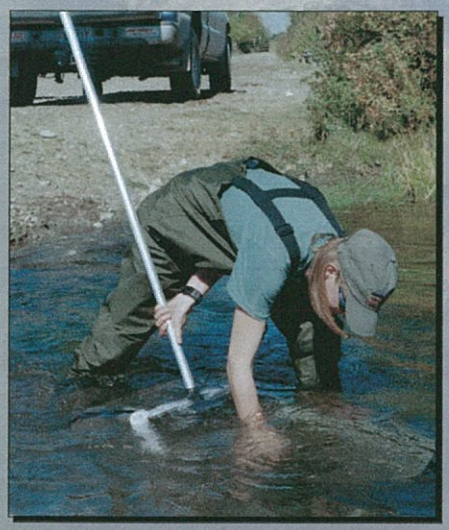
Idaho Cooperative Fish and Wildlife Research Unit

ANNUAL REPORT

1 October 2002 – 30 September 2003



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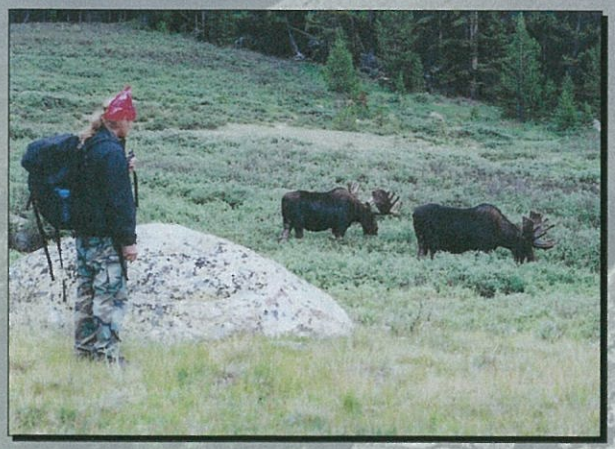

Jason Dungan
M.S. Wildlife Resources

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Annual Report

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Idaho Cooperative Fish and Wildlife Research Unit

U.S. Geological Survey
College of Natural Resources
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Idaho Department of Fish and Game
University of Idaho
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Dr. Jim Peek - Wildlife Resources
Dr. Chris Peery, Fishery Resources
Dr. Matt Powell - Fishery Resources
Dr. Janet Rachlow - Wildlife Resources
Dr. John Ratti - Wildlife Resources
Dr. Kerry Paul Reese - Wildlife Resources
Dr. Dennis Scarnecchia - Fishery Resources
Dr. Lisette Waits-Wildlife Resources

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Schuyler Greenleaf	M.S. Wildlife Resources	R.G.Wright
Brett High	M.S. Fishery Resources	T.C. Bjornn/D. Bennett
Darin Jones	M.S. Fishery Resources	C.M. Moffitt
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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) help find solutions to problems affecting anadromous fish passage in the Snake River basin; (2) evaluate methods of establishing new animal populations or augment existing populations; (3) improve estimators of animal abundance; (4) evaluate effectiveness of existing reserve and management areas in the Pacific Northwest; (5) study the basic biology of aquatic and terrestrial animals; (6) evaluate effectiveness of efforts to recover populations of endangered species and (7) evaluate factors that regulate carrying capacity in fresh water and terrestrial habitats.

Unit Research, Expertise, and Interests

Unit personnel maintain close working and professional relationships with 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, Alaska, Federated States of Micronesia, Costa Rica, and several European countries.
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.

Dr. 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: WLF 515 – Endangered Species Act at 30.

Dr. James L. 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: FISH 511 - Fish Physiology, FISH 514 - Fish Population Ecology.

Dr. Christine M. Moffitt - Assistant Unit Leader and Professor of Fishery Resources - Research emphasis includes aquaculture chemical efficacy and approval studies, understanding host-parasite relationships in ecological settings, investigations of interactions between cultured and wild fish, and fisheries history. Specialty Course: FISH510 - Advanced Fisheries Management, and FISH or WLF 501 - Graduate Seminar.

Dr. R. Gerald Wright - Assistant Unit Leader 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: WLF 520 - Human Dimensions of Wildlife Management.

Ongoing Projects - Fisheries Resources

Dr. David H. Bennett - Principal Investigator

- Reduction of Northern Pikeminnows in Lake Cascade

Dr. Jeff H. Braatne - Principal Investigator

- Baseline monitoring of floodplain vegetation and Geomorphology

Dr. 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

Dr. Kirk Lohman - Principal Investigator

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

Dr. Christine M. Moffitt - Principal Investigator

- Infrastructure to complete FDA registration of Erythromycin
- Effects of water temperature, and PIT-tags on the survival, growth, physiology, and health status of sub-yearling fall chinook salmon
- Fish operations II
- Completing empirical models to predict risks of infection of *Myxobolus cerebralis* within river drainage
- Development of empirical models of *Myxobolus cerebralis* to predict risks for populations of fish across river drainages
- Spatially based monitoring and modeling of resistant microorganisms at freshwater aquaculture facilities

Dr. Chris Peery - Principal Investigator

- Research and monitoring involving radio telemetry of adult salmon and lamprey throughout the watersheds of Walla Walla district
- Evaluation of adult salmon, steelhead, and lamprey migration past dams and through reservoirs in the Lower Columbia River and into tributaries
- Biological effects of Snake River thermal regimes on endangered salmonid species in the Lower Snake River
- Passage and survival of summer steelhead through the Yakima River
- Evaluation of steelhead kelt outmigration from Lower Granite Dam to Bonneville Dams

Dr. J. Michael Scott - Principal Investigator

- Distribution and abundance of fish in Idaho
- Size variation and fitness consequences in age 0 westslope cutthroat trout

REDUCTION OF NORTHERN PIKEMINNOWS IN LAKE CASCADE

Principal Investigator: Dr. D. H. Bennett
Student Investigator: Kajsa Stromberg
Funding Agency: Idaho Dept of Fish & Game
Completion Date: 12/31/04

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.

BASELINE MONITORING OF FLOODPLAIN VEGETATION AND GEOMORPHOLOGY

Principal Investigators: Dr. J. H. Braatne (UI-Fish/Wildlife Dept)
Pat Shafroth (USGS ~ Fort Collins Science Ctr., CO)
Student Investigator: Chanoane Hartt
Funding Agency: USGS
Completion Date: 9/30/04

Objective(s): Baseline studies of floodplain vegetation along the Elwha River, WA

FY03 Activities: Summer of FY03 marked the beginning of significant field data collection for this project. Shafroth, along with co-PI Jeffrey Braatne (Univ. of Idaho), Graduate Student Chanoane Hartt (Univ. of Idaho), and two field technicians spent much of the month of August working on the Elwha River. Activities included sampling of six cross-valley transects within Olympic National Park: three in the "control" reach in Geyser Valley (upstream of Glines Canyon dam), and three in the reach between the two dams on the Elwha R. The topography of each transect was surveyed, vegetation patch types and geomorphic surfaces were identified, and vegetation plots were established and the tree, shrub and herbaceous vegetation were sampled (47 tree plots, 127 shrub plots, 154 herbaceous plots). In addition, locations for future sampling (up to 12 more transects) were identified.

FY03 Results: Results from FY03 include: topographic cross-sections for the six transects; tree ages, tree density, cover, and basal area by species; shrub species composition and cover; herbaceous species composition and cover; dominant sediment particle sizes within the vegetation plots.

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

Principal Investigator:	Dr. 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 2002, 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. Significant decreases in swimming ability were in fact observed in 2001 and 2002 (thesis work of D. Fryer), and decreases in osmoregulatory ability were observed in 1999, 2000, and 2001 (thesis work of L. Haley).

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

EVALUATION OF THE PHYSIOLOGICAL CONDITION OF TRANSPORTED JUVENILE SALMON

Principal Investigator: Dr. J. L. Congleton
Student Investigator: T. Welker, D. Fryer
Funding Agency: U.S. Army Corps of Engineers
Completion Date: 09/30/04

Objective: In recent years, the National Marine Fisheries Service has reported marked intra-seasonal changes in survival rates 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 peaks in stress indices (cortisol and glucose) in juvenile chinook salmon were correlated with seasonal peak loading densities of steelhead in the fish-transport barges in 2000 and 2001, as in a previous study (1994, 1995: Congleton et al. 2000). Stress responses by chinook salmon were attributed to behavioral interactions with larger, more aggressive juvenile steelhead. In 2002, in contrast, stress indices in transported wild chinook salmon were relatively low and did not vary much between dates. Seasonal peaks in stress indices probably did not occur because loading densities of steelhead were low throughout the season (6 to 17 g/L; compared with an average steelhead density of 40 g/L in 2000), so reducing the exposure of chinook salmon to steelhead.

Mean gill Na^+,K^+-ATPase activities, an indicator of smoltification, were higher in wild chinook salmon than in hatchery fish throughout the migration season in 2001and 2002, indicating that wild fish were more advanced in the parr-smolt transformation and possibly better prepared to 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.

In a retrospective study using smolt-to-adult return rates (SARs) of juvenile chinook salmon PIT-tagged for NMFS transport studies, we did not find significant correlations between SARs for daily transport groups of chinook salmon and daily loading densities of co-transported 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.

EFFECTS OF SEDIMENTATION ON THE SURVIVAL OF WHITE STURGEON EMBRYOS

Principal Investigator: Dr. J. L. Congleton
Student Investigator: T. Kock
Funding Agency: Kootenai Tribe of Idaho
Completion Date: 12/31/04

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 eggs, 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 embryos.

Progress: An embryo 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 9 to 14d. 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.

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

Principal Investigator: Dr. K. Lohman
Student Investigator: Katherine Strickler
Funding Agency: USDA-Forest Service
Completion Date: 3/31/05

Objectives: The overall goal of the 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: We collected aquatic invertebrate samples in August and September 2003 from 12 streams in the South Fork of the Salmon River and Big Creek watersheds. We identified, counted, and calculated macroinvertebrate community metrics on all samples. 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. In streams with larger substrate and lower levels of embeddedness, community composition in 2003 moved toward pre-burn structure. Macroinvertebrate densities in most streams increased over 2002 and pre-burn (1998-99) samples. Further analyses of benthic invertebrate community composition and densities are in progress. An annual report will be completed by June 30, 2004.

INFRASTRUCTURE TO COMPLETE FDA REGISTRATION OF ERYTHROMYCIN

Principal Investigator:	Dr. C. M. Moffitt
Student Investigator:	Jon Amberg
Post Doctoral Investigator:	S.M.A. Mobin
Funding Agency:	BPA
Completion Date:	12/31/04

Objective:

1. Provide an infrastructure to keep erythromycin registration efforts viable in the Columbia River Basin, while required studies are conducted.
2. Conduct laboratory and field experiments and design monitoring to understand the extent of erythromycin resistant microflora in the GI tract of fish following treatment with erythromycin to satisfy the articulated needs of FDA's Division of Human Food Safety, Center for Veterinary Medicine.
3. Conduct experiments to address the fate of erythromycin in sediment ponds with a history of erythromycin treatment.
4. Conduct studies needed to provide FDA with a satisfactory method of monitoring erythromycin residues in tissues of salmonids.
5. Provide submittals to FDA that detail results and publish in peer-reviewed journals the results of key studies accomplished during drug approval.

Progress: We provided the infrastructure for use of erythromycin feed additive for fish at Idaho Department of Fish and Game, Washington Department of Fish and Wildlife, Oregon Department of Fish and Wildlife, US Fish and Wildlife Service, and Nez Perce Tribal hatcheries. We have been collecting data to describe the microflora in the GI tract of salmonids before, during and following treatment with erythromycin rations to satisfy FDA concerns of transfer of resistant microorganisms from fish to humans. We completed field trials at Lookingglass Hatchery (Oregon Department of Fish and Wildlife), and Clearwater Hatchery (Idaho Department of Fish and Game). We found the microflora were from several genera of Gram negative and Gram positive bacteria, as well as yeasts. Composition fluctuates over time, and shows some correlation with profiles of feed administered. We conducted two trials to bridge the microbiological method of analysis of erythromycin in tissues in salmon (the U of I method) with a new HPLC method developed by FDA at their Arkansas laboratory. Incurred tissue samples from FDA were sent to U of I, and to chemists at the FDA lab. We estimated potency and are working on a submittal of data at this time.

