



**Monica Hiner - M.S. Student
Project – Salmonid Warming Disease**

Annual Report

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Idaho Cooperative Fish and Wildlife Research Unit

**Stephen Mosher – M.S. Student
Project – Nightingale Reed-warbler**



Cooperating Agencies:

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

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Michael Falter - Fishery Resources
Oz Garton - Wildlife Resources
Kirk Lohman - Wildlife Resources
Christine Moffitt - Fishery Resources
Dennis Murray - Wildlife Resources
Jim Peek - Wildlife Resources
John Ratti - Wildlife Resources
Kerry Paul Reese - Wildlife Resources
Dennis Scarnecchia - Fishery Resources

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Student	Discipline	Advisor
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Jocely Aycrigg	Ph.D. Wildlife Resources	E. O. Garton
Billy Connor	Ph.D. Fishery Resources	T. C. Bjornn
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Kathy McGrath	Ph.D. Fishery Resources	J. M. Scott
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Dave Robertson	M.S. Fishery Resources	J. L. Congleton
Scott Patterson	M.S. Fishery Resources	J. L. Congleton/D. Scarnecchia
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Tom Welker	Ph.D. Fishery Resources	J. L. Congleton
Jim Wilder	M.S. Wildlife Resources	R. G. Wright

Unit Affiliated Students

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Lance Clarke	M.S. Fishery Resources	D. H. Bennett
Darin Jones	M.S. Fishery Resources	C. M. Moffitt
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Gretchen Kruse	M.S. Fishery Resources	D. Scarnecchia
Susan Loper	M.S. Wildlife Resources	K. L. Lohman
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Josh Whiting	M.S. Fishery Resources	D. H. Bennett
Paul Wik	M.S. Wildlife Resources	K. P. Reese
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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 in many states 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, and the Wildlife Management Institute. The U.S. Fish and Wildlife Service supported and coordinated the unit from its founding until 1993.

Program Direction

The Unit works toward the following basic objectives: (1) conduct research on fish and wildlife problems of state, regional, and national interest, (2) train graduate students for careers in the fish and wildlife professions, and (3) provide 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 augmenting 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; and (6) 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 and Idaho Department of Fish and Game personnel. Research studies are conducted primarily within Idaho, although some work is done in adjoining states, as well as Hawaii and Alaska.

Unit research is supported by the State contribution 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 thesis advisors for graduate students, and participate in a variety of professional activities. Cooperating faculty at the University of Idaho and Idaho State University serve as thesis advisors for additional graduate students.

J. Michael Scott - Unit Leader and Professor of Wildlife Resources – Recent research activities include studies on the: Distribution, abundance, and limiting factors of Hawaiian birds; limiting factors in endangered species; reserve identification, selection, and design in North America; use of translocation as a tool for establishing or augmenting animal populations; and Gap Analysis. Areas of interest include animal ecology, conservation biology, estimating animal numbers. Specialty course: FW-504 Advanced Topics in Conservation Biology.

Ted C. Bjornn - Assistant Unit Leader and Professor of Fishery Resources - Recent research activities include studies on: Wild trout ecology and management; effects of small hydro on stream carrying capacity; habitat features that affect carrying capacity; anadromous fish production in the Tucannon River; role of stress and BKD in salmon smolt losses; viability of hatchery versus wild steelhead; survival of salmonid embryos in relation to sediment; supplementation of wild salmon and steelhead; juvenile chinook salmon-brook trout interactions; passage of adult salmon and steelhead at dams. Areas of interest include management and ecology of wild and hatchery salmonids, and radio-telemetry. Specialty course: F510 - Advanced Fish Management.

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

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

Ongoing Projects - Fisheries Resources

David H. Bennett - Principal Investigator

- Evaluation of adult chinook salmon passage and squawfish distribution at Lower Granite dam during testing of surface bypass and collection prototype-smolt predation
- Effects of increased winter water levels in Lake Pend Oreille on kokanee survival, predation, food abundance, and aquatic macrophytes

Ted C. Bjornn - Principal Investigator

- Evaluation of adult salmon, steelhead, and lamprey migration past dams and through reservoirs in the Lower Columbia River and into tributaries
- Studies of fishways modifications and temperature, spill deflectors, and patterns at lower Snake River dams
- Synthesis of information on Snake River salmon and wild trout management
- Monitoring and evaluation of fall chinook salmon supplementation in the Snake River

Jim L. Congleton - Principal Investigator

- Evaluation of the effects of multiple dam passage on physiological condition of migrating juvenile salmon
- Development of design criteria to reduce delay of fish in areas of accelerating flows and to enhance separator performance
- Development of methods of control of infectious hematopoietic necrosis virus (IHN) in commercially reared salmonid fishes

C. Michael Falter – Principal Investigator

- Effects of increased winter water levels in lake Pend Oreille on kokanee survival, predation, food abundance, and aquatic macrophytes

Christine M. Moffitt - Principal Investigator

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

Dennis Scarnecchia - Principal Investigator

- Determination of the effects of contaminants on white sturgeon reproduction in the Kootenai River
- Bull trout studies, East Fork, South Fork Salmon River
- Habitat use and population dynamics of benthic fishes along the Missouri River
- Exotic species control in Upper Priest Lake, Idaho

J. Michael Scott - Principal Investigator

- Conservation of diversity in cutthroat trout systems

EVALUATION OF ADULT CHINOOK SALMON PASSAGE AND SQUAWFISH DISTRIBUTION AT LOWER GRANITE DAM DURING TESTING OF SURFACE BYPASS AND COLLECTION PROTOTYPE-SMOLT PREDATION

Principal Investigator: D. H. Bennett
Funding Agency: U.S. Army Corps of Engineers
Completion Date: 12/31/00

Objectives: 1) To estimate abundance of smallmouth bass and northern squawfish in the trailrace and forebay of Lower Granite Dam during operation of the Surface Bypass and Collection prototype (SBC); and 2) To estimate predation on chinook salmon by northern squawfish and smallmouth bass in the trailrace and forebay of Lower Granite Dam during operation of the SBC.

