J.M. Scott
Student Investigator: Jocelyn Acyrigg
Funding Agency: Idaho Dept. Fish & Game
Completion Date: 6/30/03

Objectives: The overall goal of this research project is to understand the observed spatial and temporal patterns of elk populations in Idaho using the metapopulation concept and to identify the factors that best explain these observed patterns at multiple spatial extents. Our objectives are (1) delineate populations based on demographic and genetic characteristics; (2) investigate demographic and environmental factors influencing populations, including harvest levels, density dependent responses, predation impacts, habitat change, weather patterns, road patterns, and nutritional requirements; and (3) identify factors that best explain patterns of elk populations, both temporally and spatially. A hierarchical approach will be employed for both local and large spatial extents. Multiple spatial extents are important to consider when studying population ecology, particularly if a population exhibits a patchy distribution at large spatial extents, but not at local extents.

Progress:

Objective 1: For the demographic characteristics, aerial survey data of elk populations for 1985-1999 was obtained from Idaho Department of Fish and Game. Some data prior to 1985 has also been obtained. Data for 2000-2003 has been requested from wildlife managers and will be obtained in the near future. Using the available data, a statewide digital map of the subunits used for aerial surveys has been completed. For the genetic population characteristics, a pilot study using microsatellite analysis on elk tissue samples gathered from the Wildlife Health Lab (Nampa, Idaho) is underway. We have extracted DNA from all of these samples of which there are about 150 and we are using polymerase chain reactions (PCR) to amplify DNA at specific loci. There are seven loci for which we have primers to identify the DNA sequence at these loci. And there are 9 more for which we have to optimize conditions. In addition to the tissue samples from the Wildlife Health Lab, we have also collected about 1200 samples from elk throughout the state and Oregon during 2001-2002. We could not have done this without the assistance from Regional Wildlife Biologists throughout the state. Furthermore, the subunit from which each tissue sample was collected will be located using the statewide subunit map. These spatial data of tissue samples will be important in analyzing the genetic population structure of elk populations in Idaho.

Objective 2: Demographic factors: Annual winter abundance of elk in the Lochsa River drainage (within the Clearwater National Forest) in north central Idaho was estimated from aerial survey data during 1969-1989. From 1969-1984, surveys were conducted with no visibility bias correction applied at the time of data collection and typically only in areas where there was a high probability of seeing elk. However, since 1985, structured surveys have been conducted with high, medium, and low stratum within the drainage. In order to analyze the aerial survey data for the Lochsa elk population, we corrected data gathered during winter 1969-1984 for visibility bias. First, we averaged the visibility correction bias values for total population estimates during 1985-1997 and applied it to estimates for 1969-1984. Second, since the aerial surveys prior to 1985 were usually flown in areas currently designated as high stratum, we averaged the visibility correction bias values for high stratum areas only and applied it to estimates for 1969-1984. The approach and analyses we used to test for statistical density dependence follow Dennis and Taper (1994). The test of the random walk model versus the stochastic exponential growth model failed

to reject the random walk model. The random walk model was rejected when tested with the density dependence model, however the P-value was borderline significant ($\hat{P} = 0.054$). A finding of statistically significant density dependence does not equate to ecological density dependence. More information needs to be known about the population and potential factors regulating it before any statements regarding ecological density dependence can be made. Ecological factors influencing the population growth of elk in the Lochsa River drainage could include harvest levels, bull:cow ratios, winter severity, and forage quality or availability. Not only are some of these factors, such as forage quality, difficult to assess, but also other factors, such as bull:cow ratios, observed in the current population may not reflect the past influences of these factors. In a wild elk population, the causal factor(s) influencing population growth may not be easily identified, however a test of statistical density dependence may provide a clue that the population is being regulated by a density-related factor.

Environmental factors: Selenium deficiency has been linked to lower productivity because of increased infertility, stillbirths, and abortions. Within Idaho, the levels of selenium in vegetation are considered low to variable. However, these levels in the vegetation do not equate to how much selenium is consumed and absorbed by elk. Other minerals, such as calcium, copper, iron, magnesium, and zinc can inhibit the absorption of selenium in the body. The availability of selenium and other minerals can be influenced by year, location, age of individual, and reproductive status of individual. We wanted to determine if there were differences in levels of selenium and selected minerals (calcium, copper, iron, magnesium, and zinc) in the blood of female elk in relation to location and year of sample collection and age class and pregnancy status. Levels of selenium, calcium, copper, iron, magnesium, and zinc were determined from blood samples taken during March of 1997, 1998, and 2002 from 104 female elk were live captured within the Clearwater region of Idaho. Blood samples were taken from and age class and pregnancy status were determined for each individual. We performed a multivariate analysis of variance (MANOVA) to determine if which predictor variables and interactions significantly influenced the response variables. Then we used the results to perform a canonical analysis. Location and pregnancy status were found to be significant with the selenium and other mineral variables. Our results indicate that selenium and other selected minerals do vary locally within north central Idaho. The level of selenium in the blood of female elk appears to be different based on location of sample and pregnancy status of the individual animal. Selenium appears to be driving the significance of the location variable, whereas selenium along with iron and copper were influencing the significance of the pregnancy status variable.
Objective 3: More demographic and genetic characteristics as well as demographic and environmental factors need to be evaluated prior to building this canonical correlation analysis.

PRONGHORN ANTELOPE POPULATION INVENTORY METHODS

Principal Investigator:	E. O. Garton
Student Investigator:	Tim Smyser
Funding Agency:	Idaho Dept. Fish & Game
Completion Date:	6/30/03

Objective: To assess variation in pronghorn antelope fawn:doe ratios relative to environmental variables.

Progress: To address this question, we will be looking in variation in pronghorn recruitment at two scales. At the larger scale, we will be compiling fall composition count data for the last 30 years across pronghorn range within the state. We will use these average fawn to doe ratios to look for correlation with a number of broad scale weather and forage quality variables assessed with satellite imagery.

On the second scale we have chosen two sites to represent the breadth of pronghorn recruitment. The first site is Eastern Owyhee County (GMU 49) characterized by low recruitment and hot, dry condition. The second site is Southern Camas Prairie (GMU 44) supporting higher recruitment rates and cool, moist conditions. Environmental variables thought to influence recruitment include weather, forage quality, and predation pressure. We will assess weather data by extrapolating from nearby weather stations maintained by the National Weather Service and the Natural Resources Conservation Services. We will use fecal indices to assess forage quality. Fecal samples will be collected throughout the lactation season and evaluated for fecal nitrogen and fecal 2,6 diaminopimelic acid as an index of net energy consumption. We will use a passive activity index consisting of a series of track stations distributed throughout throughout the two study sites to derive relative predator abundances. The focus of these stations will be to assess coyote abundance although these methods are sensitive to other terrestrial predators. Fall composition counts will be conducted in these and other GMUs in early August. Field work will commence this May and continue through August 2004.

POPULATION STATUS AND HABITAT USE OF CLEARWATER WOLVERINE

Principal Investigator:	Wayne Melquist
Funding Agencies:	Idaho Dept of Fish & Game U.S. Forest Service U.S. Fish & Wildlife Service
Completion Date:	6/30/03

Objectives: Determine the status and ecology of the wolverine and associated forest carnivores, and identify and provide proactive conservation measures for these species.