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

Principal Investigator:	Dr. C. M. Moffitt/Dr. J. L. Congleton
Student Investigator:	Jeffrey Yanke
Funding Agency:	USFWS
Completion Date:	04/01/05

Objective:

1) Determine the effects of elevated temperatures on the blood chemistry, survival and growth of sub yearling fall Chinook salmon.
2) Evaluate any effects of PIT (Passive Integrated Transponder) tags on the survival and health of sub yearling fall Chinook salmon exposed to different water temperatures
3) Evaluate blood chemistry parameters and survival of sub yearling fall Chinook following an acute seawater challenge.

Progress: This project is designed to determine the effects of water temperature and PIT tags on the survival and condition of Snake River fall Chinook salmon. The study combines detailed laboratory testing with field observations to determine the effects of temperature and the potential interactions with PIT-tagging. Previous research with PIT– tagged juvenile fall Chinook salmon released into Lower Granite reservoir in the Snake River demonstrated an inverse correlation between water temperature and fish survival. The causal mechanism for this relationship is unknown, as is the level of post-tagging mortality associated with high temperatures. To compensate, cool waters are released into the reservoir each summer when surface temperatures reach 20°C.

We conducted a laboratory study to assess the relationship between water temperature and survival in fresh and seawater, and to quantify the differential mortality that may be caused by PIT tagging. Control (i.e., not tagged) and PIT-tagged fish were gradually acclimated to constant temperatures of 16, 20, 24 and 28°C. We sampled these groups of fish at intervals during the rearing period. At each sampling interval we collected blood and separated the plasma for analysis, removed livers for analysis of heat shock proteins, measured the weight and length, removed samples of gills for analysis of NaK Atpase, and saved carcasses for analysis of lipids.

At the end of rearing, we lowered the temperatures in all tanks of test fish over 10 d to 13°C, and testing fish response to an acute seawater challenge of 24 h. Surviving fish were enumerated and sampled for the parameters listed above.

Fish held at 16 and 20°C grew rapidly and survived at high rates in both freshwater and seawater. We observed detrimental effects on growth, behavior, physical appearance, and survival in freshwater and seawater in groups of control and PIT-tagged fish that were gradually acclimated to a constant temperature of 24°C. We observed 100% mortality in groups of control and PIT-tagged fish when temperature exceeded 26°C during the acclimation period of a 28°C treatment. Our preliminary findings support the 20°C management objective for Lower Granite Reservoir and the use of PIT tags to study temperature-survival relations. Trials in 2004 will be conducted in the laboratory, with a similar design to that in 2003. We will supplement these studies with short-term tests to establish the temperature at which median acute lethal mortality occurs. Responses will be measured at different temperatures and modeled with probit models to establish the best fit and define confidence intervals.

FISH OPERATIONS II

Principal Investigator: Dr. C. M. Moffitt
Student Investigator: Kara Anlauf
Michael Colvin
Funding Agency: IDFG
Completion Date: 06/30/04

Objective: This funding was for start up funds as assistant leader, but was deferred for use to this year to support two graduate students working on whirling disease in the Pahsimeroi River Basin who were on a project that lost funding for the second year. Additional support for these students was obtained from the USGS Office of Cooperative Research Units. Details of progress are provided below: "Completing Empirical Models to Predict Risks of Infection of *Myxobolus cerebralis* within a River Drainage."

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

Principal Investigator: Dr. C. M. Moffitt
Student Investigator: Kara Anlauf
Michael Colvin
Funding Agency: USGS
Completion Date: 12/31/04

Objective: This project has two major objectives and sub objectives within each of these.

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

Progress: This project pursues a completion of aquatic habitat modeling using geospatial attributes begun in a previous project. For model refinement and testing we selected stream gradient, a landscape parameter known to influence substrate composition and the deposition of fine materials. A stratified random sampling method was used to identify systematic variation in response variables across the study area using channel slope strata. Strata were developed based on the frequencies of the stream gradients throughout the drainage. Sampling intensity was varied based on the proportion of gradients in the drainage. The strata range from 0.5% to 10% with seven slope categories. Slope was derived from the stream elevation grid and slope frequencies in the drainage were calculated. Based on frequencies, slope stratifications were delineated and the number of sites per strata calculated. Points were then generated every 100 m; point slopes, elevations, and UTM coordinates were extracted. Points were then chosen randomly within each slope strata. In addition to landscape metrics, stream habitat measurements were collected and included field slope, stream temperature, and GPS elevation. Habitat measurements/delineations included stream habitats types. Transects were chosen systematically within a habitat unit. Transect measurements included average depth, wetted width, and visual assessment of substrate composition along transect. Discharge measurements were taken on a sample of sites at base flow conditions. Sediment core samples were taken in areas of preferential *T. tubifex* habitat. The resulting sample was subsampled and 50% was allocated for sediment analysis, and 50% for invertebrate/tubifex analysis. Each oligochaete will be identified to family; all Tubificids will be identified to species. To evaluate the relationships among the parameters at both scales, multiple models will be tested incorporating various combinations of the variables measured. The goal is to quantify the variation, identify spatial patterns in distribution in the *T. tubifex* abundance data as a function of stream habitat and landscape scale parameters.

We have created a fish layer for the watershed based on existing data sets and field observations. This layer considers the available habitat and fragmentation. Reaches affected by whirling disease were snorkeled to assess fish distributions and densities by systematically sampling every fourth pool habitat unit moving upstream during summer 2003. In sample pools, observed fish were identified to species, enumerated, and size class estimated. Sample pools were geo referenced using a Global Positioning System (GPS) and imported into a GIS. We identified portions of the Pahsimeroi River that were dewatered by subsurface flow and irrigation withdrawal, producing two spatially isolated stream reaches in the valley. In affected reaches, densities and distributions of fish species varied. Efforts to restore salmonid habitat in the Pahsimeroi Valley include reconnecting existing tributaries to anadromous fish habitat, connecting fragmented anadromous salmonid habitat, and improving riparian zones in existing spawning habitat. In each case there are varying degrees of risk associated with the introduction of whirling disease to a previously pristine environment. Assessing the distribution and intensity of *M. cerebralis* in the Pahsimeroi Valley shows variability within reaches that might be attributed to the number of salmonid hosts contributing to the overall infection. The fish layer will consider species densities, spawning attributes, and we will estimate the relative risk for different stream segments, and risks associated with reconnection of river segments.

DEVELOPMENT OF EMPIRICAL MODELS OF *MYXOBOLUS CEREBRALIS* TO PREDICT RISKS FOR POPULATIONS OF FISH ACROSS RIVER DRAINAGES

Principal Investigator:	Dr. C. M. Moffitt
Student Investigator:	Maura Santora
	Kara Anlauf
	Michael Colvin
Funding Agency:	Montana State University
Completion Date:	06/30/04

Objective:

1) Collect all available data on the results of testing for *M. cerebralis* in samples of free ranging fishes and the location of exposure cage studies of *M. cerebralis*.
2) Parameterize a conceptual model for *M. cerebralis* to include data from newly determined disease dynamics aspects.
3) Develop a spatially explicit data set of *M. cerebralis* occurrence and stream reach and watershed characteristics. Evaluate empirical models based on hypotheses of key relationships identified in Objective 2
4) Validate and extend the models through additional sampling

Progress: We explored use of both population dynamic and landscape level tools to model *Myxobolus cerebralis* in fish and *Tubifex* worm populations. We developed models using empirical data gathered from the scientific literature and field data from several sources. The population based model was a discriminate model developed in Excel spreadsheet for the first 15 weeks of fry survival after emergence. One geospatial model focused on predicting likely *Tubifex* habitat, and one model was specific for fish species. For landscape level models, we refined models with observations at sites in the Pahsimeroi River and Lemhi River basins. The *Tubifex* habitat model defines the areas of likely risk = proportion of landscape in low gradients + catchment + error. Catchment area and channel gradient are considered useful as surrogates for estimating river size and velocity. These physical features for a stream reach may predict substrate size to estimate habitat available for oligochaete worms. Our landscape efforts were based on other catchment and reach scale level models that were successful in predicting habitat of specific macroinvertebrate species assemblages. For some models, elevation has been used as a correlate to predict water temperature, and mean elevation of the catchment area will be used in a like fashion to predict water temperature during our studies. A regression model was developed to incorporate the above landscape features (catchment, gradient), and mean catchment elevation as a covariate to better identify areas of risk for the establishment of the whirling disease pathogen. Such a model may allow for the application of a probability matrix on to a DEM which allows for remote characterizations of the total surface area that fall into a range of risk categories.

The second model uses GIS based attributes and other parameters to quantify the fish distributions in a basin. The amount of risk = proportion of population spawning in low gradients + elevation + density of springs + connectivity within and outside of watersheds. Combined, these models can predict the likely intensity of infection and level of risk. In this exercise, we can identify critical areas that would be suitable for habitat restoration.

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

Principal Investigator: Dr. C. M. Moffitt
Post Doctoral Investigator: Dr. S. M. A. Mobin
Funding Agency: The Northwest Center for Aquaculture Research and Education
Completion Date: 09/15/05

Objective:

1) Select a suite of target enteric bacteria for a monitoring program and conduct preliminary screening of fish at two public aquaculture facilities in the Hagerman valley, their water sources, and effluent from these hatcheries.
2) Use GIS tools to prepare maps of the water network, location of the two facilities, treatment reservoirs, and discharge locations of these facilities.
3) After preliminary data are available, and GIS maps prepared, develop plans and collaborations to provide a more comprehensive monitoring and mapping of the region.

Progress: Aquaculture systems have come under increasing scrutiny by regulatory agencies and by natural resource advocacy organizations. Often negative attitudes are perpetuated because of a lack of solid information and more complete understanding of the impacts of these facilities on the environment, and on the quality of food produced by aquaculture. Of particular interest to many regulators and the public is: what are the effects of antimicrobials used in aquaculture? This is a pilot project, and we have just begun our work. We selected Hagerman State fish hatchery for pilot site mapping and monitoring in the Hagerman Valley. We will consider expanding to other sites in the area if the pilot project is successful. We are working to identify information available as GIS coverage and geo referenced data sets. We plan most activity for June and July of 2004.

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

Principal Investigator: Dr. 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.

- 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.

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

Principal Investigator:	Dr. 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:	12/31/05

Objective(s)

1. Evaluating the degree and effects of fish fallback 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 lamprey, and factors that affect their passage at dams.

In 2003, we conducted the seventh field season in a basin-wide research study investigating migration of adult salmon, steelhead, and Pacific lamprey in the lower Columbia River. Over 2,500 adult fish were outfitted with radio transmitters at Bonneville Dam 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. Information is used in decisions on how best to manage the lower Columbia River hydropower system.

- As part of this project, we conducted a second year of monitoring spawning success and energy use of Chinook salmon returning to central Idaho tributaries of the Snake River. Measures of migration success, spawning success or pre-spawning mortality will be related to estimates of energy expenditure and migration behavior and temperature exposures.

- Currently, we are in the final stages of monitoring the 2003 steelhead run and are processing the 2002 and 2003 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 Districts.

Results: Final Report completed

BIOLOGICAL EFFECTS OF SNAKE RIVER THERMAL REGIMES ON ENDANGERED SALMONID SPECIES IN THE LOWER SNAKE RIVER

Principal Investigator:	Dr. C. Peery
Funding Agency:	U. S. Army Corps of Engineers, Walla Walla through Normandeau Consultants
Completion Date:	9/30/03

Objective(s): To develop a white paper that contained the following,

1. To conduct and compile a literature review on effects of water temperature on life history stages of Chinook salmon *Oncorhynchus tshawytscha* and steelhead *Oncorhynchus mykiss*;

2. To identify the most sensitive ESA listed salmonid stocks and life stages to water temperature patterns and extremes characteristic of the Snake River, from Hells Canyon Dam downstream to the confluence with the Columbia River and including the Clearwater River from Dworshak Dam downstream to its confluence with the Snake River;
3. To identify the life stages of the affected ESA listed species and examine the critical months, seasons, and timing for operational actions to alter or control water temperatures to maximize biological benefit; and,
4. To identify the three dimensional distribution of adult and juvenile anadromous salmonids passing through the Snake River corridor with emphasis on Lower Granite Reservoir and if possible, correlate fish locations with water temperature.