Progress: Northern pikeminnow *Prychocheilus oregonensis* and smallmouth bass *Micropterus dolomieu*, the more abundant juvenile salmonid predators in Lower Granite Reservoir were sampled from April through August 1998. Nighttime electrofishing was conducted in the Forebay, Forebay, BRZ (boat restricted zone), Tailwater, tailwater BRZ and at random locations in the Snake River Arm of Lower Granite Reservoir. Statistical comparisons of abundance indicated that highest catch rates (no./minute) for smallmouth bass < 70 mm in the Forebay were not different ($P>0.05$) than those from the Forebay BRZ and Tailrace and Upper Reservoir. Smallmouth 70-174 mm were collected in highest abundance from the Forebay BRZ and Tailrace, both of which were statistically higher in abundance than in the Forebay and other locations. Abundance of larger smallmouth bass was higher in either the Forebay or Forebay BRZ but few statistical differences were found among locations. Northern pikeminnow (<200 mm) abundance was statistically highest in the Forebay overall for all months.

Dietary examination indicated that the presence of salmonid smolts was low in both species of predators. Crayfish and nonsalmonid fishes were the predominant food items of both predators. The presence of salmonids was seasonal and generally lower than in previous years.

Bioenergetic modeling is currently being conducted to estimate the number of juvenile salmonids consumed and the overall importance of salmonids in the diet of predators. A final report is being prepared.

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

Principal Investigator: D. H. Bennett
Student Investigators: Lance Clark
Dimitri Vidergar
Funding Agency: Idaho Department of Fish and Game
Completion Date: 12/31/00

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

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

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

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

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

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

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

Principal Investigator:	T. C. Bjornn
Student Investigators:	Brett High Tom Goniea
Funding Agency:	U.S. Army Corps of Engineers
Completion Date:	12/31/2001

Objectives: 1) Prepare final work plan for field work to be conducted in 2000; 2) Complete maintenance and installation of telemetry receiver and antenna equipment at dams, reservoir and tributary sites in Lower Columbia and Snake rivers and tributaries; 3) Collect and outfit adult chinook salmon and steelhead with radio transmitters for release and tracking through Columbia and Snake rivers hydrosystem, and into tributaries; 4) Process telemetry data and begin evaluation of fish movements and passage conditions for data summaries and project reports.

Progress: In 2000, we collected and radio-tagged over 3,500 adult salmon and steelhead, to evaluate various aspects of their upstream migration through the Columbia and Snake rivers. This was the fourth year of data collection for this project since 1996 (fish were not tagged in 1999). Radio-tagged fish were monitored at four hydroelectric dams and reservoirs in the lower Columbia River, and four dams in the mid-Columbia River in cooperation with two public utility districts, and at all major tributary rivers between Bonneville and Priest Rapids dams. Radio-tagged fish were also intensively monitored by truck and boat in areas of interest, such as in the tailrace of Bonneville Dam and at the confluence of the Columbia and Snake rivers, where detailed information on fish movements and behavior was desired. Specific objectives for studies in 2000 included an evaluation of high spill levels at dams on passage and fallback of adult salmon in the lower Columbia River, to determine exposure to high dissolved gas (spring) and

water temperatures (summer) levels, evaluate effects of closing orifice gates at powerhouses on passage, investigate homing and straying rates of salmon with differing migration histories, and to investigate potential sources of loss and determine reach-specific survival rates for adult salmon and steelhead migrating upstream to spawning areas. We are currently processing data and starting analysis for project reports.

Associated with the salmon and steelhead project we are conducting a study using radio telemetry to evaluate passage for Pacific lamprey in the lower Columbia River. In 2000, we collected and radio-tagged 349 adult lamprey at Bonneville Dam. Studies were also conducted using an experimental flume to evaluate swimming performance and behavior of adult lamprey under conditions similar to those existing in fishways at Bonneville Dam. A total of 21 different test treatments were performed to evaluate passage of lamprey during both day and nighttime (fish were taped during tests using infrared lights) under various passage scenarios. Results of tests will be used to recommend modifications to fishways to improve passage for adult lamprey at dams.

STUDIES OF FISHWAYS MODIFICATIONS AND TEMPERATURE, SPILL DEFLECTORS, AND PATTERNS AT LOWER SNAKE RIVER DAMS

Principal Investigators:	T. C. Bjornn
Student Investigator:	Eric Johnson
Funding Agency:	U.S. Army Corps of Engineers
Completion Date:	12/31/01

Objectives: 1) Install and maintain radio receivers and antennas at four lower Snake River dams, in their reservoirs, and at the mouths of the major tributaries in the Snake River basin; 2) Monitor passage of radio-tagged adult spring, summer, and fall chinook salmon and steelhead (fish tagged and released at Bonneville Dam on lower Columbia River for related studies) at the four lower Snake River dams and through their reservoirs; 3) Evaluate dissolved gas and temperature exposure of adult salmon; 4) Investigate survival rates, migration timing, and final distribution of adult salmon and steelhead in the Snake River basin in relation to time of passage at Bonneville Dam in the lower Columbia River; 5) Process data and begin preparing project reports.