Progress: To meet the objectives stated above we initiated field efforts for wolverine and fisher in October 2002. Between October 2002 and January 2003 we constructed 16 new wolverine, "log-cabin" traps in the Clearwater National Forest. This complimented the 11 traps that were already constructed in 2001-2002 by the Lolo Pass Redevelopment Project crew. Although these traps are widely distributed from Lolo Pass to Mocus Creek, they are located in 6 general clusters of traps – allowing for efficient trap monitoring.

Trapping began on 4 January 2003. Between 4 January 2003 and 23 March 2003, the field crew captured 6 new male fishers and 2 new female fishers, along with 4 fishers from last year. All fishers were fit (or re-fit) with an *ATS* or *Holohill* radiocollar. The distribution of these captures spans the entire study area: from the East Fork of Lolo Creek to Mocus Creek, and South towards Elk Summit. In fact, the last fisher was trapped at approximately 6,100 ft elevation. This is interesting because the published literature suggests that fisher avoid higher elevations in favor of lower elevations near rivers and creeks.

In addition to fishers, the field crew captured a wolverine this year. The young male wolverine was captured near Elk Summit and recaptured in 3 other traps during the next week. A veterinarian implanted a transmitter in this wolverine; the wolverine is currently being monitored. We believe that wolverine are not continually living in the Highway 12 corridor at this time, but the Lochsa area may serve as an important linkage zone between the Bitterroot-Selway Ecosystem and the Kelly Creek and St. Joe Area. Weather permitting, the field crew has been conducting weekly radio-telemetry flights to monitor the wolverine and collect location data on the fishers.

Because the expense and difficulty in using radio-telemetry to monitor wolverine, we have been testing Global Positioning System/Satellite telemetry collars. We have a prototype ready for deployment for our next wolverine capture. We are hoping that the male wolverine caught at Elk summit will return to a trap in the near future; if so, we will fit this animal with a GPS collar. At this time the collars appear too large for all but the largest fisher.

We have also been back-tracking wolverine and fisher as snow conditions warrant. These data should provide us information regarding how wolverine and fisher use the landscape near and away from Highway 12. We have had 1 fisher use culverts for crossing Highway 12. After snow-tracking the fisher to the culvert and then again on the other side, we initiated an effort which included placing hair-snaring devices on nearby culverts. DNA from hair snared using this technique will allow us to identify the species and which individual fisher crossed via the culvert. We will continue this effort in late spring/early summer after spring run-off.

Finally, the field crew captured other non-targeted species in our trapping efforts, including at least 12 marten, 4 bobcats, 2 foxes, 2 coyotes, and 1 raven. DNA samples were collected from the bobcats and foxes, and are being analyzed at the Wildlife Genetics Laboratory in Missoula, Montana.

This project is being conducted in collaboration with the Lolo Pass Redevelopment Project. Michael Schwartz and Jeffrey Copeland (Project Leaders); Benjamin Jimenez (Lead Technician); Jennifer Boisvert, Jenny Schrumm, Jessica Bolis, Jack Marvin, Jay Bryan (Technicians).

DIRECT RESPONSES OF SNOWSHOE HARES TO PRE-COMMERCIAL THINNING

Principal Investigator: D. Murray
Funding Agency: Idaho Department of Fish and Game
Completion Date: 6/30/03

Objective: To document the abundance of snowshoe hares (via fecal pellet plot counts) on 6000 plots on the Idaho Panhandle Forest, and to assess how hare numbers relate to forest management practices.

Results:

1. Publication of paper validating fecal pellet plot method for hare population estimation in western U.S. (see reference)
2. Hiring of 8 undergraduate students during May-August to collect fecal pellet data on 615 transects (6150 plot locations), and 8 stands subject to alternative thinning protocols, on Idaho Panhandle National Forest (IPNF).
3. Collection of fecal pellet plot data on 30 transects, and mark-recapture data using livecaptured hares, on 6 snowshoe hare plots near Priest Lake, ID.

4. Completion of data collection on 60 pellet degradation plots near Priest Lake, ID.
5. Near-completion of collection and validation for Global Positioning System data from each of the 615 transects on the IPNF.
6. Inclusion of transect Global Positioning System data into existing hare fecal pellet database, and collation with USFS GIS databases on stand management history and landscape features surrounding each transect.
7. Entry of all pellet data collected on transects and stands during 2002 into existing database.
8. Preparation of draft paper examining differential pellet degradation across habitat types in Idaho.

ASSESSING SNOWSHOE HARE POPULATION ESTIMATION METHODS AND HABITAT RELATIONSHIPS IN NORTHERN IDAHO

Principal Investigator: D. Murray
Funding Agency: U.S, Geological Survey
Completion Date: 10/1/03

Objective: To document the abundance of snowshoe hares (via fecal pellet plot counts) on 6000 plots on the Idaho Panhandle Forest, and to assess how hare numbers relate to forest management practices.

Results:

1. Publication of paper validating fecal pellet plot method for hare population estimation in western U.S. (see reference)
2. Hiring of 8 undergraduate students during May-August to collect fecal pellet data on 615 transects (6150 plot locations), and 8 stands subject to alternative thinning protocols, on Idaho Panhandle National Forest (IPNF).
3. Collection of fecal pellet plot data on 30 transects, and mark-recapture data using livecaptured hares, on 6 snowshoe hare plots near Priest Lake, ID.
4. Completion of data collection on 60 pellet degradation plots near Priest Lake, ID.
5. Near-completion of collection and validation for GPS data from each of the 615 transects on the IPNF.
6. Inclusion of transect GPS data into existing hare fecal pellet database, and collation with USFS GIS databases on stand management history and landscape features surrounding each transect.
7. Entry of all pellet data collected on transects and stands during 2002 into existing database.
8. Preparation of draft paper examining differential pellet degradation across habitat types in Idaho.

EVALUATION OF CENSUS TECHNIQUES FOR PYGMY RABBITS

Principal Investigators: Janet Rachlow and Jim Witham
Funding Agency: Idaho Department of Fish & Game
Completion Date: 12/31/03

Objectives: The objective of this research is to evaluate census techniques for pygmy rabbits, and to test the potential for improving estimates of abundance using thermal imagery.

Progress: Surveys were conducted to assess density and activity level of pygmy rabbit burrows at three study sites in the Lemhi Valley, near Leadore, Idaho. Over 1440 burrow systems were evaluated for signs of rabbit activity, and density of active burrow systems ranged from 0.7 to 5.0 per ha across the study sites. We captured and marked 31 rabbits at two sites, and fitted 20 with radio collars. Individual rabbits have been observed using 3–10 different burrow systems, and burrow systems have been used by $\geq$3 animals. We evaluated current occupancy of burrow systems using observations of digging following fresh snowfall, and telemetry was used to confirm occupancy. This method will be used to evaluate the relationship between burrow system density and population size. Currently, we are using simulations of strip transects to evaluate survey effort required to provide estimates of density of active burrows given the range observed across the three study sites. This information will be used to recommend survey efforts for quantifying densities of rabbit burrows during survey efforts. Thermal imagery also was assessed as a potential method to determine burrow occupancy, however, preliminary results suggest that the method may not be suitable for this species.