Results: Final Report completed

PASSAGE AND SURVIVAL OF SUMMER STEELEHAD THROUGH THE YAKIMA RIVER

Principal Investigator: Dr. C. Peery
Funding Agency: U. S. Bureau of Reclamation
Completion Date: 9/30/03

Objective(s): To evaluate migration behavior and survival of adult steelhead through the Yakima River with respect to a series of low-head irrigation and hydropower dams.

Progress: This is a collaborative project between University of Idaho (UI) and Bureau of Reclamation (BOR) who manage the dams in Yakima River. Researchers from the BOR collected and outfitted 250 adult salmon with radio transmitters at Roza Dam in the Yakima River. UI personnel then monitored fish movements through the Yakima River using a series of fixed site receivers and mobile tracking by truck as they migrate upstream to spawning areas. BOR and UI personnel are jointly developing a technical report on the results, which should be completed by early 2004. Results will be used to better manage passage facilities at dams and flows within the Yakima River for adult steelhead.

Results: Report draft prepared by Bureau of Reclamation (BOR) researchers.

EVALUATION OF STEELHEAD KELT OUTMIGRATION FROM LOWER GRANITE DAM TO BONNEVILLE DAM

Principal Investigator: Dr. C. Peery
Funding Agency: U. S. Army Corps of Engineers, Walla Walla through Normandeau Consultants
Completion Date: 3/31/04

Objective(s):

Task 1. Evaluate return rates of kelts transported by barge to below Bonneville Dam versus those allowed to migrate in-river from the Lower Granite Dam tailrace

Task 2. Estimate kelt passage rates and survival from Lower Granite Dam to Bonneville Dam with radio telemetry
Task 3. Enumerate the number of kelts at the Lower Granite juvenile fish facility bypass, collect data on age structure, general morphology, and fish condition

Progress: In the spring of 2003, as part of a continuing study of Snake River steelhead kelt abundance and survival and the efficacy of transporting kelts to the estuary to enhance repeat spawning, we examined 1,839 steelhead collected from the Lower Granite Dam separator. Using ultrasound techniques, we identified 1,711 (93%) as kelts: 296 (17%) males and 1,415 (83%) females, about 50% were of wild origin and the majority of all fish were considered to be in good (46%) or fair (26%) overall condition. A sample of 212 steelhead kelts in good or fair condition was radio-tagged and released in the Lower Granite Dam tailrace to evaluate migration rates and hydrosystem survival. We PIT tagged an additional 1,311 kelts and randomly assigned 701 to either be transported to the estuary or released in the tailrace of Lower Granite Dam to migrate in-river. Return rates of these fish will be analyzed in 2004. Analysis of returns of kelts from this study released in 2002 indicated a return rate of 2.7% for kelts transported to the estuary versus 0.8% for kelts allowed to migrate in-river.
The Snake and Columbia River drainages were delineated into seven between-dam reaches (GR-GO, GO-LM, etc.). Migration rates of radio-tagged kelts were lower in the Snake River reaches (mean = 32.4 km/d, *range* = 1.8-90.0 km/d)) than in the Columbia River reaches (mean = 55.2, range 11.4-135.9 km/d). Migration rates were positively correlated with river flow and generally increased in progressively downstream reaches. Of the 212 kelts radiotagged and released in the Lower Granite Dam tailrace, 116 (55%) were detected in the tailrace of Ice Harbor Dam and 72 (34%) were detected in the tailrace of Bonneville Dam. There was no difference in migration rates or hydrosystem survival for kelts of hatchery or wild origin. There was no difference in migration rates of kelts in good or fair condition, though kelts in good condition were more likely (Chi test, $P<0.0001$) to survive to the Bonneville Dam tailrace.

Final Report is expected early 2004.

DISTRIBUTION AND ABUNDANCE OF THE FISHES OF IDAHO

Principal Investigator:	Dr. J. M. Scott/Dr. 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, and 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 sets and to delimit the range of the species, and 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), and 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.

SIZE VARIATION AND FITNESS CONSEQUENCES IN AGE 0 WESTSLOPE CUTTHROAT TROUT

Project Investigator: Dr. J. M. Scott
Student Investigator: Kathy McGrath
Funding Agency: USDA FS
Closing Date: 05/30/04

Objective: Characterize of size variation in age 0 westslope cutthroat trout (*Oncorhynchus clarki lewisi*) in the North Fork Coeur d'Alene River basin, Idaho.

Results: Phenotypic diversity is an important component of ecological diversity in fishes. Phenotypic diversity potentially leads to divergence and speciation via local adaptation and stabilization of population abundance in variable environments. Although benefits of being large are well documented, size variation may have benefits as well. Understanding the spatial distribution of size variation across important environmental gradients will contribute to understanding of relationships between inland salmonids and their environment. For age 0 westslope cutthroat trout (*Oncorhynchus clarki lewisi*) in the Coeur d'Alene basin, Idaho, I found most size variation to occur at the broadest scale studies (10km) associated with water temperature and productivity gradients. Instream habitat variables, but not age 0 size structure, differed between wide and narrow valley streams. At the stream reach scale, habitats occupied by large and small age 0 trout differed, whereas at the habitat unit scale, those occupied by homogeneously-versus heterogeneously-sized individuals did not differ. Maintenance of population abundance and diversity may depend on diverse habitats at the reach scale whereas maintenance of meaningful habitat complexity may depend on management at the stream scale. I used the growth record available in sagittal otoliths to examine overwinter size-selective mortality and phenotypic adaptations in two streams that differed in temperature. I found overwinter selection for growth rate in 2001-02 but not in 2000-01. Direction of selection was different in the two streams, favoring fast growth in the warm stream and slow growth in the cold stream. Fish in the warmer stream varied more in emergence timing whereas fish in the colder stream showed compensatory growth characteristics that reduced intrapopulation size variation and increased average size. Populations at the extremes of critical environmental gradients may be less variable and therefore more sensitive and less resilient to disturbance, but may also represent intraspecific diversity that is important to conserve. Conservation of intraspecific variation will

likely require the maintenance of high quality habitats across multiple environmental gradients, including landform, temperature, and productivity, and across the spatial scales at which those gradients occur.
Final report completed and filed with funding agency.

Completed Projects - Fisheries Resources

Dr. George LaBar - Principal Investigator

- Reducing introgression with the use of a barrier in tributaries of the South Fork Snake River, Idaho

Dr. Matt Powell - Principal Investigator

- Hybridization in westslope cutthroat trout

REDUCING INTROGRESSION WITH THE USE OF A BARRIER IN TRIBUTARIES OF THE SOUTH FORK SNAKE RIVER, IDAHO

Principal Investigator: Dr. G. 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.

Results: The goal of the Yellowstone Cutthroat Conservation Management Plan for the state of Idaho is to provide the management framework that will ensure the long-term persistence of the subspecies, at levels capable of providing angling opportunities, within its current range in Idaho as well as those parts of its historical range within the state where it can be practicably restored. This Conservation Management Plan brings together information on Yellowstone Cutthroat trout *(YCT)* throughout its range in the state of Idaho. It is designed to serve as a guide for assessment and management of populations of YCT throughout its Idaho range. The Plan describes current systematics, distribution and status of YCT, and then describes each of 14 Geographic Management Units (GMUs). It then describes what is known of the status of current populations, the role of stocking in past YCT management, the genetic status of current populations, where known, and the history of Endangered Species Act actions.

The document then evaluates threats and the effect of past management actions on the sub-species. Finally, the plan presents an evaluation of assessment priorities of all streams within each GMU, based on habitat, genetic and population status and connectivity and a method for determining management priorities and actions.

George LaBar, G.W. 2002. Management Strategies For Yellowstone cutthroat trout (*Oncorhynchus clarki bouvieri*) in Idaho. Draft report presented to Idaho Department of Fish and Game, Boise, Idaho, 80 pp.

Final report filed with funding agency.

HYBRIDIZATION IN WESTSLOPE CUTTROAT TROUT

Principal Investigator: Dr. M. 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.

Results: 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 Polymerase 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.

Ongoing Projects - Wildlife Resources

Dr. E. Oz Garton - Principal Investigator

- Effects of competition with deer on elk populations
- Using the metapopulation concept to understand the spatial and temporal population dynamics of elk in Idaho
- Limiting factors for elk in Idaho
- Pronghorn antelope population inventory methods

Dr. Wayne Melquist - Principal Investigator

- Population status and habitat use of Clearwater wolverine

Dr. 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
- Investigation of reproduction in pygmy rabbits

Dr. Kerry P. Reese - Principal Investigator

- Population dynamics of Sage-grouse in Little Lost Cow Creek, Idaho
- Jarbidge Sage-grouse ecology project
- Translocation of trumpeter swans
- Sage-grouse chick ecology
- Graduate student studies
- Sage-grouse nesting

Dr. J. Michael Scott - Principal Investigator

- Development of unmanned airborne vehicle for monitoring wildlife
- Breeding ecology and philopatry in red-shouldered and red-tailed hawks
- Ecology of the endangered nightingale reed warbler on Saipan, Micronesia
- Determination of recovery plan population goals
- Decision making for comprehensive conservation planning in the U.S. Fish and Wildlife Service
- Endangered Species Act at 30: Science, Policy and Law
- Focal species as conservation targets
- Habitat analysis: Toward converting a set of competing techniques into a set of competing hypotheses

Dr. Lisette Waits - Principal Investigator

- Using DNA to monitor grizzly bear population trends
- Red wolf microsatellite genetics and habitat use program

Dr. R. Gerry Wright - Principal Investigator

- Biological data investigation in northern semi-arid National Parks
- Landscape analysis of black bear movements and habitat use
- Understanding the range of historical variability in Snake River plain plant communities
- Habitat use & moose browsing effects in Rocky Mountain National Park
- Reproduction and habitat use of moose in expanding populations in Idaho
- Black bear food habits in Yosemite National Park
- An inventory of bat species and a determination of bat roost habitat characteristics at John Day Fossil Beds, N.M.

EFFECTS OF COMPETITION WITH DEER ON ELK POPULATIONS

Principal Investigator: Dr. E. O. Garton
Student Investigator: Jeff Manning
Funding Agency: Idaho Dept. of Fish & Game
Completion Date: 12/30/04

Objectives:

- Estimate the effects of competition and other factors 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: A formal research proposal titled "The Role of competition in the dynamics of elk and deer populations: interactions and predictions" was completed on May 14, 2003 and submitted to the IDFG and University of Idaho's Department of Fish and Wildlife. We met with regional IDFG wildlife managers and conducted field visits to primary winter and summer ranges of elk and deer in most regions of the study area and discussed the details of the long-term datasets. Long-term cervid population and harvest data from the IDFG are continuing to be compiled and entered into a database for data management, and exploratory analyses continue.

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

Principal Investigator: Dr. E. O. Garton/ Dr. J. M. Scott
Student Investigator: Jocelyn Acyrigg
Funding Agency: Idaho Dept. Fish & Game
Completion Date: 12/30/04

Objectives: Theodore Roosevelt had strong beliefs regarding conservation of natural resources. He termed his concept of conservation the Roosevelt Doctrine, which had three fundamental principles. The first being that natural resources can, and must be managed as integrated systems. Second, conservation through wise use is a public responsibility, and ownership of wildlife and other natural resources is a public trust. And finally, the best scientific information and judgment are the basis for management decisions (Toweill & Thomas 2002, Leopold 1986). This doctrine still holds merit today in meeting the challenges of modern conservation and management. A particular challenge is to effectively conserve and manage a species over large areas, which includes several populations.

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

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

Progress:

OBJECTIVE 1: For demographic characteristics, aerial survey data of elk populations for 1985-1999 were obtained from Idaho Department of Fish and Game. Some data prior to 1985 have also been obtained. Additional aerial survey data will be obtained for 2000-2004. To complement the aerial survey data, a statewide digital map of the aerial survey search units has been completed.