Progress: Adult salmon and steelhead were monitored as they passed the four lower Snake River dams to evaluate passage conditions in and around fishways and through reservoirs. Fish with transmitters were intensively tracked in the tailrace of Ice Harbor Dam and at the Snake-Clearwater rivers confluence to determine temperature and dissolved gas exposure levels. A test was performed to evaluate effectiveness of weir modifications to improve passage of adult salmon and steelhead in the transition pool at Lower Granite Dam. Extensive tracking surveys have been conducted by truck to locate fish in tributaries as they approach and reach spawning areas and hatcheries. We are currently monitoring steelhead movements in the system and have started processing chinook salmon data in preparation of analysis and preparing project reports.

SYNTHESIS OF INFORMATION ON SNAKE RIVER SALMON AND WILD TROUT MANAGEMENT

Principal Investigator: T. C. Bjornn
Funding Agency: U.S. Geological Survey
Completion Date: 9/30/01

Objectives: 1) To prepare a book-length manuscript on the biology, management, and history of Snake River salmon and steelhead; and, 2) To prepare a book-length manuscript on the biology, population dynamics, and management of wild trout in the Pacific Northwest.

Progress: Data compilation is nearly complete, and writing has been started on each of the major drainages in the Snake River basin. Information on hatchery fish produced and released in the various drainages, redds counted, and counts of the various runs into the Snake River have been updated. The basis for projecting run sizes has been established, and the analysis of long-term trends is underway.

MONITORING AND EVALUATION OF FALL CHINOOK SALMON SUPPLEMENTATION IN THE SNAKE RIVER

Principal Investigator: T. C. Bjornn
Student Investigator: William Connor
Funding Agency: U.S. Fish and Wildlife Service
Completion Date: 12/31/00

Objectives: 1) Assess timing of emergence and migration of natural fall chinook salmon as related to survival to the tailrace at Lower Granite Dam; 2) Assess the residualism of natural and hatchery fall chinook salmon in the Snake and Clearwater rivers; and 3) Assess the attributes of hatchery fall chinook salmon following release into the Snake River and their survival to Lower Granite Dam.

Progress: During FY2000, William P. Connor passed his written and oral qualifying examinations to become a candidate for a doctoral degree. We revised the scope of Connor's project to focus entirely on the ecology of wild subyearling chinook salmon. Connor's dissertation outline was revised to include five papers. These papers will cover: the run composition and early life history attributes of wild subyearling chinook salmon in the Snake River; the role of rapid growth on age at seaward migration by wild spring chinook salmon; fall chinook salmon early life history as affected by dams; factors affecting downstream migration rate of subyearling chinook salmon; and factors affecting survival of subyearling chinook salmon. During FY2000, the first two of the above papers were passed through Connor's graduate committee. The run composition paper was submitted to Northwest Science, and the rapid growth paper was submitted to Transactions of the American Fisheries Society. The early life history and growth paper, and the downstream migration rate paper, are both in draft form.

EVALUATION OF THE EFFECTS OF MULTIPLE DAM PASSAGE ON PHYSIOLOGICAL CONDITION OF MIGRATING JUVENILE SALMON

Principal Investigator: J. L. Congleton
Student Investigators: Tom Welker
Lorrie Haley
Funding Agency: U.S. Army Corps of Engineers
Completion Date: 12/31/00

Objectives: 1) Sample spring chinook smolts of wild and hatchery origin to determine and compare physiological responses to barge transportation; 2) Analyze blood and tissue samples; provide blood and tissue samples to other investigators; 3) Determine if significant differences exist between wild and hatchery chinook salmon such that they might have different survivorship following collection, bypass, or transportation; and 4) Determine the cumulative effects of dam passage on stress indices, energy stores, and “tissue damage” enzymes in migrating chinook salmon.

Progress: In 1998, 1999, and 2000, PIT-tagged spring/summer 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 concentrations and total quantities were determined so that the rate of use of energy reserves could be estimated as the fish migrated downstream to, and then through, the hydropower system. Plasma triglyceride, cholesterol, and total protein concentrations and alkaline phosphatase activity were measured as indices of nutritional status. Plasma activities of the enzymes alanine aminotransferase, aspartate aminotransferase, lactate dehydrogenase, and creatine kinase were measured as indices of metabolic status.

The lipid, protein, and caloric reserves of juvenile chinook salmon originating from three Idaho hatcheries decreased (–65 –30, and –40% on a length-standardized basis relative to mean prerelease values; $P < 0.0001$ for each analysis) as the fish migrated 116 to 283 km downstream to Lower Granite Dam on the Snake River. Lipid, protein, and caloric reserves continued to decline (–40, –12, and –16% relative to mean values at Lower Granite Dam; $P < 0.0001$) as the fish migrated an additional 348 km downstream, through five dams and reservoirs, to John Day Dam on the Columbia River. Changes in mean fork lengths were small (0 to 4 mm). Standardized lipid content was negatively correlated with travel time to the dams ($P = 0.01$). The lipid content of fish sampled at John Day Dam and at Bonneville Dam was low—1 to 2.5% of body weight—and would provide little reserve energy if the fish experienced poor feeding conditions during the first few weeks of marine life.

Plasma triglyceride, cholesterol, and total protein concentrations and alkaline phosphatase activities decreased significantly as the fish migrated to Lower Granite Dam, and continued to decrease as the fish migrated to John Day Dam. These results indicate that the energetic deficit in migrating fish is in part due to a low rate of food intake.

Plasma activities of the gluconeogenic enzymes ALT and AST increased as the fish migrated from release points to Lower Granite Dam and to Little Goose Dam, but subsequently declined as the fish continued migrating to John Day Dam. Activities of creatine kinase and lactate dehydrogenase also declined significantly as the fish migrated from Lower Granite Dam to John Day 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.

Fish reared at Dworshak National Fish Hatchery were smaller than fish reared at McCall and Rapid River hatcheries and were less robust, with only one-half the lipid content. The marine survival rates for fish from the three hatcheries will be compared in future years and tested for correlations with physiological condition during the smolt migration.