CONSERVATION GENETICS OF IDAHO GROUND SQUIRREL *(SPERMOPHILUS BRUNNEUS)*

Principal Investigator:	Janet Rachlow
Student Investigator:	Alisse Garner
Funding Agency:	Idaho Department of Fish & Game
Completion Date:	12/31/03

Objectives: 1) to develop appropriate microsatellite markers to characterize genetic structure within and among populations of Idaho ground squirrels; 2) to examine divergence among and diversity within populations relative to geographic distance and time since isolation to better understand genetic consequences of population fragmentation; 3) to provide genetic information critical to conservation planning for the species; and 4) to develop genetic tools for use in evaluation of future conservation efforts (such as habitat restoration, translocation, or captive breeding).

Progress: During the 2002 field season, hair samples were collected for genetic analyses from >450 individuals from 8 populations of southern Idaho squirrels and 7 populations of northern Idaho ground squirrels. DNA has been extracted from the hair samples, and success of the DNA extractions was assessed by PCR amplification using mitochondrial primers. Nine microsatellite loci from the Columbian ground squirrel (*S. columbianus*) have been evaluated for use in the Idaho ground squirrel, and of those, five loci are polymorphic in Idaho ground squirrels. Currently, additional microsatellite loci are being developed for Idaho ground squirrels, and the DNA samples are being analyzed.

LAMB PRODUCTION IN CALIFORNIA BIGHORN SHEEP

Principal Investigator: Janet Rachlow
Student Investigator: Regan Berkley
Funding Agency: Idaho Department of Fish & Game
Completion Date: 12/31/04

Objectives: 1) to evaluate survival of adult females and production and survival of lambs; 2) to assess dates and causes of mortality; 3) to examine differences in habitat use and forage quality and quantity across three subpopulations experiencing differing levels of lamb recruitment; 4) to calibrate use of fecal progesterone to determine pregnancy rates of free-ranging mountain sheep.

Progress: Fieldwork was conducted during April through August 2002. Of 38 adult sheep radio-collared in February 2002, 9 have died, two died within one month of collaring, and the mortalities may have been related to capture. Three sheep were killed by mountain lions. Causes of death could not be assigned in the other cases, however, signs at two of the carcasses indicated mountain lion presence. Lambing began around April 20 and continued through June 12. Eighty-two percent of adult females were observed with lambs. Most of the summer lamb mortality occurred between May 17 and June 15. Nine of the 28 lambs originally observed disappeared over the course of the summer, resulting in a lamb:collared ewe ratio of 56% in August. An additional 13 radio-collars were fitted to adult females in March 2003. Ground monitoring of the newly collared sheep will begin in April 2003.

ECOLOGY AND DEMOGRAPHICS OF MOUNTAIN QUAIL

Principal Investigator: K. P. Reese
Student Investigator: B.C. Herman
Funding Agency: Idaho Department of Fish and Game
Completion Date: 6/30/03

Objectives: Our objectives were to further understand the demographics and habitat use patterns of mountain quail in west-central Idaho.

Progress: Manuscript was submitted and it shows that mountain quail survival differs between years and is not related to age or sex class. We also show that mountain quail heavily utilize riparian areas and are closer to water sources than random. These and results and other aspects of mountain quail ecology, in addition to their corresponding management recommendations, are included in this manuscript prepared for the Idaho Department of Fish & Game and the Bureau of Land Management.

POPULATION DYNAMICS OF SAGE GROUSE IN LITTLE LOST/COW CREEK, ID

Principal Investigator: K. P. Reese
Funding Agency: Idaho Department of Fish and Game
Completion Date: 6/30/03

Objectives: Survey greater sage-grouse leks in the Little Lost/Cow Creek watersheds of southern Idaho.

Progress: Lek counts have been completed and all data provided to IDFG for use in the statewide sage-grouse conservation planning efforts.

JARBRIDGE SAGE GROUSE ECOLOGY PROJECT

Principal Investigator: K. P. Reese
Student Investigator: J. Shepherd
Funding Agency: Idaho Department of Fish and Game
Completion Date: 6/30/03

Objectives: The general effects of shrubsteppe fragmentation on Greater Sage-Grouse have been implicated as a cause in range-wide declines, yet have not been studied and are not well understood. Research that has been conducted on Greater Sage-Grouse use of fragmented habitat has not quantified levels of fragmentation not sought to understand Greater Sage-Grouse use of fragmented areas. The purpose of this study is to provide land management and wildlife agencies that have jurisdiction over shrubsteppe habitat or Greater Sage-Grouse with a more complete understanding of the effects of natural and man-caused shrubsteppe fragmentation. the goals are; 1) to determine if the landscape metrics for home ranges with various levels of fragmentation explain movement patterns, productivity, and other measures of general habitat use of Greater Sage-Grouse, and 2) develop a model that uses vegetation patch characteristics (cover type, size, interpersion, and juxtaposition), topography (aspect and evaluation), and soil types to explain observed nesting and brood-rearing habitat use patterns using remotely sensed vegetation data, digital elevation models, and digitized soil maps, and 3) test this model in an area with known nest and brook-rearing success.

Progress: A third year of fieldwork was conducted through August 2002. Data analysis is underway.

TRANSLOCATION OF TRUMPETER SWANS

Principal Investigator: K. P. Reese
Student Investigator: K. Patrick
Funding Agency: Idaho Department of Fish and Game
Completion Date: 6/30/03

Objectives: The primary objective is to determine whether winter translocations of trumpeter swans is effective at increasing the distribution of the species.

Progress: IDFG radio-marked, translocated and has monitored trumpeter swans during the winter of 2002. The graduate student is developing a research proposal to investigate survival and distribution of the birds.

MULE DEER ANALYSIS

Principal Investigator: K. P. Reese
Funding Agency: Idaho Department of Fish and Game
Completion Date: 6/30/03

Objectives: Provide undergraduate students interns to assist with IDFG research projects in the Clearwater region.

Progress: Four interns were selected in April 2002 and worked from Mid-May to mid-August on Idaho Department of Fish & Game big game projects.

GUIDELINES FOR COMPREHENSIVE CONSERVATION ASSESSMENTS

Principal Investigators: J. Michael Scott/Leona Svancara
Funding Agency: U.S. Geological Survey
Completion Date: 03/31/03

Objective: With increasing human populations and a national policy of sustainable growth dependent on increased rates of consumption of natural resources, extinction threatens any species not adapted to anthropogenic environments and ecosystem not found in areas managed for the long-term maintenance of biodiversity. While efforts to protect landscapes have increased, the prioritization of land and creation of new reserves often operate without a comprehensive plan in mind, resulting in an opportunistic and uncoordinated attempt at protection. Our objectives are to a) identify a complimentary network of conservation opportunity areas that captures all under-protected, native species and cover types of Idaho in areas sufficient in size and connectivity to ensure viable populations and integrity of ecological processes, b) more fully document the capabilities and limitations of GAP data sets in the identification, selection, and design of reserves, and c) provide a protocol for others to create similar products in a user friendly format for policy makers, land managers and others making land use decisions.