Furthermore, we delineated elk populations using cluster analysis in Game Management Unit (GMU) 4 in northern Idaho. Aerial survey search units were clustered together based on similar demographic characteristics, such as population estimates, calf/cow ratios, bull/cow ratios, and mature bull/total bull ratios.

For the genetic population characteristics, a pilot study using microsatellite analysis on elk tissue samples gathered from the Wildlife Health Lab (Nampa, Idaho) was conducted. We extracted DNA from 150 tissue samples, used polymerase chain reactions (PCR) to amplify DNA at specific loci, and analyzed individual samples at seven loci. Five different approaches were used for examining genetic population structure (i.e., Fisher's Exact test, average expected and observed heterozygosity and mean number of alleles per locus, F_{st} values which measure the total genetic variation that is partitioned among populations, number of migrants per generation, and an assignment test which assigns individuals to the most likely population based on the individual's genotype and allelic frequency). Our preliminary findings based on our pilot study indicated that elk populations could be delineated based on genetic analysis.

Since the completion of the pilot study, we have collected more tissue samples and now have over 1100 samples. We could not have done this without the assistance from Regional Wildlife Biologists throughout the state. And we have expanded the number of polymorphic loci to be analyzed. We hope to include 18 loci total in our analysis, however a few still remain to be optimized.

Objective 2: Deficiency of essential minerals, such as selenium 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. Our objective is to determine if there is a difference in selenium and other minerals (i.e., calcium, copper, iron, magnesium, phosphorus, and zinc) in the blood of elk from different regions within the state and pregnancy status. Using blood collected from captured elk, we initially examined mean values of all minerals for the north central and southeastern Idaho and we explored the relationship between all the minerals across the regions. And finally we related pregnancy status within each region to the values of each mineral.

Our results indicated that selenium and other selected minerals do vary between north central and southeastern Idaho. Mean values of selenium were lower in north central than southeastern Idaho. No other mineral showed a similar pattern, however, means values of iron, magnesium, and phosphorus displayed an inverse relationship with selenium. In regions where selenium values were higher iron, magnesium, and phosphorus were all lower and vice versa. Calcium and

zinc had a pattern similar to iron, magnesium, and phosphorus, but not as pronounced. Copper appeared to have no patterns across the five regions. Comparisons to approximate adequate levels indicated that calcium, iron, and magnesium mean values were within the adequate range. Phosphorus and copper values were within the adequate range, but were on the low end of the range. Zinc mean values were below the adequate range and selenium varied from below adequate to adequate levels. There were no obvious patterns of pregnancy in elk within the regions. The multiple logistic regression by region showed that selenium was significantly related to pregnancy status in north central Idaho, specifically the Lochsa area.

The differences in the minerals between these regions could be attributed to either demographic or environmental factors. Demographic factors such as population composition and age structure may influence the amounts of minerals detected in blood samples. However, weather and vegetation could alone, as well as together, affect the patterns of mineral distribution between the regions in Idaho.

LIMITING FACTORS FOR ELK IN IDAHO

Principal Investigator: Dr. E. O. Garton
Student Investigator: Deborah Montgomery
Funding Agency: Idaho Dept. of Fish & Game
Completion Date: 12/30/04

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.
2. Explore relationships between nutrition and growth of elk calves.

Progress:

Project 1:

First, a literature review has been conducted on survival analysis techniques and elk survival. Second, the data have been organized and edited for 4 different radio collared populations of elk from the Coeur d'Alene area, Lochsa River area 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 sample of our dataset. We have also located 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 Arc View of the elk in the 4 different populations and obtained various data layers. For the main analysis, we have decided to use Cox's proportional hazards model. The details of that analysis have been worked out and the data is being structured in preparation for analysis.

Project 2:
A literature review has been conducted on elk calf growth and development. Linear mixed models have been used to model age as a function of three morphometric variables. Hoof line length, weight, and tooth length have been combined to predict age

PRONGHORN ANTELOPE POPULATION INVENTORY METHODS

Principal Investigator:	Dr. E. O. Garton
Student Investigator:	Tim Smyser
Funding Agency:	Idaho Dept. Fish & Game
Completion Date:	12/30/04

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

Progress: To address this question, we will be looking at 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 conditions. 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 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:	Dr. W. Melquist
Funding Agencies:	Idaho Dept of Fish & Game U.S. Forest Service U.S. Fish & Wildlife Service
Completion Date:	6/30/05

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 complemented 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 wolverines 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).

EVALUATION OF CENSUS TECHNIQUES FOR PYGMY RABBITS

Principal Investigators: Dr. J. 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 individual burrow systems have been used by ≥3 animals. We evaluated current occupancy of burrow systems using observations of digging following fresh snowfall, and telemetry was used to confirm occupancy. If the relationship between number of active burrow systems and number of rabbits is consistent across sites, then density estimates for each site were: Cedar Gulch 0.38 rabbits/ha (0.15/acre); Rocky Canyon 0.54 rabbits/ha (0.22/acre); and Warm Springs 2.72 rabbits/ha (1.10/acre). One caveat about extrapolating across areas is that the proportion "active" versus older burrow systems varied markedly across our three study sites. Until we have a better understanding of the turn-over rates of burrow systems (switching between "active" and "in-active" status over time) and patterns of use of burrow systems, caution should be exercised in extrapolating the number of active burrow systems per rabbit (1.84 bs per rabbit in Cedar Gulch) to other areas. A Ph.D. student at the University of Idaho currently is investigating patterns of burrow system use and changes in burrow system status across 3 study areas.

Recently, thermal imagery has been used to census a variety of mammals including arctic ground squirrels (*Spermophilus parryii*) in burrows (Hubbs et al. 2000). One objective of this study was to evaluate the potential for using thermal imagery as a tool to improve estimates of rabbit abundance based on burrow counts by determining current occupancy of burrows. We attempted to address four questions about this application of thermal imagery: 1) Can a thermal camera detect rabbits in burrow systems? 2) Can thermal imagery distinguish empty burrow systems from occupied ones? 3) What factors might influence reliability of this technique? 4) Given our preliminary results, is thermal imagery a useful tool for population census in pygmy rabbits?

We rented a hand-held thermal camera (ThermaCAM E2) from FLIR Systems for a 2-week period during November of 2002. The camera converts infrared energy emitted from objects into visible images that are viewed on a LCD screen and can be downloaded to a computer. We first tested ability to detect rabbits in burrows by observing rabbits enter burrow systems or radio-tracking rabbits to burrow systems, and then scanning burrow entrances with the thermal camera. Second, we evaluated the ability of the camera to identify empty burrows. Because rabbits actively clear snow from burrow entrances shortly after snowfalls, we interpreted a lack of tracks in the snow at and around burrow entrances to indicate that the system was currently unoccupied. Presence of snow cover during November eliminated the need for using tracking boards as outlined in the grant proposal. We obtained thermal images during the early morning hours (5:30-7:30) when soil temperatures surrounding burrow entrances were lowest, and therefore, the temperature difference between the soil and burrow entrances would be maximized.

A clear visual signature was apparent from occupied burrows. When animals remained near the burrow entrance and occasionally were visible at the entrance, the visual signal was noticeably brighter. Results of the unoccupied burrows were less definitive. In most cases, a faint to moderate visual signal was apparent, even at burrow systems that did not show signs of rabbit activity. Several factors may have contributed to our inability to consistently distinguish occupied and unoccupied burrows for pygmy rabbits using thermal imagery. First, it is possible that some burrows that we categorized as unoccupied were in fact inhabited by rabbits or other small mammals. Second, temperatures in pygmy rabbit burrows during winter remain relatively constant (between -1.3° and -4.3°C; Katzner, 1994). When external temperatures were low, we may have detected a temperature difference between the soil and burrow entrances, even for unoccupied burrows. Third, we noticed that as animals moved within burrow systems, the strength of the visual signal varied. Therefore, position of the rabbit within a burrow, complexity of the burrow system, and perhaps length of time that a rabbit has been inside of a burrow may influence ability to detect animals. Although thermal imagery may be useful for some research applications, this technique has limited utility for census purposes in this species due to the inconsistency in correctly assessing burrow occupancy, as well as the high initial cost (thermal cameras cost between $15,000 - 50,000)

Hubbs, A.H., T. Karles, and R. Boonstra. 2000. Indices of population size for burrowing mammals. Journal of Wildlife Management. 64:296-301.

Katzner, T.E. 1994. Winter ecology of the pygmy rabbit (*Brachylagus idahoensis*) in Wyoming. M.S. Thesis, University of Wyoming, Laramie.

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

Principal Investigator: Dr. J. Rachlow
Student Investigator: Alisse Garner
Funding Agency: Idaho Department of Fish & Game
Completion Date: 5/31/04

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, 467 hair samples were collected from 8 populations of Southern Idaho ground squirrels and 7 populations of Northern Idaho ground squirrels. DNA was extracted from the hair samples at the Laboratory for Ecological and Conservation Genetics at the University of Idaho. We genotyped all samples at four microsatellite loci from the Columbian ground squirrel (*Spermophilus columbianus*), one locus previously developed for Northern Idaho ground squirrels, and three newly-developed loci for Southern Idaho ground squirrels. New loci were developed in cooperation with Genetic Identification Services, Chatsworth, CA. Allele frequencies were analyzed to evaluate genetic diversity levels in each population and divergence among populations.

The Northern Idaho ground squirrel exhibited relatively high levels of genetic diversity (mean heterozygosity = 0.58) and low to moderate levels of divergence among populations. In contrast, Southern Idaho ground squirrels exhibited low levels of diversity (mean heterozygosity = 0.43), and some populations exhibited high levels of divergence, indicative of isolation. These results suggest that, with one or two exceptions, there is less immediate need for genetic mediation in populations of Northern Idaho ground squirrels than had been anticipated. From a genetic standpoint, longer-term conservation strategies, such as habitat restoration, should remain a top priority for Northern Idaho ground squirrels. Also contrary to expectations, some Southern Idaho ground squirrel populations may require more immediate conservation measures to mediate for genetic diversity loss (i.e. translocations or captive breeding). Analyses of mitochondrial DNA are on going. Results and conservation implications for each population are discussed in further detail in the master's thesis, which will be completed in May 2004.

LAMB PRODUCTION IN CALIFORNIA BIGHORN SHEEP

Principal Investigator: Dr. J. 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 2002-03, and will be completed during April-August 2004. A total of 38 sheep were radio-collared in 2002, and an additional 14 collars were fitted in 2003. During the first field season, 9 sheep 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. Seven 7 ewes died during the 2003 field season; two mortalities occurred within one month of capture, and thus may be capture related. Of the remaining 5 mortalities, 3 appeared to be due to predation by mountain lions, while 2 were accessed too late to reliably assign cause of death.

In 2002, 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. In the second field season, the first lamb was observed on April 13 and lambing continued through May 25, with a peak between April 25 and May 10. Four collared ewes died prior to the onset of lambing in 2003. Of the 38 collared ewes that survived through the onset of lambing, 27 (71%) were observed to have produced a lamb. Blood samples taken during the March capture effort indicated that one of the 14 newly collared sheep was not pregnant. Of those 14, one additional animal was never observed with a lamb. Of the 27 lambs observed with collared ewes during the current field season, 7 disappeared. Three additional collared ewes also died, resulting in a lamb: collared ewe ratio of 20:35 (57%). During both field seasons, the lamb: ewe ratios differed among the three drainages in the study area. Field work will be completed in August 2004,

We have collected monthly fecal samples and have conducted vegetation sampling at feeding sites in each of the three drainages. We are collecting fecal pellets from captive bighorn sheep for calibration of three indices of pregnancy status. The master's thesis will be completed in May 2005.

INVESTIGATION OF REPRODUCTION OF PYGMY RABBITS

Principal Investigator: Dr. J. Rachlow
Funding Agency: Idaho Department of Fish & Game
Completion Date: 6/30/04

Objective(s): The objective of this project was to gather data on reproductive behaviors and parameters, and to provide preliminary information for a more detailed study of population dynamics of pygmy rabbits.

Progress: We fitted 20 adult females with radio-collars at 2 locations in the Lemhi Valley, Idaho, during March-May to facilitate observation of reproductive behaviors. Weights of adult females varied from 400 g to >545 g (maximum value of the spring scale plus weighing bag). Palpation indicated that females captured during 19-23 March were in the early stages of pregnancy.