DEVELOPMENT OF DESIGN CRITERIA TO REDUCE DELAY OF FISH IN AREAS OF ACCELERATING FLOWS AND TO ENHANCE SEPARATOR PERFORMANCE

Principal Investigator: J. L. Congleton
Funding Agency: U.S. Army Corps of Engineers
Completion Date: 12/31/00

Objective: Evaluate the potential of secondary separation for incrementally improving total project separation efficiency at fish collection facilities with two-stage separators. Secondary separation methods to be evaluated include in-flume separation and secondary separation within raceways and barge holds.

Progress: Results from earlier years were summarized and a completion report prepared. The light-weight, portable fish separators tested at Lower Granite Dam in 1997 and 1998 performed reasonably well, separating fish smaller than 180 mm fork length (primarily chinook salmon) from fish larger than 180 mm (primarily steelhead) with efficiencies ranging from 40 to 80%. These separators clogged rapidly with debris, however, so that engineering solutions would be needed to improve debris removal before the portable fish separators could be used.

The feasibility of letting mixed-species groups of fish collected from bypass systems "volitionally" separate into upstream and downstream sections of raceways was tested at McNary Dam. A vertical bar array was placed in the middle portion of the raceway and test fish were introduced into the downstream end. Separation of fish into the upstream and downstream raceway sections after overnight exposure to various attraction flows (flows introduced into the upstream end of the raceways) were compared. In general, more fish of each species moved into the upstream section of the raceway at the lowest attraction velocity tested (valve opening of 25 percent = V25). However, the difference was only significant for sockeye salmon (68.1 versus 34.1 percent; $P = 0.04$). Separation of steelhead was, as expected, much lower than for the other, smaller species, and was similar at higher (valve fully open, V100) and lower (V25) attraction flows.

When all species were combined in the analysis, significantly more fish of all species smaller than 180 mm separated into the sanctuary section at V25 than at V100 (54.3 versus 34.1 percent; $P = 0.01$) indicating that the lower attraction velocity resulted in better size separation and that increasing attraction velocity did not increase separation efficiency. Further, while separation at V25 was higher than at V100, it was generally close to 50 percent, which is too low to be useful for separation of larger from smaller fish.

Because the efficiency of small fish/large fish separation at Little Goose Dam declined after a roof was installed over the separator, we carried out trials to see if increasing the intensity of artificial light over the separator would improve separation. We found a greater separation of species (almost significant, $P = 0.06$) and a significantly greater separation of fish by size class (52.4 versus 46.3 percent; $P = 0.02$) with the artificial lights on. These results indicate that

facility-wide separation by species and size was better with the lights on. However, the magnitude of the difference was small (6.1%).

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

Principal Investigator: J. L. Congleton
Funding Agency: Western Regional Aquaculture Consortium
Completion Date: 12/31/01

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

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

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

Principal Investigator: C. M. Falter
Student Investigator: Tyler Wagner - Undergraduate
Funding Agency: Idaho Department of Fish and Game
Completion Date: 12/31/99

Objectives: 1) To monitor abundance and distribution of aquatic macrophyte to determine if the higher winter pool elevation is a benefit to the establishment of Eurasian water milfoil *Myriophyllum spicatum spicatum*.

Progress: This study compares the aquatic macrophyte community of meso-oligotrophic Lake Pend Oreille (Idaho) under two drawdown regimes. We studied species composition, biomass, and the influence of substrate composition. From 1995 through 1998, reduced experimental winter drawdowns of 2.1 m (previous winter drawdown = 3.5 m) occurred to increase the amount of potential spawning substrate for lake-spawning kokanee (*Onchorhynchus nerka*). Mean aquatic macrophyte biomass significantly increased in the drawdown zone (0 – 3.5 m) from 39.9 g·m⁻² under a 3.5 m drawdown in 1990 to 99.2 g·m⁻² and 103.7 g·m⁻² under a 2.1 m drawdown in 1998 and 1999, respectively. Mean aquatic macrophyte biomass, however, did not significantly increase in depths greater than 3.5 m. This suggests that the increased biomass in the drawdown

zone can at least partially, be attributed to decreased winter mortality. Cluster analysis revealed distinct communities under the two- drawdown regimes. *Myriophyllum sibiricum*, *Chara* spp., and *Potamogeton richardsonii* dominated the aquatic macrophyte community under the 3.5 m winter drawdown, while *Chara* spp., *P. berchtoldii*, and *P. crispus* dominated under higher winter water levels. Logistic regression indicated a higher probability of finding clay and cobble substrates in the drawdown zone. On these clay substrates, there were significantly lower densities of aquatic vegetation ($17.9 \text{ g}\cdot\text{m}^{-2}$) than on sand ($86.6 \text{ g}\cdot\text{m}^{-2}$) or silt ($129.0 \text{ g}\cdot\text{m}^{-2}$) substrates and few plants were observed on cobble substrates, illustrating the lasting effects winter drawdown can have on aquatic plant habitat through sediment alteration. In 1998, the exotic *Myriophyllum spicatum* became established in the lake for the first time, attaining dense beds of over $1,000 \text{ g}\cdot\text{m}^{-2}$ in a 5-mile reach of the outlet arm by late 1999.