Progress: To date, we have identified 317 native, non-anthropogenic terrestrial species that regularly breed in Idaho. Of these, 38.8% currently have <10% of their predicted habitat in areas managed for the long-term maintenance of biodiversity. This includes 61 bird species, 38 mammals, 16 reptiles, and 8 amphibians. Of the 317 total species, an average of 184.6 species were predicted to occur per hexagon (standard deviation = 39.8, range = 80-254). While areas of highest species richness (> 233 species) occurred in southern Idaho along the Snake River Plain, the sub alpine and alpine areas of northern and central Idaho, the shrub-steppe habitats of Owyhee County, and the largely non-vegetated lava fields of southern Idaho had the lowest richness values. Although species richness is lower in these regions, they provide unique habitats to some species that are found nowhere else in the state (e.g., northern bog lemming [*Synaptomys borealis*] in northern Idaho, Rock squirrel [*Spermophilus variegates*] in Owyhee County). This highlights just one of the shortcomings of prioritizing lands solely on species richness.

We are currently developing priorities and creating selection algorithms that incorporate the principles of representation, redundancy resiliency, complementarity and irreplaceability. Due to limited population size and/or distribution, we are considering threatened and endangered populations separately, using established guidelines for identifying size and distribution of conservation areas for these species and cover types. To assess the number of individuals and populations possible in protected areas, home range requirements for each species have been obtained from the literature and, where empirical data was lacking, estimates made using body size. The final step will be to assess potential conservation areas for primary threats (i.e., economic development, urbanization, road density), costs of land acquisition, and constraints to upgrading management status for those on public land.

GAP ANALYSIS OF UKRAINE

Principal Investigator: J. M. Scott
Student Investigator: Anna Pidgorna
Funding Agency: The George Soros Fund Open Society Institute
Completion Date: 05/17/03

Objectives: Determine representation of biological and geophysical features of Ukraine in existing nature reserves. From this analysis identify gaps in extant protective network of nature reserves.

Progress: Information on geophysical and biological features of the Ukraine have been obtained in digital form, study plan written and location of nature reserves digitized. Initial analyses documenting occurrence of geophysical and biological features in nature reserves has begun.

UNMANNED AIRBORNE VEHICLE

Principal Investigator: J. M. Scott/ Pete Zager
Funding Agency: U.S. Geological Survey
Idaho Department of Fish and Game
Completion Date: 12/31/04

Objectives:

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

Progress: Reviewed possible platforms, interviewed potential users and built partnerships to host a symposium in April 2003 on Unmanned Aerial Vehicles.

BREEDING ECOLOGY AND PHILOPATRY IN REDSHOULDERED AND RED-TAILED HAWKS

Principal Investigator: J. M. Scott
Student Investigator: Peter Bloom
Funding Agency: Personal
Completion Date: 12/31/06

Objectives:

1. Determine nesting success response of redshouldered and red-tailed haps to varying habitats and climatic conditions.

2. Determine philopatry from redshouldered and red-tailed hawks in different habitat and under variable climatic conditions.

Progress: Banded 2112 nestling red-shouldered haws and recapture 99, and recovered 82. Banded 3.860 red-tailed hawks and 8 have been recapture and 121 recovered. Recaptures and recoveries apply to breeding age birds only. An initial analysis has been completed revealing a very atypical movement of young red-tailed hawks in a northward direction followed by a return to the natal area. Both species tend to be philopatric with the red-tailed hawk exhibiting relatively intense philopatry despite 1,000 mile movements north as juveniles. Fieldwork continues and will be completed in October 2003.

ECOLOGY OF THE ENDANGERED NIGHTINGALE REED WARBLER ON SAIPAN, MICRONESIA

Principal Investigator: J. M. Scott
Student Investigator: Steve Mosher
Funding Agency: U.S. Fish & Wildlife Service
Completion Date: 12/31/03

Objectives:

1. Compare vegetation structure and composition among areas of differing reed warbler densities.
2. Determine the timing of breeding and molting of nightingale reed warblers.
3. Describe the breeding ecology of the reed warbler
4. Compare localized movements, dispersals and territoriality of reed warblers among habitat types.

Progress: Fieldwork has been completed. Discovery and formal description of the nests, eggs and nestlings of the nightingale reed warbler was published in the Wilson Bulletin 114:1-10. Draft manuscript has been prepared for question 1. Data analysis completed for questions 2 - 4 and draft manuscripts prepared for questions 2 - 3.

DETERMINATION OF RECOVERY PLAN POPULATIONS GOALS

Principal Investigator J. M. Scott
Student Investigator: David Stannish
Funding Agency: U.S. Geological Survey
Completion Date: June 2004

Objectives:

1. Determine which biological variables are correlated with recovery goals.
2. Evaluate relationships between population goals and listed threats
3. Assess relationship between recovery goals and ecological role of species

Progress: Questionnaire completed. Three hundred recovery plans for vertebrate species have been reviewed and preliminary analysis has been completed.

DECISION MAKING FOR COMPREHENSIVE CONSERVATION PLANNING IN THE U.S. FISH & WILDLIFE SERVICE

Principal Investigator: J.M. Scott
Student Investigator: Kevin Gergely
Funding Agency: U. S. Geological Survey
Completion Date: 12/31/03

Progress: The initial phase of the research project is complete. A research synthesis was conducted related to the U.S. Fish & Wildlife Service refuges program and was used in an analysis of the recently passed Refuge Improvement Act (RIA). This paper was published in the Natural Areas Journal in 2000 and provides the context for the rest of the research project. The process has been started for a comparative case study analysis of the National Wildlife Refuge Planning efforts as mandated by the RIA. Data collection is being conducted consistent with grounded research theory. Data is being generated from planning documents, the planning record, and from interviews with participants in the chosen cases. Planning record archives have already been collected. Data collection by interviews for the Stillwater National Wildlife Refuge plan is nearly complete. Respondents represent planners, refuge management staff at the field level, regional office staff, and headquarters staff. This represents the full hierarchy of U.S. Fish & Wildlife Service management.

ENDANGERED SPECIES ACT AT 30: SCIENCE, POLICY AND LAW

Principal Investigator: J. M. Scott & Dale Goble
Funding Agency: Bren School of Environmental Science
U.S. Geological Survey
Turner Endangered Species Fund

Objectives:

1. To examine results in science policy and law during 30 years of implementing the Endangered Species Act.
    - What are we protecting?
    - What have we accomplished?
    - Where do we go from here?
2. Accomplish objective 1 through personal research and directing the research activities on this topic of 30 other researchers.
3. Host a 3 day symposium at which research findings would be shared with developers of policy.

Progress: Hosted 3 day meeting of authors and 4 commentators at the University of California, Santa Barbara. Secured funding, identified and assigned topics for papers, developed outreach and publication strategy, identified and invited Plenary Speakers: Governor Dirk Kempthorne, President National Governor's Association, Bruce Babbitt, former Secretary of Interior and Stephen Schneider of Stanford University. Identified and invited 20 commentators and completed preliminary discussions with book publisher.