We observed the first 2 juveniles on 5 May, one of which was captured and weighed at 110 g. We recorded weights for 17 juveniles and estimated ages based on growth of captive pygmy rabbits. Given a gestation period of 22-25 days, the estimated conception dates for the first kits we observed were between 8 -16 March. The distribution of juvenile weights suggested two cohorts approximately 4 weeks apart. However, between 26 and 30 May, we captured juveniles with estimated ages ranging from 3 to 8 weeks. These data suggest that breeding in this population was less synchronous than previously reported for this species in southern Idaho (Wilde 1978, Fisher 1979). A lack of birth synchrony was further supported by the distribution of adult female body weights. Some females captured during all of June and early July were in advanced stages of pregnancy, suggesting that a third and less synchronous cohort was produced during July.

Locations of parturition and nests had not been documented previously for this species. Observations during captive breeding have provided the most detailed information on reproductive behaviors of pygmy rabbits. Pregnant females were observed digging single-entrance natal burrows that terminated in a nest chamber. Females excavated the natal burrows from 7 to 10 days prior to parturition, and lined the nest chamber with grass and hair (Lamson and Shipley 2002). We studied free-ranging pygmy rabbits during April – July 2003, during which we located 7 natal burrows. These observations represent the first documentation of natal burrows for free-ranging pygmy rabbits. We measured dimensions of the tunnel and nest chamber of the 7 vacated natal burrows. Remaining nesting materials were collected, air-dried, weighed, and examined for content. We evaluated spatial relationships between natal burrows and residential burrow systems by searching the area within a 50-meter radius of each natal burrow for currently active or recently active residential burrow systems.

Fine grasses, shredded bark from sagebrush (*Artemisia* spp.), and hair were the primary components of the nesting materials. We also found fleas and mites in some of the nests. Pygmy rabbits appeared to establish natal burrows away from their residential burrow systems. Three of the natal burrows we examined had no active or recently active residential burrow systems within 50 meters; average distance to an active residential burrow system was >35 meters. Vegetation structure and composition around the natal burrows was typical for the earth-mound micro-topography ("mima mounds"). Shrubs tended to be taller and denser on the mounds, with little or lower shrub cover in the areas within mima mounds, and 6 natal burrows were located at the base of shrubs (5 under sagebrush and 1 under rabbitbrush).

Fisher, J.S. 1979. Reproduction in the pygmy rabbit in southeastern Idaho. M.S. Thesis, Idaho State University, Pocatello. 33 pp.

Lamson, R., and L. Shipley. 2002. Washington pygmy rabbit (Brachylagus idahoensis): captive breeding summary 2002. Unpublished report.

Rachlow, J.L., D.M. Sanchez, and W.A. Estes-Zumpf. Natal burrows and nests of free-ranging pygmy rabbits (*Brachylagus idahoensis*). Western North American Naturalist. *In press*.

Wilde, D.B. 1978. A population analysis of the pygmy rabbit (Sylvilagus idahoensis) on the INEL site. Ph.D. Dissertation, Idaho State University, Pocatello. 172 pp.

POPULATION DYNAMICS OF GREATER SAGE-GROUSE IN LITTLE LOST AND COW CREEK, IDAHO

Principal Investigator: Dr. 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 and Cow Creek watersheds of southern Idaho.

Progress: Lek counts were completed and all data provided to IDFG for use in the on-going statewide sage-grouse conservation planning effort.

Final report filed with funding agency.

JARBIDGE GREATER SAGE-GROUSE ECOLOGY PROJECT

Principal Investigator: Dr. K. P. Reese
Student Investigator: J. Shepherd
Funding Agency: Idaho Department of Fish and Game
Completion Date: 6/30/04

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. 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, interspersion, 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: Field work was completed in August 2002. Data analysis is continuing. Preliminary results will be presented at the Idaho Chapter of The Wildlife Society annual meeting in March 2004.

TRANSLOCATION OF TRUMPETER SWANS

Principal Investigator: Dr. K. P. Reese
Student Investigator: Darlene Kilpatrick
Funding Agency: Idaho Department of Fish and Game
Completion Date: 6/30/04

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 monitored trumpeter swan cygnets during the winter of 2002 and is doing so again in the winter of 2003. The graduate student developed a research proposal to investigate survival and distribution of the birds. She is currently collecting data in her first field season (November 2003 – March 2004).

GREATER SAGE-GROUSE CHICK ECOLOGY

Principal Investigator: Dr. K. P. Reese
Student Investigator: N. A. Burkepile
Funding Agency: Idaho Department of Fish and Game
Completion Date: 6/30/04

Objectives: Our objectives were to determine age and cause-specific mortality rates in greater sage-grouse chicks in southern Idaho.

Progress: Sage-grouse populations have declined throughout their range, including Idaho. Previous studies in Idaho have revealed that clutch sizes, nest initiation and success rates, along with survival of adults suggests that these are adequate for stable populations of grouse. Therefore, in 1999, we initiated a study to determine if chick survival to 10 weeks post-hatch is limiting sage-grouse populations. During 1999-2002, we radio-marked greater sage-grouse females and monitored nesting activity. After eggs hatched, we radio-marked one-day-old chicks and monitored survival to 10 weeks. Nest success ranged between 41-51% and did not differ between years. From 1999-2001, chick survival ranged between 27-33% and did not differ between years. However, in 2002 chick survival was higher (56%) than the previous three years. In all years the highest mortality occurred during the first three weeks post-hatch. Low survival of chicks to 10 weeks during 1999-2001 indicates that chick survival to September may be limiting reproductive output in southeast Idaho. Currently, we are developing habitat models to determine what habitat characteristics influence chick survival.

GRADUATE STUDENT STUDIES

Principal Investigator: Dr. K. P. Reese
Funding Agency: Idaho Department of Fish and Game
Completion Date: 6/30/04

Objectives: The objective is to cooperatively develop a graduate student project of interest to IDFG on an upland gamebird or waterfowl species.

Progress: Discussions about a suitable project are underway.

GREATER SAGE-GROUSE NESTING

Principal Investigator: Dr. K. P. Reese
Funding Agency: Idaho Department of Fish and Game
Completion Date: 6/30/04

Objectives: This research seeks to further understand the role of habitat structure in the nest site selection and nest success of greater sage-grouse.

Progress: Sage-grouse hens have been captured on leks during the springs of 2002 and 2003, radio-marked and monitored throughout the nesting period. Detailed habitat measurements have been recorded from each nest site. Analysis is currently on going.

DEVELOPMENT OF UNMANNED AIRBORNE VEHICLE FOR MONITORING WILDLIFE

Principal Investigator: Dr. 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 grasslands)

Progress: Reviewed possible platforms, interviewed potential users, and built partnerships. Co-hosted a symposium in April 2003 on Unmanned Aerial Vehicles with Florida Cooperative Research Unit. Field tested the ability of small aircraft to detect life size turkey and waterfowl decoys and transmit video images to the ground. July 2004 scheduled field test of military grade UAV in collaboration with U.S. Army. Developed and submitted proposal to host symposium on the use of unmanned aircraft for monitoring wildlife at 2005 meeting of the Wildlife Society.

BREEDING ECOLOGY AND PHILOPATRY IN RED-SHOULDERED AND RED-TAILED HAWKS

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

Objectives:

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

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

Progress: Banded 2,112 nesting red-shouldered hawks and recaptured 99, and recovered 82. Banded 3,860 red-tailed hawks and 8 have been recaptured 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:	Dr. 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	Dr. J. M. Scott
Student Investigator:	David Stanish
Funding Agency:	U.S. Geological Survey
Completion Date:	5/30/2005

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 collected and reviewed and preliminary analysis has been completed.

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

Principal Investigator: Dr. 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.

Manuscript completed and dissertation successfully defended. Results of work have been delivered to key decision makers in U.S. Fish and Wildlife Service.

ENDANGERED SPECIES ACT AT 30: SCIENCE, POLICY AND LAW

Principal Investigator: Dr. J. M. Scott/ Dr. Dale Goble
Funding Agency: Bren School of Environmental Science
U.S. Geological Survey
Turner Endangered Species Fund
Completion Date: 9/20/04

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. Scheduled a symposium for November 2003. Initial findings indicate:

1. We are not getting ahead of the extinction curve
    - Endangered species far outnumber threatened species. Nearly 7000 species waiting to be listed
2. Recovery efforts under funded.
3. Use of recovery tools not fully realized
4. Recovery actions biologically relevant. We can and do make a difference when funding is available.
5. Greater transparency needed in implementing actions.
6. Legal actions are driving the system.

FOCAL SPECIES AS CONSERVATION TARGETS

Principal Investigator: Dr. J. M. Scott
Student Investigator: Leona Svancara
Funding Agency: USGS
Completion Date: 09/30/05

Objectives:
Habitat management strategies used by the US Forest Service (USFS) and the Bureau of Land Management (BLM) often incorporate the idea of "focal", "indicator", or "umbrella" species, where a select set of species are used to set management priorities. In Idaho, these focal species are often meso-carnivores, raptors, or species associated with specific habitats (e.g., Canada lynx, Northern goshawk, Coeur d'Alene salamander, Sage grouse). Managing the majority of land in Idaho, the USFS and BLM are in the position to provide habitat protection for a number of species. However, it is unknown whether current management strategies based on focal species allow for adequate protection of other terrestrial vertebrates known to regularly breed in the state. Our objectives were to a) identify the species selected for management by USFS across the US, b) assess the adequacy of current and future conservation areas for focal species and / or habitat specialists to provide sufficient protection for other, non-focal, under-represented cover types and terrestrial vertebrates, and c) evaluate the affect of geographic variability in habitat selection by the focal species.

Progress:
To date, we have identified the suite of management indicator species used by each of the national forests and grasslands in the US. We have management plans in possession for over 75% of these areas and are summarizing differences in management strategies. Site selection algorithms (e.g., SITES, MARXAN, RESNET) will be used to identify areas important for focal species. These areas will then be compared with the results from the Idaho Comprehensive Conservation Assessment to determine spatial agreement. In addition, these areas will be described by the amount of habitat protected for other sensitive, but not focal, species.

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

Principal Investigator: Dr. J. M. Scott
Student Investigator: William Kristan
Agency Funding: USGS
Completion Date: 09/30/04

Objectives:

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

Progress: Work began on RW0107 in Jan 2003. The project's goal is to evaluate the ecological interpretation of different statistical approaches to modeling animal-habitat relationships, to provide guidance for the use of different approaches, and to use the fit of different models to occurrence data to explore the characteristics of habitat use by a species. Between Jan 03 and Sept 03, we concentrated on laying the foundations to address these questions.

One motivating factor for this study is that the predictive accuracy of habitat models if frequently disappointing. Selecting a model with the best representation of a habitat association is likely to produce the best predictive accuracy. However, some sources of erroneous predictions are not due to deficiencies in the model. As an initial step, we developed an approach to characterizing the relative importance of different sources of prediction accuracy (e.g. incorrect habitat model, inadequate sampling intensity, "rounding error") so that the expected accuracy of a model could be calculated. One source of error, the "rounding error" that occurs when a continuous predictor is compared against a set of discrete observations, has not to our knowledge been characterized before in predictive habitat modeling. Including explicit measures of expected prediction accuracy from a variety of sources will help the GAP project interpret their predicted vertebrate distribution maps, and to provide adequate caveats to end-users. Scheduled a half-day symposium at the meeting of the Cooper Ornithological Society.

USING DNA TO MONITOR GRIZZLY BEAR POPULATION TRENDS

Principal Investigator: Dr. 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, and 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: Over the three years of the study 10,814 hairs samples were collected at hair traps; 10,448 hair samples were collected at rub trees; and 4,415 fecal samples were collected. Species identification analyses revealed the following species proportions by method: 65% black and 35% brown for hair traps, 34% black and 66% brown for rub trees, 60% brown and 40% black for fecal samples. Across all years of the study, 329 brown bears were detected. Preliminary population estimates using Lincoln-Peterson are 404(325-533). Sex identification of samples revealed the following ratios per method: 58%female/42%male for hair traps, and 34%female/66% male for rub trees.