SUSCEPTIBILITY OF BULL TROUT, *SALVELINUS CONFLUENTUS*, TO INFECTION BY REINBACTERIUM SALMONINARUM, CAUSATIVE AGENT OF BACTERIAL KIDNEY DISEASE

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

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

Progress: Bull trout have been obtained for these tests from Creston National Fish Hatchery in Montana. Graduate student Darin Jones completed several preliminary trials during the summer to determine the appropriate range of bacterial challenge needed for an estimation of LD_{50} . This fall we began a pivotal trial comparing the response of infection by *R. salmoninarum* in bull trout with that of comparably sized arctic char *Salvelinus alpinus*, lake trout *Salvelinus namaycush*; and rainbow trout *Oncorhynchus mykiss*, at two water temperatures. The responses measured will include survival to challenge of *R. salmoninarum*, clinical assessment of fish health, and total swimming time to reach exhaustion, measured at standardized water velocities in an experimental swimming stamina apparatus constructed for these trials. For testing stamina, we constructed a 12" PVC pipe with the top portion removed to resemble a trough. A 20 horsepower pump generates water flow, and the apparatus consists of a head box and trough to reduce turbulence and provide a more uniform flow. Adjusting the input to the head box and varying the slope of the trough controls test velocity. We are using velocities of 4 - 6 body lengths per second in tests. Chilled fresh water makeup insures that the water remains clean and at the desired temperature. The tests of swimming stamina will provide a measure of the effects of sublethal infections of *R. salmoninarum* on swimming performance.

DETERMINATION OF THE EFFECTS OF CONTAMINANTS ON WHITE STURGEON REPRODUCTION IN THE KOOTENAI RIVER

Principal Investigator: D. Scarnecchia
Student Investigator: Gretchen Kruse
Funding Agency: Idaho Department of Fish and Game
Completion Date: 12/31/00

Objective: To determine if contaminants (PCBs, pesticides and heavy metals) in gonad, egg, and larval tissue of Kootenai River white sturgeon are limiting survival of sturgeon eggs and larvae.

Progress: This study used biomarkers to evaluate the effects of environmental levels of organochlorine, organophosphate, organonitrate, and carbamate pesticides, polychlorinated biphenyls (PCBs) and metals in the aquatic system on Kootenai River white sturgeon, *Acipenser transmontanus*. The biomarkers that were used include tissue residue analysis, plasma steroid production and egg size in adult sturgeon, survival and contaminant uptake during incubation in embryos, red blood cell chromosome content and variability, liver histology, tissue residue analysis and acetylcholinesterase inhibition in juvenile sturgeon. Chemical residues were assessed in ovarian tissue from mature adult females, in wholebody tissue from juveniles, in incubated embryos, and in water and sediment samples from the river. Contaminant residues in ovarian tissue and river-bottom sediment (collected between 1989 and 1999) were compared with residues detected in samples collected between 1989 and 1991. Incubating white sturgeon embryos were exposed to different rearing media (water, sediment and suspended solids collected directly from the Kootenai River) to determine mortality rate and uptake of environmental contaminants. Blood samples were collected from adult and juvenile sturgeon to determine plasma steroid (testosterone, 11-ketotestosterone, and estradiol) levels, cholinesterase inhibition and chromosomal DNA variability. Results from chemical residue analysis indicated that copper, zinc, iron and the PCB Aroclor 1260 were at levels that could adversely affect sturgeon reproduction as well as other aquatic organisms and overall system productivity. Plasma steroid concentrations in Kootenai River sturgeon were comparable to those reported for their species of sturgeon. However, the significant negative correlations between testosterone production and bioaccumulated aroclor 1260 (Spearman; $r = -0.753$) and zinc (Spearman; $r = -0.652$) suggest that males may experience decreased sperm production if they have bioaccumulated these contaminants at levels similar to those found in females. The significant positive between the female hormone estradiol and DDT (Spearman; $r = 0.893$) also suggests potential feminization of male sturgeon that bioaccumulate DDT levels similar to those found in females. Zinc that resides in sturgeon ovarian tissue was significantly (Mann-Whitney U test; $P < 0.05$) higher than in samples taken between 1989 and 1991. River bottom sediments were found to be a significant source of metal and PCB exposure for incubating white sturgeon embryos. Environmental levels of copper and PCB Aroclor 1260 in the rearing media were associated with increased mortality (Spearman; $r = 0.568$) and decreased incubation time of sturgeon embryos. Results from liver histology, cholinesterase and DNA analysis in juveniles indicated that although juvenile sturgeon were experiencing low-level contaminant exposure, physiological functions were not limited or altered. The biomarkers used in this study indicated effects and are not a measure of cause. Therefore, it was concluded that embryonic, juvenile and adult life stages are potentially experiencing sublethal effects from contaminants in the Kootenai River. The embryonic life stage appears to be the most susceptible to the effects of these contaminants. Although spawning may succeed, despite parental burden of contaminants, embryos potentially suffer significant mortality (in comparison with control conditions), as a result of additional exposure to contaminants in water and sediment.

BULL TROUT STUDIES EAST AND SOUTH FORK SALMON RIVER

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

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

Progress: Second and final field season was completed in Fall 2000. Data analysis and thesis writing will be done during the fall of 2000 and spring of 2001.

HABITAT USE AND POPULATION DYNAMICS OF BENTHIC FISHES ALONG THE MISSOURI RIVER

Principal Investigator: D. Scarnecchia
Student Investigator: Tim Welker
Funding Agency: U.S. Army Corps of Engineers
Completion Date: 7/31/01

Objectives: The goal of the overall study is to gain information to assist in planning a broader study that will help the COE in complying with the Endangered Species Act. 1) Describe and evaluate recruitment, growth, size structure, body condition, and relative abundance of selected benthic fishes in the Missouri River between the Yellowstone River-Missouri River confluence and the headwaters of Lake Sakakawea, North Dakota, and between Garrison Dam and the headwater of Lake Oake; 2) Describe the use of six dominant habitats (main channel, outside bend, inside bend, tributary mouth, connected secondary channel, nonconnected secondary channel), and 3) Measure hydrological (e.g. velocity), physical (e.g. bottom type), and water quality (e.g. turbidity, temperature) features where fish are collected.