USING DNA TO MONITOR GRIZZLY BEAR POPULATION TRENDS

Principal Investigator:	L. Waits
Student Investigators:	David Roon, Melanie Murphy
Funding Agency:	U.S. Geological Survey
Completion Date:	12/31/03

Objectives: 1) Develop annual minimum grizzly bear population counts for three years. Develop a genetic database; 2) Based on the amount of sign variation found during surveys conducted over three years, estimate the power of these data to detect grizzly bear population declines; 3) Estimate the proportion of the total Glacier National Park bear population not detected by sign surveys, and adjust survey design to improve efficiency; 4) Evaluate the power of passive hair collection to detect population trends; 5) Adapt the techniques used to extract DNA from fecal samples to process large number of samples; and 6) Estimate the relative size of the black bear population from the ratio of black to grizzly bear sign found on survey routes.

Progress: DNA analysis was completed on 4000 hair samples collected in 1998, 500 scat samples collected in 1998, and 1200 scat samples collected in 1999. Currently, we are extracting DNA from 4000 rub tree samples and 500 additional scat samples from 1999. Based on results from 2440 hairs collected on traps in 1998, we have found 35% brown bears, 65% black bears. Success rates for species ID are 95%. Brown bear samples were analyzed to individual and 147 individuals were identified. 45% were male and 55 % were female. Success rates for individual ID were 80%. From the 1998 rub trees hairs, 81% were brown bears, and 19% were black bears. Seventy-eight (78) brown bears were observed and 53 of these were not detected in the hair traps. The sex ratio was 68% male and 32% female. These data were used to obtain a mark-recapture population estimate of 350 – 550 brown bears. The scat samples from 1998 and 1999 were only identified to species due to the lower success rate and high cost of individual ID. In 1998, 60% were brown, 40% were black and success rates were 60%. In 1999, 55% were brown, 45% were black are success rates were 85%.

For hair analysis, we have also been using computer modeling to evaluate the impact of genotyping error rates on minimum and mark-recapture population estimation. We have also run experiments to determine that individual ID success rates drop 15 – 20% when samples are stored for more than 6 months before extraction. For fecal analysis, we have run experiments to evaluate the impact of preservation method, diet, time and conditions in the field, storage time and DNA extraction method on success rates. We have determined that 90% ethanol is the optimal storage method and that DNA does not degrade during 6 months of storage at room temperature. We have fed captive bears restricted diets of salmon, deer, grass, alfalfa, carrots, and blueberries and tested fecal samples for DNA amplification success. Individual ID success rates were significantly lower for salmon scat but no other differences were detected. In a different experiment, we also determined that DNA amplification success rates drop most rapidly when fecal samples are in wet climates. The greatest drop in success rates occurred between 1 and 3 days in the field, but DNA could be obtained even after two months in the field.

RED WOLF GENETICS

Principal Investigator: L. Waits
Student Investigator: Jennifer Adams
Funding Agency: U.S. Fish and Wildlife Service
Completion Date: 3/31/03

Objectives: 1) Design a genetic approach for discriminating between red wolves, coyotes, and domestic/feral dogs inhabiting the red wolf recovery area in northeastern North Carolina; 2) Evaluate the genetic characteristics of hybrids between these species and develop a rapid diagnostic method using genetic markers to detect hybrids; and 3) Develop a non-invasive genetic sampling method.

Progress: We developed a genetic test to differentiate fecal samples for red wolves, coyotes, dogs, red fox, gray fox, bear and bobcat. In the spring of 2000, we collected fecal samples on all roads in Alligator River National Wildlife Refuge, and obtained 400 samples with GIS coordinates for each sample. DNA has been extracted from all 400 samples and we are currently completing species ID on these samples. Success rates for species ID are 85%. To date, we have detected 60 red wolf samples, 25 bobcat samples, and 2 dog samples.

We have collected and extracted DNA from over 150 coyote samples from Virginia, NC, Texas, Kentucky and California to use as comparisons to red wolf genetic samples. We have collected and extracted DNA from over 50 samples of red wolves from the captive population. We have also optimized microsatellite primers for 15 loci and will be using these in a genetic diagnostic for differentiating red wolves, coyotes and hybrids. We completed mtDNA sequencing for 16 known hybrid samples and determined that 8 of these samples contained red wolf DNA. This indicates that breeding is occurring between red wolf females and coyote or hybrid males more frequently that previously suspected.

BIOLOGICAL DATA INVESTIGATION

Principal Investigator: Gerry Wright
Funding Agency National Park Service
Completion Date: 5/1/05

Objectives:

1. Complete the compilation of historic data for all species of vascular plants and vertebrate believed to occur in Northern Semi-Arid Lands Network parks from a variety of sources, including park data bases, museum records of voucher specimens, previous studies, and input this data into the appropriate NPS databases.

2. Complete field surveys for the 28 inventories in the networks parks with the goal of documenting 90% of all species estimated to occur in each park. Greater emphasis will be placed on inventories of species of special concern to the parks.

3. Gather inventory information using a study design that will allow information to be incorporated into a long-term monitor program.

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

Progress: A multi-year project currently underway. Vertebrate inventories have been completed for six parks, plant inventories done for 7 parks.

LANDSCAPE ANALYSIS OF BLACK BEAR

Principal Investigator	Gerry Wright
Student Investigator:	Kim Sager
Funding Agency:	National Park Service
Completion Date:	3/31/05

Objectives:

- Assess performance and observational bias using Global Postionind System radio-telemetry
- Describe seasonal hope ranges of black bears in Olympic National Park
- Determine annual patterns of site fidelity of black bears
- Examine seasonal patterns of elevation distribution by black bears
- Examine seasonal patterns of landscape use
- Describe bear use of riparian areas.

Progress: Instrumented six immobilized bears with Telemetry Solutions GPS-Simplex 1D radio-collar. We programmed each radio collar to attempt to obtain a location fix 4 times daily during spring-summer-fall and once daily during the denning period (1 November - 31 March). During 2002, each collar successfully uploaded on 2 occasions: once in July, and again in September. Each collar deployed in 2002 was programmed to drop-off in late September 2003.

We examined potential biases and performance of GPS radio-collars by placing unused radio-collars at randomly chosen locations near trail systems in the Elwha Valley and Hurricane Ridge areas of Olympic National Park.

We identified and developed two categorically variables for use in establishing sampling locations: from Olympic National Park's Geographic Information System (GIS): canopy cover and "satellite view". we determined percent of overstory vegetative cover for each 25 by 25m pixel in the Elwha watershed based on GIS habitat layers. We then partitioned percent of canopy cover into 4 categories: 0-10% cover (includes al meadow types and shrub layers), 11-40% cover, 41-70% cover, and 71-100% cover.

We also developed the variable "satellite view" by using GIS topographic data layers. This category incorporates aspect and percent "sky-view".

MANAGING RESOURCE DATA

Principal Investigator: Gerry Wright
Funding Agency: National Park Service
Completion Date: 9/30/03

Objective: Edit and update the national resources bibliographic database for Glacier national Park.