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 MICROSATELLITE GENETICS & HABITAT USE PROGRAM

Principal Investigator	Dr. L. Waits
Student Investigator:	Jennifer Adams
Funding Agency:	USFWS
Completion Date:	09/30/05

Objective(s):

1) **Modify existing non-invasive genetic tests (mtDNA) to use nuclear DNA microsatellite markers**

Progress: We used the 2000 scat dataset to optimize the use of microsatellite markers in collected fecal samples. Using probability of identity calculations, we determined that 6 microsatellite loci are necessary to distinguish between individuals in the wild red wolf population. Because oftentimes loci fail to amplify in fecal samples, we decided to optimize 8 loci. The 8 loci were optimized into 4 PCR reactions, one singleplex, two diplexes, and one triplex. We then amplified the 209 scats that had worked using mitochondrial DNA markers. We were able to obtain reliable data at 110 of those scats for an amplification success rate of 53%. Furthermore, we were able to match the haplotypes found in the 110 scats to a database of known individuals. The haplotypes found in 107 of the scats were matched to 15 known individuals, the highest number of detections for one individual being 21 and the lowest being 1. The haplotypes found in the other 3 scats did not match any individuals in the known dataset and so represent three previously unknown individuals. This documents the ability of this method to identify new, never before captured individuals.

This method was also applied to the 2003 scat dataset in order to test its ability to detect both unknown individuals and hybrid individuals. A total of 509 scats were collected and we have obtained genotype data on 123 of them for an amplification success rate of 24%. This is drastically lower than the success rate for 2000; however, we did not use the mitochondrial DNA markers to exclude scats from analysis in 2003. If we had not screened the scats in 2000 with mitochondrial DNA the success rate would have dropped to 27% (110/404). At this time, of the 123 scats, 87 of them have been matched to known individuals, the highest number of detections being 23, and the lowest being 1. Sixteen of the 123 scats potentially represent 14 new individuals. Of the potential 14 new identities, one has been identified as 100% red wolf, and one has been identified as a coyote backcross (75% coyote). We are still working to resolve the ancestry of the other identities. These preliminary results suggest that this method is not only able to find new identities, but can also detect unknown hybrids as well.

2) **Improve existing maximum likelihood genetic test by including data from 14 red wolf founders**

Progress: The principal threat to the persistence of the endangered red wolf (*Canis rufus*) in the wild is hybridization with the coyote (*Canis latrans*). To facilitate identification and removal of hybrids, we developed assignment tests, which use genotype data to estimate identity as coyote, 1/4, 1/2, 3/4 or full red wolf. The tests use genotypes from the red wolves that founded the surviving population and the resulting pedigree, rather than a contemporary red wolf sample. The tests are evaluated by analyzing both captive red wolves at 18 microsatellite loci, and data simulated under a highly parameterized, biologically reasonable model. The accuracy of assignment rates are generally high, with over 95% of known red wolves identified correctly. There are, however, tradeoffs between ambiguity and misassignments, and between misidentifying red wolves as hybrids and hybrids as red wolves. These result in a compromise between limiting introgression and avoiding demographic losses. The management priorities and level of introgression determine the combination of test and removal strategy that best balances these tradeoffs. Ultimately, we conclude that the use of the assignment tests has the capacity to arrest and reverse introgression. To our knowledge, the presented approach is novel in that it accounts for genetic drift when the genotypes under analysis are temporally separated from the reference populations to which they are being assigned. These methods may be valuable in cases where reference databases for small populations have aged substantially, pedigree information is available, or data are generated from historical samples.

3) **Combine data from non-invasive genetic sampling with GIS technology to determine both red wolf home range size and habitat usage.**

Progress: No further progress has been made on this objective

Publications for all projects

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

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

Miller, C.R., J. R. Adams, and L. P. Waits. 2003. Pedigree based assignment tests for reversing coyote (Canis latrans) introgression into the wild red wolf (Canis rufus) population. Molecular Ecology 12:3287-3301

Murphy, M., L. Waits, K. Kendall (2003) Impact of diet on faecal DNA amplification and sex identification in brown bears (*Ursus arctos*). Molecular Ecology 12:2261-2265

Murphy, M., L.P. Waits, K. Kendall, S. Wasser, J. Higbee, R. Bogden (2002) An evaluation of long-term preservation methods for brown bear (*Ursus arctos*) faecal DNA samples. Conservation Genetics 3:435-440.

Roon D, L.P. Waits, K. Kendall (2003) A quantitative evaluation of two methods for preserving hair samples, Molecular Ecology Notes 3:163-166.

BIOLOGICAL DATA INVESTIGATION IN NORTHERN SEMI-ARID NATIONAL PARKS

Principal Investigator: Dr. R. G. 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 vertebrates believed to occur in Northern Semi-Arid Lands Network parks from a variety of sources, including park data bases, museum records of voucher specimens, and previous studies, Input this data into the appropriate NPS databases.

2. Complete field surveys for the 8 inventories in the network parks with the goal of documenting 90% of all species estimated to occur in each park. Greater emphasis will be placed on inventories of species of special concern to the parks.

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.

Final reports completed on this project:

1. Madison, E., T. Rodhouse, and L. Garrett. 2003. Mammal inventory for Craters of the Moon National Monument and Preserve. Report for subagreement No. 20 for Cooperative Agreement No. CA9000-95-018.
2. Madison, E., K. Oelrich, T. Rodhouse, and L. Garrett. 2003. Mammal inventories City of Rocks National Reserve. Report for Subagreement No. 20 for Cooperative Agreement No. CA9000-95-018.

3. Strobl, C., L. Garrett, L. and T. Rodhouse. 2003. Mammal and herpetological inventories Nez Perce National Historical Park. Report for Subagrement 20 for Cooperative Agreement No. CA9000-95-018.
4. Strobl, C., L. Garrett, L. and T. Rodhouse. 2003. Mammal and herpetological inventories Big Hope National Battlefield. Report for Subagreement No. 20 for Cooperative Agreement No. CA9000-95-018.
5. Shrive, J.P. and C.R. Peterson. 2002. Herpetological inventory of the City of Rocks National Reserve. Report by the Herpetology Laboratory, Idaho Museum of Natural History, Idaho State University.
6. Anderson, S. 2003. Butterflies of the John Day Fossil Beds National Monument. Unpublished Report, Department of Biological Sciences, Oregon State University.

LANDSCAPE ANALYSIS OF BLACK BEAR MOVEMENTS AND HABITAT USE

Principal Investigator	Dr. R. G. Wright
Student Investigator:	Kim Sager
Funding Agency:	National Park Service
Completion Date:	3/31/05

Objectives:

- Assess performance and observational bias using Global Positioning System radio-telemetry
- Describe seasonal home 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. Collars deployed in 2002 dropped-off in late September 2003 as programmed and data was downloaded. We are still trying to retrieve two collars that remained on bears as of November 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".

A paper on this project entitled *A landscape analysis of black bear habitat use in the Elwha watershed of Olympic National Park* was given by Kim Sagar and Gerry Wright at the Western Black Bear Workshop in Chico Hot Springs, Montana, March 2003.

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

Principal Investigator: Dr. R. G. Wright
Student Investigator: Marcus Swan
Funding Agency: U.S. Geological Survey
Completion Date: 12/31/04

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, and census data to develop a historic vegetation map of the 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.

A first draft of an MS thesis on this project has been written.

HABITAT USE AND MOOSE BROWSING EFFECTS IN ROCKY MOUNTAIN NATIONAL PARK

Principal Investigator: Dr. R. G. 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.
5. To develop a nutritional based ecological carrying capacity model for moose in the park.

Progress: Two years (summer to fall) of fieldwork has been completed. In one segment of the project, male moose activity patterns have been documented and recorded in over 38 individual 24-hour surveys or diels during the summer of 2003. During these diels, feeding rates, bite counts, and browse composition have been recorded. Seasonal moose distribution throughout the eastern portion of the park has been fairly well documented. Browse estimates have been measured in three large exclosures along the Colorado River flooplain and in three temporary exclosures established in the summer of 2003 in upland meadow willow communities. Forage and fecal samples were collected from throughout the study area. Forage samples were analyzed for nitrogen, protein, and trace minerals in the fall of 2003 at the Wildlife Nutrition Lab at WSU. During the summer of 2003 we experimented with remotely marking moose with unique paint colors from paint-ball guns. Color definition and retention was not sufficient to make this method useful. 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 exclosures 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.

REPRODUCTION AND HABITAT USE OF MOOSE IN EXPANDING POPULATIONS IN IDAHO

Principal Investigator: Dr. R. G. Wright
Student Investigator: Jon Muir
Funding Agency: National Park Service
Completion Date: 4/30/06

Objectives: The goal of this research is to gain an understanding of the biology of moose in areas of population expansion in Idaho. Specific objectives include:

1. Contrast habitat use and movement patterns of moose inhabiting traditional and expansion zones.
2. Contrast reproduction and body condition of moose in expanding and traditional areas.
3. Gain a stateside perspective on patterns of population expansion through analyses of existing survey data.

Research questions:

1. How do movement patterns (frequency, distances, and spatial distributions) differ between moose in areas of expanding and stable populations?
2. How do habitat use and selection differ between moose in traditional habitats and those in areas of population expansion?
3. Does reproduction differ between expanding populations and geographically stable ones? Does body condition differ and is it correlated with calf production and/or survival?

4. Given available survey data, can we identify changes in relative abundance and distribution of moose in Idaho, and use those patterns to predict areas of future expansion?

As moose populations increase and expand in geographic range, observations of moose recorded during aerial surveys conducted for elk also should increase. This information along with data from surveys conducted for moose in the Panhandle Region, may be useful for characterizing changes in distribution and relative abundances of moose. This information will provide a context for examining current and future patterns of moose population expansion in Idaho.
Progress: This project commenced in August 2003. No fieldwork has been done. We are awaiting final approval from University Animal Care and Use Committee on animal handling protocols.

BLACK BEAR FOOD HABITS IN YOSEMITE NATIONAL PARK

Principal Investigator: Dr. R. G. Wright
Student Investigator: Schuyler Greenleaf
Funding Agency: National Park Service
Completion Date: 12/31/04

Objectives:

1. Collect and analyze food habits of black bears in Yosemite Valley during the spring, summer and early fall season using scat samples and a reference collection of available food items.
2. Record the movement and habitat use of existing radio-collared black bears in the valley using a 24-hour diel procedure, and record points on a small-scale GIS map of the valley.
3. Attempt to correlate bear movements in human-dominated habitats with the proportion of anthropogenic food items identified in the diet.

Progress: Scat samples from two years, three seasons each have been analyzed by the grad student. A third summer was spent in the field (2003) to gather refined movement data in habitats on the lower and mid slopes of the valley where telemetry signals and GPS reception are often blocked by topography. Additional scat samples were collected at that time. We also expanded the study objectives to look at the use of stable isotope analysis as a method to get a signature on the food profiles of individual bears.

AN INVENTORY OF BAT SPECIES AND A DETERMINATION OF BAT ROOST HABITAT CHARACTERISTICS AT JOHN DAY FOSSIL BEDS NATIONAL MONUMENT

Project Investigator: Dr. R. G. Wright
Student Investigator: Tom Rodhouse
Funding Agency: National Park Service
Completion Date: 12/31/04

Objectives:

1. To inventory all bat species using the John Day River floodplain in the three units of John Day Fossil Beds National Monument. Inventories to be done using mist-net collection and an Annabat echo location recorder.
2. Use remotely monitored radio-transmitters on bats to locate night roosts and measure their characteristics.

Progress: Fieldwork was completed in the summer of 2003. A final report to the park is in progress. A draft journal article on the night roost portion of the study is in progress to be submitted to the Western North American Naturalist.