Progress: In 1995, the Missouri River Benthic Fish Study (MRBFS) was begun with support from the U. S. Army Corps of Engineers, the U. S. Geological Survey, and several state universities. The study was designed to provide information on the status of the benthic-riverine fish communities of the Missouri River from its headwaters in Montana to its mouth at St. Louis, Missouri. The objectives were to: (1) describe habitat use of benthic fishes among dominant benthic macrohabitats within and among study sections and segments; and (2) describe and evaluate recruitment, growth, size structure, body condition, and relative abundance of selected benthic fishes within and among study sections and among segments. Data from the MRBFS and other supplemental data were used to complete this dissertation.

In 1996, 1997, and 1998 fish habitat and fish community data were collected in segments of the Missouri and Yellowstone Rivers and used to examine previously unexplored aspects of the fish community. In the Missouri River in North Dakota, a moderately altered segment and a highly altered segment exhibited greatly different sucker communities. Bigmouth buffalo (*Ictiobus cyprinellus*), smallmouth buffalo (*Ictiobus bubalus*), and river carpsucker (*Carpiodes carpio*) represented 94% of the sucker catch in the moderately altered segment, whereas in the highly altered segment, white sucker (*Catostomus commersonii*) and longnose sucker (*Catostomus catostomus*) constituted 98% of the sucker catch. In the moderately altered segment, high

zooplankton densities led to greater sucker zooplanktivory and food niche overlap than in the highly altered segment.

Near the confluence of the Missouri and Yellowstone rivers, the fish community was sampled in four distinct river segments to obtain information on the distribution and habitat use of the flathead chub (*Platygobio gracilis*), sicklefin chub, (*Macrhybopsis meeki*), sturgeon chub (*Macrhybopsis gelida*), and western silvery minnow (*Hybognathus argyritis*), four declining fish species (Family Cyprinidae) native to the Missouri River basin. Catch rates for sicklefin chub and sturgeon chub were highest in deep main channel habitat and catch rates for flathead chub and western silvery minnow were highest in shallow channel border habitat. Catches of all species were highest in the two segments least altered by anthropogenic disturbance.

The fish communities in a moderately altered segment and two highly altered segments of the Missouri River from the mouth of the Yellowstone River to Kansas City, Missouri were sampled to determine if streamlining can influence fish community structure in altered reaches of a large river. In the least altered segment, higher diversity of depths and current velocities led to a fish community that was less streamlined and that exhibited greater streamlining diversity than in the two highly altered segments, which had lower diversity of depths and velocities.

One lower Yellowstone River segment and two Missouri River segments were sampled to determine if habitat changes caused by a mainstem dam had influenced niche relations among three native cyprinid species—flathead chub, sicklefin chub, and sturgeon chub. Niche relations differed among the three fish species within and among segments. The highest niche overlap among the three species was found in the two segments least altered by anthropogenic disturbance and that exhibited the greatest environmental instability. This result is interpreted to mean that environmental instability and resource partitioning can interact in structuring niche relations among these three cyprinids.

EXOTIC SPECIES CONTROL IN UPPER PRIEST LAKE, IDAHO

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

Objectives: 1) To determine diel and seasonal migration patterns of lake trout, bull trout and cutthroat trout between Upper Priest Lake and Priest Lake; and 2) compare the migration patterns of lake trout, bull trout, and cutthroat trout between Upper Priest Lake and Priest Lake in relation to physical habitat parameters such as lake water temperatures and water clarity, and Thorofare water temperature, depth and discharge.

Progress: During the last 50 years, introduction of non-native species has changed the species assemblage in Upper Priest and Priest Lakes, Idaho, causing bull trout numbers to decline. Bull trout are nearly extirpated in Priest Lake and declining in Upper Priest Lake with lake trout introductions noted as the primary cause. Lake trout freely migrate between Upper Priest and Priest Lakes through a 3 km stream channel known as the Thorofare, rendering lake trout removal efforts in Upper Priest Lake ineffective. In order to prevent lake trout migration into Upper Priest Lake, a migration barrier is needed. However, implementation of a migration barrier may affect native westslope cutthroat trout and bull trout. For effective management of the Upper Priest-Priest Lake fishery, a better knowledge of diel and seasonal migration patterns of lake trout, bull trout, and westslope cutthroat trout using a modified fike net in the Thorofare and tracking radio

tagged lake trout during the period 1999-2001.

CONSERVATION OF DIVERSITY IN CUTTHROAT TROUT SYSTEMS

Principal Investigator: J. M. Scott
Student Investigator: Kathy McGrath
Funding Agency: U.S. Forest Service
Completion Date: 12/31/01

Objectives: 1) Analyze existing data to describe associations between the structural composition of cutthroat trout populations and select environmental characteristics. The analysis will include but is not limited to area and contextual variables. The analysis will also consider sampling issues that may confound or limit the interpretation of length frequency data; 2) Conduct a review of the literature on strategies for the conservation of biological diversity across the scales and levels of organization relevant to interior native fishes. Consider specifically the prioritization of watershed conservation and restoration efforts based on the range of potentially conflicting and complimentary diversity measures.