Progress: The project is about 75% completed.

BEAR CONFLICTS ALONG THE McCARTHY ROAD CORRIDOR IN THE WRANGELL ST. ELIAS NATIONAL PARK AND PRESERVE

Principal Investigator: R. G. Wright
Student Investigator: Jim Wilder
Funding Agency: U.S. Geological Survey
Completion Date: 12/31/03

Objectives: 1) Gain a better understanding of the type of bear/human conflicts that current exist or may develop as a consequence of increased visitor use and facility development; 2) Document the general biological and behavioral characteristics of the bear population in the study area and contrast those with the specific characteristics of those bears involved in conflicts with humans.

Progress: Fieldwork on this project began in May 2000, directed by graduate student James Wilder and assisted part-time by an National Park Service intern. Prior to starting fieldwork in the Wrangells, Jim spent a week at Glacier NP observing the protocols being used there on a similar bear hair-trapping study. He also spent some time in Denali NP observing bear handling and tagging protocols used there. The study used non-invasive genetic sampling to obtain an estimate of the minimum number of black and brown bears in the valley, their distribution, and sex ratios. It also used genetic analysis on shed hair to identify individual bears involved in bear-human conflicts. Questionnaires and interview were used to quantify and describe the nature of the bear-human conflicts.

Ninety-two (92) bears were identified: 84 black *(Ursus americanus)* and 8 brown *(U. arctos)*. Seventeen individual bears (18.5% of the total) were genetically identified as being involved in bear-human conflicts. Overall sex ratios (% male:female) for the bear populations and conflict bears were 60:40 and 75:25, respectively. Local residents were responsible for 80% of reported conflicts, which were primarily caused by the widespread availability of garbage and human food. We concluded the Kennicott Valley may serve as a populations sink for local bear populations, particularly brown bears, due to the high quality of its natural food resources *(Shepherdia canadensis)* and human-induced mortality of the bears.

The project is now concluded. An MS thesis was produced, a journal article is in preparation and a paper will be given to the 8th Western Black Bear Workshop in Montana in April 2003.

UNDERSTANDING THE RANGE OF HISTORICAL VARIABILITY IN SNAKE RIVER PLAIN PLANT COMMUNITIES

Principal Investigator: R. G. Wright
Student Investigator: Marcus Swan
Funding Agency: U.S. Geological Survey
Completion Date: 03/15/03

Objectives:

1. To locate appropriate historic aerial and ground photos of the area in order to establish a baseline from which to compare contemporary photos.

2. To identify locations of and to re-photograph historic ground photos and to qualitatively compare these historic and contemporary photos to assess any changes or lack of changes that may have occurred. Secondly, to use aerial photos to present a birds eye view of the major landscape level changes over several time intervals.
3. To use aerial and ground photos, soil surveys, census data to develop a historic vegetation map of the intensive study area and to relate this map to the broader study area. Secondly, to compare this map to current vegetation maps (i.e. GAP analysis, etc.).

Progress: All available and useful historical aerial photography has been acquired. Likewise, we sought to obtain historic oblique photos from several sources. Photo-retakes of all oblique historic photos have been taken and the landscapes interpreted. We also acquired and interpreted the original Public Land Survey data for the five-county study area. Historic land cover maps have been produced and are being compared with existing GAP derived cover maps.

HABITAT USE & MOOSE BROWSING EFFECTS IN ROCKY MOUNTAIN NATIONAL PARK

Principal Investigator: Gerry Wright
Student Investigators: Jason Dungan
Brad Stumph
Funding Agency: National Park Service
Completion Date: 12/31/04

Objective(s):

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

Progress: One year (summer to fall) of fieldwork has been completed. This was largely exploratory and involved getting a feel for the study area and moose distribution, particularly west of the Continental Divide. We refined techniques to observe moose feeding habits, including 24 hour diel surveys. Forage and fecal samples were obtained from throughout the Colorado River drainage and are being prepared for analysis. A set of three exlosures were re-fenced to exclude beavers and existing browse survey transects in those exclosures were read. We refined study objectives to include the need to remotely mark moose with unique paint colors and convinced the park of the necessity of doing that.

EXPANSION OF MOOSE IN IDAHO

Principal Investigator: Gerry Wright
Student Investigator: To be determined
Funding Agency: National Park Service
Completion Date: 4/30/06

Objectives:

1. To examine how moose using interior established habitats differ from those on the fringe of core areas and which are expanding their range, and from those that have been translocated by Idaho Fish and Game into new habitats. Focus will be on movement rates, activity periods, and habitat selection and use.
2. To examine how movements and habitat selection by individuals are influenced by landscape features. We will also examine how these behaviors affect spatial and temporal rates of population expansion.

Progress: Project has not yet been initiated. Potential graduate students are now being interviewed.

Completed Projects - Wildlife Resources

Dennis Murray - Principal Investigator

- Assessing snowshoe hare populations in Northern Idaho

Kerry Reese - Principal Investigator

- Ecology of sage grouse in Owyhee County
- Sharp-tailed grouse project
- Ecology of sage grouse chicks
- Statewide habitat characteristics of nesting sage grouse
- Ecology of Juvenile Sage Grouse

Gerry Wright - Principal Investigator

- Synthesis of scientific information - Voyageurs National Park, Minnesota

ASSESSING SNOWSHOE HARE POPULATION IN NORTHERN IDAHO

Principal Investigator: Dennis Murray
Funding Agency: Idaho Dept of Fish & Game
Completion Date: 9/30/02

Objective: To document the abundance of snowshoe hares (via fecal pellet plot counts) on 6000 plots on the Idaho Panhandle Forest, and to assess how hare numbers relate to forest management practices.

Results:

1. Publication of paper validating fecal pellet plot method for hare population estimation in western U.S. (see reference)
2. Hiring of 8 undergraduate students during May-August to collect fecal pellet data on 615 transects (6150 plot locations), and 8 stands subject to alternative thinning protocols, on Idaho Panhandle National Forest (IPNF).
3. Collection of fecal pellet plot data on 30 transects, and mark-recapture data using livecaptured hares, on 6 snowshoe hare plots near Priest Lake, ID.
4. Completion of data collection on 60 pellet degradation plots near Priest Lake, ID.
5. Near-completion of collection and validation for GPS data from each of the 615 transects on the IPNF.
6. Inclusion of transect GPS data into existing hare fecal pellet database, and collation with USFS GIS databases on stand management history and landscape features surrounding each transect.
7. Entry of all pellet data collected on transects and stands during 2002 into existing database.
8. Preparation of draft paper examining differential pellet degradation across habitat types in Idaho.

ECOLOGY OF SAGE GROUSE IN OWYHEE COUNTY

Principal Investigator: K. P. Reese
Student Investigator: Paul Wik
Funding Agency: Idaho Department of Fish and Game
Completion Date: 6/30/02

Objectives: 1) Determine the physical characteristics female sage grouse are selecting in nest sites and brood-rearing areas of Owyhee County, Idaho, 2) determine if present grazing regimes prevent selected characteristics from being available across the landscape, 3) determine hen reproductive success and mortality rates, and to determine if these rates differ by grazing intensities, 4) determine the timing and seasonal movements and the general seasonal ranges of male and female sage grouse in Owyhee County study area, and 5) determine if construction of emitter sites and use of "no-drop" zones influence habitat use by sage grouse before and after the planned construction during spring 2000.