Completed Projects - Wildlife Resources

Dr. E. Oz Garton - Principal Investigator

- Effects of forested buffer width of breeding bird communities in coastal forests of southeast Alaska with a comparison of avian sampling techniques

Dr. Janet Rachlow - Principal Investigator

- Pygmy rabbit survey
- Pygmy rabbit habitat modeling

Dr. J. Michael Scott - Principal Investigator

- Development of guidelines for comprehensive conservation
- Conservation assessment of Ukraine: Biological and geophysical features

Dr. Lisette Waits - Principal Investigator

- Red Wolf Genetics

Dr. R. Gerry Wright - Principal Investigator

- Managing Resource Data
- Bear conflicts along the McCarthy Road corridor in the Wrangell St. Elias National Park and Preserve

EFFECTS OF FORESTED BUFFER WIDTH OF BREEDING BIRD COMMUNITIES IN COASTAL FORESTS OF SOUTHEAST ALASKA WITH A COMPARISON OF AVIAN SAMPLING TECHNIQUES

Principal Investigator: Dr. E. O. Garton
Student Investigator: Michelle Kissling
Funding Agency: U.S. Fish and Wildlife Service
Completion Date: 12/30/03

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.

Results: Standard point counts are the most common method used for estimating abundance of birds, but typical analysis methods fail to account for detection probability differences among observers and other factors influencing detectability. We adapted a technique that combines distance sampling and double sampling to estimate detection probabilities. Two independent observers collected data simultaneously at each unlimited- radius point count station. Density estimates for each observer and each species were adjusted for differences in detection probabilities by multiplying each observer's estimated density by their corresponding correction factor, relaxing the assumption that p=1.0 at the plot center. We applied this method to point count surveys conducted in Southeast Alaska. We compared results from four analysis methods: Single Observer fixed radius plots, Single Observer variable circular plots (SOVCP), Double Observer fixed radius plots, and Paired Observer variable circular plots (POVCP). Prior to adjustment for detectability bias, detection probabilities at the plot center for single observers varied among observers (n=7) for all species: 0.83 – 0.99 for Winter Wren (*Troglodytes troglodytes*), 0.71 – 1.00 for Townsend's Warbler (*Dendroica townsendi*), 0.80 – 0.98 for Pacific-slope Flycatcher (*Empidonax difficilis*), 0.61 – 1.00 for Hermit Thrush (*Catharus guttatus*), and 0.67 – 1.00 for Golden-crowned Kinglet (*Regulus satrapa*). Average detection probabilities for paired observers increased approximately 11% for all species. Although detection probabilities were improved with paired observers, the assumption that g (0)=1 was not met. Using the POVCP technique, density estimates increased by approximately 237% (range = 68 – 676%) over Single Observer fixed radius plot estimates, 7% (range = 1 – 12%) over SOVCP estimates, and 94% (range = 3 – 310%) over the Double Observer fixed radius estimates. Standard deviation estimates using POVCP for all five species were less than 0.13 males per hectare. Failure to account for differences in detection probabilities results in biased population estimates which can be substantially below true densities.

PYGMY RABBIT SURVEY

Principal Investigator: Dr. J. Rachlow and Jim Witham
Funding Agency: Idaho Department of Fish & Game
Completion Date: 6/30/03

Objective(s): The goal of this project was to census pygmy rabbit populations at both known, occupied sites and potentially suitable sites on public land administered by the BLM Shoshone Field Office. Specific project objectives included to: 1) conduct a field evaluation of areas mapped as potentially suitable habitat for pygmy rabbits; 2) determine the current location and distribution of pygmy rabbit populations in the Shoshone Field Office area; and 3) search for undocumented populations.

Results: We used a habitat model that we developed for pygmy rabbits (see below) to stratify the BLM Shoshone Field Office Area (FOA) for habitat sampling. We surveyed 114 sites to evaluate potential pygmy rabbit habitat and rabbit presence, and searched an additional 40 locations for rabbit presence in the Shoshone FOA during summer 2003. During that work, we observed 2 live pygmy rabbits at one site and identified 14 locations where presence of sign (i.e., burrows and fecal pellets) warranted further investigation to evaluate occupancy by pygmy rabbits. We are conducting follow-up surveys during winter and spring at sites identified as potential populations. We have documented rabbits at two of the 14 potential sites (Mormon Reservoir and Magic Reservoir).

PYGMY RABBIT HABITAT MODELING

Principal Investigator:	Dr. J. Rachlow and Leona Svancara
Funding Agency:	Idaho Department of Fish & Game
Completion Date:	6/30/03

Objective(s): The goal of this research was to evaluate potential habitat for pygmy rabbits on a statewide extent, and to provide guidance for ground surveys to improve understanding of the status and distribution of the species in Idaho.

Results Pygmy rabbits (*Brachylagus idahoensis*) historically inhabited sage steppe regions across the Great Basin, and in Idaho, their historic distribution spanned much of the Snake River Plains. Information on current distribution and abundance is needed to assess their conservation status. Within Idaho, the historic distribution of pygmy rabbits likely extended across much of the Snake River Plains and adjoining areas of sage steppe. Museum records documenting the prehistoric distribution of the species in Idaho reflect a similar range.

We reviewed literature to identify and select habitat attributes associated with presence of pygmy rabbits (or their burrows). We used a Geographic Information System (GIS) to create a base map of potential habitat in Idaho, and to rank the potential habitat to prioritize survey efforts. Locations of historic and current populations were used to evaluate habitat variables to assign priority ratings. Occurrences were plotted and assessed for the following variables: vegetation type, elevation, slope, soil depth, and average percent clay in the soil. Values for each variable that encompassed 80-85% of all occurrences were considered "higher priority", and were assigned a priority rating of "1." Values outside of those ranges were assessed as "lower priority", and were assigned a priority rating of "2." All habitat variables were overlaid using a GIS and average priority ratings were assigned to each pixel of 30 m. The resulting map ranks habitat from higher to lower priorities in 6 categories. Most of the known locations fell into the top 2 priority ranks, which encompassed an area of 3.4 million hectares. Recommendations were provided for survey areas within Idaho where habitat was predicted to be suitable on a coarse scale, but where pygmy rabbit populations have not been documented (See Rachlow and Svancara 2003).

Rachlow, J. and L. Svancara. 2003. Pygmy Rabbits and their Habitat in Idaho: Synthesis of Historical and Spatial Information. Project Completion Report. 29pp.

DEVELOPMENT OF GUIDELINES FOR COMPREHENSIVE CONSERVATION ASSESSMENTS

Principal Investigators:	Dr. J. M. 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.

Results: 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 any 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 were 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.

We 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, lowest richness values occurred in the subalpine 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. 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 identified conservation priorities and implemented various selection algorithms (e.g., SITES, MARXAN, RESNET) that incorporate aspects of representation, redundancy resiliency, complementarity and irreplaceability. Due to limited population size and/or distribution, we considered 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 were obtained from the literature and, where empirical data was lacking, estimates were made using body size. We assessed 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 and compared these areas with sited identified by the Nature Conservancy. Manuscripts are in preparation.

CONSERVATION ASSESSMENT OF UKRAINE: BIOLOGICAL AND GEOPHYSICAL FEATURES

Principal Investigator: Dr. 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.

Results: Approximately 4% of the territory of Ukraine is in nature reserves. The area of these reserves is distributed unevenly among soil fertility and elevation classes. Nature reserves were most frequently located at higher elevations and on poorer soils. An assessment of occurrences of soil types and land cover types within the reserves indicated that only six of 42 soil types and eight of 29 land cover types identified had $\geq$ 10% of their area in nature reserves. Newly enacted legislation calls for more than 10% of Ukraine to be in nature reserves by 2015.

Manuscript completed and thesis defended. Final report filed with funding agency.

RED WOLF GENETICS

Principal Investigator: Dr. 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.

Results: We developed a genetic test to differentiate fecal samples for red wolves, coyotes, dogs, red fox, grey fox, bear and bobcat. In the spring of 2000, and 2001 we collected fecal samples on all roads in Alligator River National Wildlife Refuge. A total of 956 samples were collected and GIS coordinates were recorded for each sample. DNA has been extracted from all samples and success rates for species ID are 80%. In 2000 we detected 210 wolves, 65 bobcats, 5 dogs, and 2 black bears. In 2001 we detected 399 red wolves, 7 bobcats, 3 dogs, 3 mustelids, 2 otter, 1 red fox, and 5 coyote/hybrid scats. These results demonstrate that this method can detect the presence of resident coyote/hybrids.

We have collected and extracted DNA from over 150 coyote samples from Virginia, North Carolina, 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, and bone samples from the fourteen red wolf founders. We have also optimized 18 microsatellite loci and data from these loci have been incorporated into a genetic diagnostic method for differentiating red wolves, coyotes and hybrids. This method has been used to establish the ancestry of unknown individuals captured in the wild population.

MANAGING RESOURCE DATA

Principal Investigator: Dr. R. G. Wright
Funding Agency: National Park Service
Completion Date: 9/30/03

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

Results The project is complete.

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

Principal Investigator:	Dr. 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 currently 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.

Results: Fieldwork on this project began in May 2000, directed by graduate student James Wilder and assisted part-time by a 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 interviews were used to quantify and describe the nature of the bear-human conflicts.

Ninety-two (92) individual 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.

This project is now concluded. An MS Thesis was produced:
Wilder, J. 2003. Quantifying bear populations and bear-human conflicts using non-invasive genetic sampling in the Kennicott Valley of Wrangell St. Elias National Park and Preserve. University of Idaho.

A paper by the same name was given at the Western Black Bear Workshop in Chico Hot Springs, Montana in March 2003. A journal article is in progress.

SUMMARY OF ACTIVITIES

Honors and Awards:

Michael E. Colvin. ID Chapter AFS, Ted Bjornn Graduate Student Scholarship, 2003

Dr. James Congleton. Cooperative Research Units Leadership Award, 2003

Dr. Christine M. Moffitt. Outstanding Advisor, College of Natural Resources, 2003

Dr. Christine M. Moffitt. Who's Who in America; Who's Who of American Women, 2003, 2004

Dr. R. Gerald Wright. U.S. Department of Interiors Meritorious Service Award, 2003

Technical Assistance:

Christine M. Moffitt. Sport Fishing and Boating Partnership (USFWS) Fisheries Strategic Plan Steering Committee.

Fisheries Papers/Posters Presented:

Congleton, J. 2002. Responses of hatchery-reared chinook salmon to in-river migration and to dam bypass systems. Annual Program Review of the Pacific Northwest Division of Corps of Engineers, Portland, Oregon. November, 2002.

Congleton, J., B. LaVoie, T. Wagner, D. Jones, D. Fryer, J. Evavold, and B. Sun. August 2003. Blood-chemistry correlates of nutritional condition in migrating juvenile chinook salmon. Symposium on Use of Physiology to Assist in Management of Declining Fish Stocks, Annual Meeting of American Fisheries Society, Quebec City, Quebec, Canada.

Fryer, D. and J. Congleton. February 2003. Swimming performance of hatchery-reared yearling chinook salmon before and after passage through the Snake-Columbia River hydropower system. Twenty-fourth Annual Smolt Workshop, University of Idaho, Moscow, Idaho.

Fryer, D. and J. Congleton. February 2003. Swimming performance of hatchery-reared yearling chinook salmon before and after passage through the Snake-Columbia River hydropower system. Annual meeting of Idaho Chapter of American Fisheries Society, Boise, Idaho.

LaFrentz, B., S. LaPatra, G. Jones, J. Congleton, B. Sun, and K. Cain. April 2003. Characterization of serum and mucosal antibody responses in rainbow trout following immunization with *Flavobacterium psychrophilum*. Third International Symposium on Fish Vaccinology, Bergen, Norway. (Poster).

Jones, D., T. Wagner, and J. Congleton. February 2003. Swimming endurance and blood chemistry profiles of fed and fasted juvenile chinook salmon exposed to single and repeated confinement stressors. Twenty-fourth Annual Smolt Workshop, University of Idaho, Moscow, Idaho.

Jones, D., T. Wagner, and J. Congleton. April 2003. Swimming endurance and blood chemistry profiles of fed and fasted juvenile chinook salmon exposed to single and repeated confinement stressors. Western Division of American Fisheries Society, San Diego, California.

Moffitt, C. M. 2003. Effects of PIT Tags on Growth, Survival and Blood Chemistry of Fall Chinook Salmon in Different Temperatures. 133rd annual meeting of the American Fisheries Society, Quebec City, Quebec. August 2003Moffitt, C. M. 2003. Progress in Approval of Erythromycin for Salmonid Bacterial Kidney Disease. INAD Workshop, 30-31 July, Bozeman Montana.