Progress: Second year of fieldwork has been completed. Preliminary data analysis for year 1 completed and that for year 2 has been initiated. Original project objectives have been completed; required products were delivered to the U.S. Forest Service on or prior to April 30, 2000. Additional objectives have been added to the project:

3. Conduct fieldwork on up to 12 stream systems in each of the Panhandle and Selway-Bitterroot National Forests, collecting spawning westslope cutthroat trout by angling, electroshocking, and/or weirs; collecting resident westslope cutthroat trout by electroshocking; collecting stream habitat data.
4. Collect from agencies such as the U.S. Forest Service, Idaho Department of Fish and Game, and University of Montana, existing westslope cutthroat trout community data including size structure, genetic, age/growth, life history, species diversity, and stream habitat information.
5. Conduct scale and genetic tissue (microsatellite DNA) analyses to describe age and growth and genetic structuring of the sampled cutthroat trout populations.
6. Characterize sample sites using basin and channel diversity measurements.
7. Obtain all necessary access authorization and collection permits, coordinate as necessary with Idaho Department of Fish and Game and appropriate U.S. Forest Service Forest and Ranger Districts.
8. Describe the variation in growth and size of young of the year cutthroat trout within and among streams included in existing work plans. Provide a subsample of at least 25 fish for analysis of parental origin by life history type in streams that overlap with RMRS [funding agency] objectives.

Additional funding has been received in support of these objectives. Significant progress has been made on the new objectives. Fieldwork was conducted during 1999 and 2000 on 20 streams in the Panhandle National Forest and four streams in the Selway-Bitterroot National Forest,

collecting resident westslope cutthroat trout and stream habitat data. Additional collections of resident fish will be made during 2001. Collection of spawning cutthroat trout was attempted during spring, 1999 but was unsuccessful. No additional collection of spawners will be attempted. Information on genetic structuring and life history of westslope cutthroat trout has been collected from various agencies; this objective has not yet been completed. Scale and genetic tissue analyses have not yet been completed. Sample sites have been characterized by in-field measurements, additional information available from topographic maps remains to be obtained. All access and collector's permits were obtained as required during 1999 and 2000. A minimum of 30 fish were collected from each of 16 streams during 2000, in cooperation with or on behalf of the funding agency. Samples from additional streams are likely to be collected during 2001.

Completed Projects - Fisheries Resources

David H. Bennett - Principal Investigator

- Projected effects of drawdown on resident fishes and shallow water habitat in John Day Reservoir

PROJECTED EFFECTS OF DRAWDOWN ON RESIDENT FISHES AND SHALLOW WATER HABITAT IN JOHN DAY RESERVOIR

Principal Investigator:	D. H. Bennett
Funding Agency:	U.S. Army Corps of Engineers
Completion Date:	12/31/99

Objectives: 1) To review existing information on shallow water habitat, fishes and habitat associations in John Day Reservoir; 2) To analyze effects of drawdown to 170 and 220 ft elevation on fishes and associated habitat in John Day Reservoir; and 3) To develop recommendations for future studies to provide necessary data and monitor effects of draw down.

Results: Available information was reviewed on fishes and habitat and projections made as to assess effects of proposed drawdown on the John Day ecosystem. Limited information exists on the benthic macroinvertebrates in John Day Reservoir although recent water quality and fish sampling provided important information to project effects of the two projected drawdowns at 220 ft MSL and 165 ft MSL on the biota. GIS was used to examine the physical aspects of the altered habitats and make projections of the existing habitat under both 220 ft and 165 ft elevation. Potentially limiting aspects of the life cycle of the more abundant game and nongame fishes were examined under the projected altered environment. The altered environment of the John Day ecosystem under the two proposed water levels will probably have substantial effects on the biota. Riverine conditions will predominate and fish food production and fish community structure will probably change to a more riverine community, more similar to the original fish community.

A final report has been prepared and accepted by the funding agency.



Ongoing Projects - Wildlife Resources

E. O. Garton - Principal Investigator

- Elk Habitat
- Point Reyes National Seashore Tule elk populations
- Beach buffer effectiveness project

Kirk Lohman – Principal Investigator

- Evaluation of the effects of prescribed fire on terrestrial and aquatic ecosystems in the South Fork Salmon River drainage

Dennis Murray – Principal Investigator

- Predator-prey relationship of Canada Lynx and snowshoe hares on the Clearwater National Forest and surrounding areas
- Evaluating factors potentially affecting red wolf demography and population recovery

Kerry P. Reese - Principal Investigator

- Sage Grouse Ecology
- Owyhee Sage Grouse Ecology
- Sage Grouse Chick
- Sharp-tailed Grouse
- Mountain Quail
- Game Bird Research
- Blue Grouse Ecology
- Jarbridge Sage Grouse

J. Michael Scott - Principal Investigator

- Large Area Mapping of Biodiversity
- Idaho Partners in Flight Program
- Elk Habitat

Lizette Waits - Principal Investigator

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

R. Gerald Wright- Principal Investigator

- A survey of amphibian activity in ponds in the Palouse grasslands of Idaho
- Understanding the range of historical variability in Snake River Plain plant communities
- Bear conflicts along the McCarthy Road corridor in the Wrangell St. Elias National Park and Preserve
- Breeding bird and raptor inventories, Nez Perce National Historical Park
- Natural resource bibliographic database project
- Synthesis of scientific information – Voyageurs National Park, Minnesota
- Interpretive training

ELK HABITAT PROJECT

Principal Investigators: E. O. Garton
J. M. Scott
Student Investigator: Leona Bomar
Funding Agency: Idaho Department of Fish and Game
Completion Date: 11/10/00

Objectives: 1) Identify and describe patterns in Idaho elk populations using Idaho Department of Fish and Game aerial survey data at various scales; 2) Determine if correlations exist between patterns in elk demographics and independent variables, such as net primary productivity, precipitation, geologic type, and canopy cover; 3) Develop predictive models of cow density, calf:cow ratios, and bull vulnerability that will identify priority areas and evaluate alternative management strategies; and 4) Determine the effect of the MAUP on elk recruitment and habitat relationships when GMUs are aggregated to 3 different levels in 2 different configurations.