Results: Breeding populations of greater sage-grouse (*Centrocercus urophasianus*) have been reduced 17-47%, which is thought to be a result of over-exploitation, habitat loss, and habitat degradation. The seasonal habitats, movements, and survival of sage-grouse populations in southwest Idaho were poorly understood, and this lack of information hindered planning efforts of the United States Air Force (U.S.A.F), which received approval for training sites to be constructed in Owyhee County beginning in 1999. This research was designed to help assess potential effects in sage-grouse from these activities.

Male and female sage-grouse were captured and fitted with necklace-style radio transmitters in 1999, 2000, and 2001 to determine survival, movements, and success from nests and broods. Annual survival rates for males were 0.54 (n = 14, 199/2000, September 1999 - August 2000) and 0.61 (n = 17, 2000/2001, i.e. September 2000 - August 2001). Sub-adults (10 weeks of age to 16 months) survival rates ranged from 0.74 - 1.00 for adults and from 0.40 - 1.00 for sub-adults.

Nest success was 43% (9 of 21, 2000) and 50% (8 of 16, 2001) with an average first clutch size of 6.5 ± 0.27 (95% C.I.). In 2000, 20% of the hens that lost their first nest renested (2 of 10) and no estimates of renesting could be obtained for 2001. Nests were placed under taller shrubs ($P \leq .001$) with greater shrub cover ($P \leq 0.001$), taller grass ($P \leq 0.001$), and greater cover provided by grass ($P = 0.003$) than randomly available.

Brood-rearing success was low in 2000 (38%) and increased in 2001 (83%), but production from both years (0.43 and 0.66 chick/hen in 2000 and 2001, respectively for flush counts at 7 weeks) as well below the 2.25 chick/hen though necessary to maintain a stable or increasing population. Hens with broods used taller ($P = 0.025$) shrubs with greater grass cover ($P = 0.004$) than was randomly available. In 2000, hens with broods used the same habitat through the rood-rearing period, whereas in 2001, hens switched habitats at the end of June. In 2001, 5 forbs were identified to occur more frequently in habitats used by broods in the early brood-rearing season (4-5 weeks post-hatch), and 4 forbs were identified to occur more frequently at brood sites in the late brood-rearing period.

Most birds moved south to southwest from spring to summer range. Males tended to use higher elevation habitats during the summer and females used the upland shrubs and agricultural fields centered around the community of Riddle, Idaho. Females moved an average of 1.7 ±0.42 km (95% C.I.) from lek of capture to nest, with renests averaging 790 m (240 - 1300m) from the first nest. Mean distance moved from spring range to summer range for males was 23.9 ± 2.13 km (95% C.I., ages combined) and 17.0 ± 1.44 km (95% C.I., ages combined) for females. Males moved farther than females ($P = 0.027$) to reach their summer range.

Decay rates of sage grouse intestinal droppings were examined to determine whether they could be used as a sampling tool for detecting changes in habitat use. Droppings were placed in 3 habitats (*A. t. wyomingensis, A. arbuscula, and Agropyron cristatum)* in groups of piles and singes. Single droppings decayed at a similar rate ($P = 0.702$) among the 3 habitats, but piles decayed slower ($P = 0.051$) in the *A. arbuscula* habitat than the other 2 habitats during 734 days of exposure. Using dropping counts for detecting changes in sage grouse use is viable with count intervals ≤ 1 year.

Insuffient data had been collected to determine whether any effects from the construction of the U.S.A.F. sites occurred. Additional data will be collected on dropping counts placed around 4 Enhanced Training in Idaho (ETI) sites constructed by the U.S.A.F. during 1999-2--1 to continue assessing this issue.

STATEWIDE HABITAT CHARACTERISTICS OF NESTING SAGE GROUSE

Principal Investigator: K. P. Reese
Funding Agency: Idaho Dept of Fish & Game
Completion Date: 6/30/02

Objective: Determine soil types, local weather data and grazing system for the sage-grouse nest sites examined by IDFG in 2002.

Results: Fifty-seven nests were measured in 11 study locations. Soil types will be determined from BLM and NRCS data bases. Nest sites will be classified as one of 38 habitat types identified by Hironaka etal. (1983). All data generated by the field work was provided to IDFG for further analysis.

SHARP TAILED GROUSE ECOLOGY

Principal Investigator: K. P. Reese
Funding Agency: Idaho Department of Fish and Game
Completion Date: 6/30/02

Objective: To determine reproductive success of newly released and formerly released Columbian sharp-tailed grouse translocated into the Shoshone Basin.

Results: No progress other than final report submitted in 2001, plus lek count data for Spring 2002 provided to IDFG.

ECOLOGY OF SAGE GROUSE CHICKS

Principal Investigator: K. P. Reese
Student Investigator: Nathan Burkepile
Funding Agency: Idaho Department of Fish and Game
Completion Date: 6/30/02

Objectives: To determine the cause- and age-specific mortality of greater sage grouse chicks in southeastern Idaho.

Progress: In 1999, we initiated a 4-year study of greater sage-grouse chick survival in southeastern Idaho. During the summer of 1999, we developed a method to attach radio-transmitters to one-day-old chicks. This attachment method was used to monitor chick survival the following 3 years. During all four years we monitored hen nest success and chick survival. Apparent nest success ranged from 41 - 57% and did not differ between years. Chick survival ranged between 20 - 24% and did not differ during 1999 - 2001. However, chick survival during 2002 was 45% and higher than the past three years. Average age of chicks at death ranged between 9 - 13 days post-hatch and did not differ between years. Predation was the proximate factor contributing to >85% of the mortalities. Death through exposure resulted in < 10% of chick mortalities.

Results: Currently, only preliminary analyses have been completed. Further analysis will be conducted during the summer of 2003.

ECOLOGY OF JUVENILE SAGE GROUSE

Principal Investigator: K. P. Reese
Student Investigator: Matthew B. Lucia
Funding Agency: Idaho Department of Fish and Game
Completion Date: 12/31/01

Objective: To determine cause- and age-specific mortality of juvenile sage grouse.

Results: Progress on the project was slowed due to an injury to the student investigator. Now recovered, he expects to complete the research by December 2003.

SYNTHESIS OF SCIENTIFIC INFORMATION - VOYAGEURS NATIONAL PARK, MINNESOTA

Principal Investigator: R. G. Wright
Funding Agency: National Park Service
Completion Date: 1/31/03

Results: This project has been completed. A draft final report providing a synthesis of past and on-going terrestrial biological research at Voyageurs has been written and submitted to the park for review. This report was organized using both a trophic level and ecological process approach. The most important aspect of the report were its recommendations for needed research to fill gaps in the biological knowledge of the park.