Moffitt, C. M. 2003. New Approaches to Evaluate and Understand Risks of Pathogens to Cultured and Free-Ranging Fish Populations. Uses and Effects of Propagated Fishes in Fisheries Management. June 03, Boise, ID.

Moffitt, C. M. 2003. Gerald D. Schmidt Memorial Lecture "The puzzle of whirling disease: can we use landscape level approaches to understand and model risk?" Rocky Mountain Conference of Parasitologists, 34rd Annual Meeting May 1-3rd Colorado Springs, CO.

Moffitt, C. M. 2003. Models for whirling disease. 9th Annual Whirling Disease Symposium, February 03, Seattle WA.

Moffitt, C. M. 2003. Aquaculture America Special Session on Drug Approval Studies, February. Louisville, Kentucky.

Wagner, T. and J. Congleton. November 2002. Intraseasonal changes in response of juvenile chinook salmon to barge transportation: the importance of steelhead density. Annual Program Review of the Pacific Northwest Division of Corps of Engineers, Portland, Oregon.

Wagner, T. and J. Congleton. February 2003. Clinical chemistry indices in migrating juvenile chinook salmon: putting together the pieces of the puzzle. Twenty-fourth Annual Smolt Workshop, University of Idaho, Moscow, Idaho.

Wagner, T. and J. Congleton. August 2003. Clinical chemistry indices in migrating juvenile chinook salmon: putting together pieces of the puzzle. Annual Meeting of American Fisheries

Wildlife Papers/Posters Presented:

Greenleaf, S. February 2004. Seasonal food habits of black bears in Yosemite Valley based on scat analysis. Idaho Section Wildlife Society Meeting. Moscow, ID. (Poster – co-first place poster winner).

Greenleaf, S. February 2004. Anthropogenic food in the diet of black bears at Yosemite National Park. International Bear Conference. San Diego, CA.

Greenleaf, S. April 2004. Seasonal food habits of black bears in Yosemite Valley based on scat analysis. University of Idaho Graduate Student Association Symposium. Moscow, ID. (Poster – co-first place poster winner).

Sager, K. and G. Wright. March 2003. A landscape analysis of black bear habitat use in the Elwha watershed of Olympic National Park. Western Black Bear Workshop in Chico Hot Springs, Montana.

Sager, K. February 2004. An accuracy assessment of GPS telemetry collars in a mountainous temperate rainforest environment. Idaho Section Wildlife Society Meeting. Moscow, ID. (Poster – co-first place poster winner).

Sager, K. February 2004. Landscape analysis of black bear distribution patterns in Olympic National Park. International Bear Conference. San Diego, CA.

Sager, K. April 2004. An accuracy assessment of GPS telemetry collars in a mountainous temperate rainforest environment. Washington Section Wildlife Society Meeting. Ellensburg, WA.

Sager, K. April 2004. An accuracy assessment of GPS telemetry collars in a mountainous temperate rainforest environment. University of Idaho Graduate Student Association Symposium. Moscow, ID. (Poster – co-first place poster winner).

Scott, J.M. Maintaining scientific credibility when working with endangered species. Chapter The Wildlife Society, Spokane, WA.

Scott, J.M. October 2002. How much is enough? or How small is too small? Conservation Planning Workshop, Billy Creek, Idaho.

Scott, J.M. December 2002. Habitat models a first step in identifying critical habitat. Canadian Wildlife Service, Toronto, Canada

Scott, J.M. April 2003. New Technologies in aerial natural resources survey: Promises and progress. University of Florida, Gainesville, Florida.

Scott, J.M. August 2003. A conservation estate for the United States: Challenges & Prospects. Idaho Lava Lake Land & Livestock, L.L.C. Science and Conservation Advisory Board Meeting, Lava Lake, Idaho.

Scott, J.M. September 2003. A conservation estate for the United States: Challenges & Prospect. World Parks Congress, Durban, South Africa.

Stump, B. and J. Dungan. March 2004. Moose distribution and carrying capacity at Rocky Mountain National Park. Rock Mountain National Park Science Conference. Estes Park, CO.

Svancara, L. K. and R. Brannon. 2003. What is representation? A review of conservation targets. National GAP Analysis Program, Ft. Collins, CO.

Svancara, L. K. and J. M. Scott. 2003. Scale and uncertainty: Managing for elk in the Clearwater. Society of American Foresters, Idaho Chapter. Lewiston, ID.

Svancara, L. K. and J. L. Rachlow. 2003. Identifying and prioritizing Idaho's pygmy rabbit habitat. Idaho Chapter of The Wildlife Society Annual Meeting. Boise, ID.

Svancara, L. K. and J. M. Scott. 2003. Comprehensive conservation assessments: a future for Idaho? Idaho Chapter of The Wildlife Society Annual Meeting. Boise, ID.

Svancara, L. K., C. R. Peterson, and C. Jenkins. 2003. Change in the sagebrush steppe: a look at reptile distributions. Idaho Chapter of The Wildlife Society Annual Meeting. Boise, ID.

Wilson, G. M. 2003. Does 15 meters matter? Idaho Chapter of The Wildlife Society Annual Meeting. Boise, ID.

Wilder, Jim. March, 2003. Quantifying bear populations and bear-human conflicts using non-invasive genetic sampling in the Kennicott Valley of Wrangell St. Elias National Park and Preserve. Western Black Bear Workshop in Chico Hot Springs, Montana.

Reports:

Madison, E., T. Rodhouse, and L. Garrett. 2003. Mammal inventory for Craters of the Moon National Monument and Preserve. Report for subagreement No. 20 for Cooperative Agreement No. CA9000-95-018.

Madison, E., K. Oelrich, T. Rodhouse, and L. Garrett. 2003. Mammal inventories City of Rocks National Reserve. Report for Subagreement No. 20 for Cooperative Agreement No. CA9000-95-018.

Strobl, C., L. Garrett, L. and T. Rodhouse. 2003. Mammal and herpetological inventories Nez Perce National Historical Park. Report for Subagrement 20 for Cooperative Agreement No. CA9000-95-018.

Strobl, C., L. Garrett, L. and T. Rodhouse. 2003. Mammal and herpetological inventories Big Hope National Battlefield. Report for Subagreement No. 20 for Cooperative Agreement No. CA9000-95-018.

Shrive, J.P. and C.R. Peterson. 2002. Herpetological inventory of the City of Rocks National Reserve. Report by the Herpetology Laboratory, Idaho Museum of Natural History, Idaho State University.

Anderson, S. 2003. Butterflies of the John Day Fossil Beds National Monument. Unpublished Report, Department of Biological Sciences, Oregon State University.

Guest Lectures:

Leona K. Svancara, Eva Strand, Dr. Edward O. Garton (Co-Instructors). Advanced GIS Applications in Natural Resources. University of Idaho, Moscow, ID. Spring Semester 2003.

Leona K. Svancara, Gina Wilson. 4-H Natural Resource Identification Contest Latah County 4-H program, Moscow, ID. March 2003.

Gina Wilson (Guest Lecturer). NR470 – Interdisciplinary Planning. University of Idaho, Moscow, ID. Fall Semester 2003.

Gina Wilson (Guest Lecturer). Hands-on GIS. Troy Elementary School - 2nd Grade Troy, Idaho. April 2003.

Publications:

Adams, J, L. Waits, B. Kelly (2003) Using faecal DNA sampling and GIS to monitor hybridization between red wolves *(Canis rufus)* and coyotes *(Canis latrans)* Molecular Ecology12: 2175-2186.

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

Cantu, C., R.G. Wright, J. M. Scott and E. Strand. 2003. Conservation assessment of current and proposed nature reserves of Tamaulipas State, Mexico. Natural Areas Journal 23:220-228.

Hiner, M. and C.M. Moffitt. 2002. Modeling *Myxobolus cerebralis* infections in trout: associations with habitat variables. Whirling Disease: Reviews and Current Topics. American Fisheries Society. Symposium 29:167-179.

Kiryu, Y. and C.M. Moffitt.2002. Models of comparative toxicity of injectable erythromycin in four salmonid species. Aquaculture 211:29-41.

LaFrentz, B.R., S.E. LaPatra, G.R. Jones, J.L. Congleton, B. Sun, and K.D. Cain. 2002. Characterization of serum and mucosal antibody responses and relative percent survival in rainbow trout (*Oncorhynchus mykiss*) (Walbaum) following immunization and challenge with (*Flavobacterium psychrophilium*). Journal of Fish Diseases 24:703-713.

Miller, C.R., J. R. Adams, and L. P. Waits. 2003. Pedigree based assignment tests for reversing coyote (*Canis latrans*) introgression into the wild red wolf (*Canis rufus*) population. Molecular Ecology 12:3287-3301.

Murphy, M., L. Waits, K. Kendall (2003) Impact of diet on faecal DNA amplification and sex identification brown bears (*Ursus arctos*). Molecular Ecology 12:2261-2265.

Murphy, M., L.P. Waits, K. Kendall, S. Wasser, J. Higbee, R. Bogden (2002) An evaluation of long-term preservation methods for brown bear (*Ursus arctos*) faecal DNA samples. Conservation Genetics 3:435-440.

Peery, C.A., K.L. Kavenaugh and J.M. Scott. 2003. Pacific salmon: Setting ecologically defensible recovery goals. Bioscience 52:622-623.

Roon D, L.P. Waits, K. Kendall (2003) A quantitative evaluation of two methods for preserving hair samples, Molecular Ecology Notes 3:163-166.

Scott, J.M. 2003. Hot spots, cold spots. American Scientist. 91:384-385.

Williams, C.J. and C.M. Moffitt. 2003. Bayesian estimation of fish disease prevalence from pooled samples incorporating sensitivity and specificity. Pages 39-52. Bayesian Inference *and* Maximum Entropy Methods in Science and Engineering: 22nd International Workshop, (Ed. C.J. Williams). American Institute of Physics.

Non-Peer Reviewed Publications:

Rachlow, J. and L. K. Svancara. 2003. Pygmy rabbit habitat in Idaho. Project Completion Report, Bureau of Land Management, Boise, Id.

Svancara, L. K., W. Kristan, and J. M. Scott. 2002. Comments Inspired by O'Connor. Gap Analysis Bulletin 11:6-11.

Theses and Dissertations:

Claire, Christopher W. 2003. Pacific lamprey larvae life history, habitat utilization and distribution in Red River Subbasin, South Fork Clearwater River Drainage, Idaho. M.S.

Crist, Patrick. 2002. A comparison of the effect of unit of analysis on the conservation status of terrestrial vertebrates in the western United States. Ph. D.

Goniea, Thomas M. 2002. Temperature influenced migratory behavior and use of thermal refuges by Upriver Bright Fall Chinook salmon. M.S.

High, Brett. 2002. Effect of water temperature on adult steelhead migration behavior and survival in the Columbia River Basin. M.S.

Host, Scott. 2003. Reducing introgression with the use of barrier in tributaries of the South Fork Snake River, Idaho. M.S.

Jones, Darin T. 2002. Susceptibility of bull trout, *Salvelinus confluentus*, to *Renibacterium salmoninarum*, causative agent of bacterial kidney disease. M.S.

Kissling, Michelle L. 2003. Effects of forested buffer width of breeding bird communities in coastal forests of southeast Alaska with a comparison of avian sampling techniques. M.S.

Pidgorna, Anna. 2003. Conservation assessment of Ukraine: Biological and geophysical features. M.S.

Schiff, Danielle. 2003. Life history characteristics and spatial and temporal distribution of bull trout North Fork Clearwater River, Idaho. M.S.

Welker, Tom. 2002. Factors affecting oxidative stress in juvenile Chinook salmon (*Oncorhynchus tshawytscha*) of hatchery origin. Ph. D.

Wik, Paul. 2002 Ecology of greater sage-grouse in Southcentral Owyhee County, Idaho. M.S.

Wilder, James M. 2003. Quantifying bear populations and bear-human conflicts using non-invasive genetic sampling in the Kennicott Valley of Wrangell-St. Elias National Park and Preserve, Alaska. M.S.