SUMMARY OF ACTIVITIES

Honors and Awards:

- Lifetime Achievement Award, American Fisheries Society (Bjornn)
- Honorary Member, Cooper Ornithological Society (Scott)
- Star Award, June 2001. For publication of "Evolution, Ecology and Management of Hawaiian Birds: A Vanishing Aviafauna". (Scott)
- Katherine Strickler was awarded a $10,000 scholarship fromAnheuser-Busch and the National Fish and Wildlife Foundation
- Darin Jones won the Alumni Association Award for Excellence, University of Idaho

Papers Presented:

- Physiological studies on in-river migrating and barge-transported juvenile salmonids. Annual review of Anadaromous Fish Evaluation Program, US Army Corps of Engineers, Walla Walla, WA. November 2001.
- The role of physiological studies in understanding hydrostem-related delayed mortality. Delayed Mortality Workshop, US Army Corps of Engineers, Stevenson, WA. February 9-20, 2002.
- Use of lipid and protein reserves by juvenile chinook salmon migrating through the Sanake-Columbia river hydropower system, 1999-2001. Annual meeting of Western Division of American Fisheries Society, Spokane, WA. April 19, 2002

Technical Assistance:

- Assisted National Marine Fisheries Service personnel (Seattle, WA) with design of post-barging extended rearing study at Bonneville Dam. (Congleton)
- Member of the advisory board for David H. Smith Memorial Grants Advisory Board. (Scott)
- Member of the forest bird recovery team of the U.S. Fish and Wildlife Service. (Scott)
- Member of the Advisory Board of the Anhauser-Busch Scholarship Advisory Board (Scott)
- Member of review team for David H. Smith postdoctoral program. (Scott)

Training Provided:

- Instructor in motorboat operators certification course. (Training Session/Short Course) (Congleton)

Publications:

Abbitt,R.J. F. and J.M. Scott. 2001. Examining differences between recovered and endangered species. Conservation Biology 15(5): 1274-1284.

Groves, C.R. D.B. Jensen, K.H. Redford, M.L. Shaffer, J.M. Scott et al. 2002. Planning for biodiversity conservation. Putting conservation science into practice. Bioscience 52(6): 499-512.

Haukenes, A. H. and C. M. Moffitt. 2002. Hatchery evaluation of erythromycin phosphate injections in prespawning spring chinook salmon. North American Journal of Aquaculture 64: 167-175.

Herman, B.C., K.P. Reese, P. Zager, and P.E. Heekin. (in press). Seasonal and annual habitat use and survival of mountain quail in west-central Idaho. (for submittal to the Journal of Wildlife Management).

Hiner, M. and C. M. Moffitt. 2002. Epidemiological modeling of Myxobolus cerebralis infections in trout: associations with habitat variables. Whirling Disease Symposium Proceedings. American Fisheries Society. Symposium Series 26:167-179.

Karl, J. W., L. K. Svancara, P. J. Heglund, N. M. Wright and J. M. Scott. 2002.Species commonness and the accuracy of habitat association models. Pp. 573-580. in J.M. Scott et al. Predicting species occurrences:issues of accuracy and scale. Island Press Covelo, CA.

Kelsey, D. A., C. B. Schreck, J. L. Congleton, and L. E. Davis. 2002. Effects of juvenile steelhead on juvenile chinook salmon behavior and physiology. Transactions of American Fisheries Society 131:676-689.

Kiryu, Y. and C. M. Moffitt. 2002. Models of comparative acute toxicity of injectable erythromycin in four salmonid species. Aquaculture 211:29-49.

L. Eareckson and R. G. Wright. 2002. Long term monitoring of amphibians in the Palouse region of northern Idaho. Science Teacher 35:45-50.

Miller, J.K., J.M. Scott, C.R. Miller and L.P. Waits. 2002. The Endangered Species Act: dollars and sense? Bioscience 52(2): 163-168.

Moffit, C. 2002. Hatchery evaluation of erythromycin phosphate injections in pre-spawning spring chinook salmon. North American Journal of Aquaculture 64:167-174.

Scott, J.M. 2002. Biodiversity: what are we protecting? Pages 297-299 in Biodiversity and its effects on private property. D.D. Goble (ed.) Idaho Law Review 38(2).

Scott, J.M. P.J. Heglund , M.L. Morrison et al. 2002. Introduction Predicting species occurrences: issues of accuracy and scale pages 1-6 in J.M. Scott et al. (editors) Predicting species occurrences: issues of accuracy and scale. Island Press, Covelo , California. 868 pages.

Shaffer, M.L., J.M. Scott and F. Casey. 2002. Noah's options: initial cost estimates of a national system of habitat conservation areas in the United States. Bioscience 52(5):439-443.

Svancara,L.K., E.O. Garton, K, Chang J.M. Scott , P. Zager and M. Gratson. 2002. The inherent aggravation of aggregation: an example with elk aerial survey data. Journal of Wildlife Management 66:776-787.

Williams, C. J. and C. M. Moffitt. 2002. A brief critique of methods of sampling and reporting pathogens in populations of fish. American Fisheries Society Symposium 26: 213-214.

Theses and Dissertations:

Adams, J. 2002. *Using molecular approaches to evaluate hybridization between two closely related species Canis rufus and Canis latrans*. PhD

Cegelski, C. 2002. *An evaluation of genetic diversity, gene flow, and population genetic structure among wolverine (gulo gulo) populations in Rocky Mountains.* MS

Connor, W. Dec. 2001. *Juvenile life history, downstream migration rate, and survival of wild Snake River fall chinook salmon.* PhD

Davis, M. May 2002. *Macroinvertebrate drift in selected Lower Snake River Ecosystems: Dietary importance and occurrence of gas supersaturation.* MS

Eareckson, L. 2002. *Longterm minitoring of amphibians in The Palouse Bioregion of Idaho*. MS

Haley, L. 2002. *Effects of dietary and body lipid content on seawater acclimation in juvenile chinook salmon Oncorhynchus tshawytsch.* MS

Herman, B. 2002. *Spring & summer ecology of Mountain Quail in West/Central Idaho.* MS

Hogan, D. 2002. *Spatial and temporal distribution of Bulltrout, (Salvelinus confluentu), in the Upper East Fork South Fork Salmon River Watershed, Idaho.* MS

Husseman, J. 2002. *Prey selection patterns of wolves and cougars in East Central Idaho.* MS

Karchesky, C. April 2002. *Effects of winter drawdown on fish community structure and behavior in the Pend Oreille River, Idaho.* MS

Miyasaki, H. 2001. *Ecology of blue grouse in west-central Idaho.* MS

Roongadullpisan, K. Jan 2002. *Siamese fireback pheasant (Lophura diardi) status in landscape changing in the Sakaerat Biosphere Reserve in Thailand.* MS

Steury, T. 2002. *Causes and consequences of individual variation in territory size and modeling the reintroduction of lynx to the southern periphery of its range.* MS

Venard, D. 2001. *Diel and seasonal movement of lake trout, cutthroat trout, and bulltrout between Upper Priest Lake and Priest Lake, Idaho.* MS

Young, W. 2002. *Juvenile habitat use and growth of white sturgeon in the Kootenai River.* MS