Progress: To investigate relationships between environmental variables and broad-scale patterns of elk population dynamics in Idaho, we analyzed 12 years (1987-1998) of aerial survey data collected in Game Management Units (GMUs) across the state. After adjusting for hunter-harvest, calf:cow ratios followed a normal distribution with 73% of GMUs between 25 and 40 calves:100 cows. Average ratios in southern Idaho GMUs were significantly higher than the rest of the state, and those in central Idaho GMUs were significantly lower. Factor analysis explained 93% of the variance among 16 environmental variables with four factors (forest productivity, soil-canopy, warm-dry climates, fire). Multiple regression of these four factors, the proportion of non-batholith land, and elk population measurements indicated that average elk recruitment during the study period was greatest in areas not on the Idaho Batholith, with lower forest productivity and high mature bull (≥ 5 points on each antler) densities ($r^2 = 0.313$, $P < 0.05$). Higher values of forest productivity occurred in areas with increased precipitation and net primary productivity, indicating potentially high vegetative growth rates and dense overstory. We propose that lower elk recruitment in these areas may be due in part to reduced ground and shrub layer production, and therefore decreased forage quantity, quality, or both. To improve elk recruitment in Idaho, we recommend land management activities such as timber harvest and fires that open forest canopy in the most productive forests.

POINT REYES NATIONAL SEASHORE TULE ELK POPULATIONS

Principal Investigator: E. O. Garton
Student Investigator: Susan Roberts
Funding Agency: Rocky Mountain Elk Foundation
Completion Date: 10/19/00

Objectives: 1) To identify the plant species tule elk are consuming at Point Reyes National Seashore; 2) To identify areas of vegetation under intense foraging pressure; 3) To identify the abundance and distribution of the plant species occurring on the elk range at Point Reyes; and 4) To quantify the digestibility, protein, and trace minerals content of the forage.

Progress: To continue with my investigation of the foraging ecology of tule elk at Point Reyes, California, I completed the laboratory aspect of my research in the spring semester of 2000. To assess the forage quality of the diet, I determined the apparent (*in-vitro*) digestibility of 1824

plant samples, the micronutrient and protein content of 186 plant samples and the diet composition of 32 fecal samples. I estimated the amount of forage (biomass) available to the elk over the entire study area and I calculated the ecological carrying capacity for the area. I analyzed all of the multivariate feeding data and the multivariate forage quality data using SAS™ statistical software.

In August 2000, I was invited to present the results of my research to a panel of Biologists and the Superintendent of Point Reyes National Seashore.

For my thesis, I organized my research into four chapters. Chapter one will discuss diet composition, using 2 methods, presence and behavior of forage selectivity using 3 analyses, nutritional quality of the diet, and the amount of forage available on the study area. Chapter two will investigate the differences in diet composition and nutritional quality of the diet between lactating and non-lactating female tule elk. Chapter three will discuss the difference in foraging area selection by the elk between a year with extremely high precipitation (1998) and a year with average precipitation (1999). Chapter four will present an independent estimate of ecological carrying capacity using population dynamic data sets from the past 10 years and a computer program developed by Garton et al (1992).

Presently, I have completed drafts of chapters one and two, and I hope to complete chapters three and four by the mid-November. My defense date is tentatively set for the first week of December and I hope to graduate in the Fall semester of 2000.

BEACH BUFFER EFFECTIVENESS PROJECT

Principal Investigator:	E. O. Garton
Student Investigator:	Michelle Kissling
Funding Agency:	U.S. Fish and Wildlife Service
Completion Date:	5/30/02

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

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

EVALUATION OF THE EFFECTS OF PRESCRIBED FIRE ON TERRESTRIAL AND AQUATIC ECOSYSTEMS IN THE SOUTH FORK SALMON RIVER DRAINAGE

Principal Investigator: K. Lohman
Funding Agency: Idaho Department of Fish and Game
Completion Date: 6/30/00

Objective: To examine fire effects on cavity nesting avian species in the terrestrial environment and tailed frogs, Idaho giant salamanders, dippers, and water quality in the aquatic environment.

Progress: We surveyed streams in the South Fork Salmon River basin for American dippers (*Cinclus mexicanus*) during the early summer of 1999 and for two amphibians, tailed frog (*Ascaphus truei*) and Idaho giant salamander (*Dicamptodon aterrimus*) the first week in August 1999. Our objectives were to gather preliminary data on the distribution and abundance of these species in the drainage and to identify potential control and treatment study sites suitable for evaluating the effects of prescribed burning on dippers and stream amphibians in a long-term study.

We surveyed portions of 5 streams for American dippers (*Cinclus mexicanus*) between May 22 and June 30, 1999. Surveys began at the confluence of each stream with the East Fork South Fork Salmon River and continued upstream for varying distances depending on the length and size of the stream. Within the study area, our survey included approximately 2 km each of Telephone and Deadman Creeks; 4.5 km of Reagan Creek; and 4 km of Parks Creek. In addition, we surveyed Fitsum Creek from its confluence with the South Fork Salmon River to 2 km upstream.

A stream sampling point was located randomly either upstream or downstream of a trail or road crossing. At this point, we established a 30-m stream transect and conducted stream sampling at the ends and midpoint of the transect. Physical characteristics were measured at each sampling point. In addition, we collected one benthic invertebrate sample from each sampling point (3 samples per transect) using a Surber sampler. We then surveyed a 2-km segment of the stream centered on the sampling point for American dippers. We recorded the number and age of all dippers observed during the stream survey as well as the location and characteristics of any nests found.

We did not observe any American dippers on Reagan, Telephone, or Deadman Creeks. Telephone and Deadman Creeks appear too small to support nesting dippers, and generally lack suitable nest sites, although dippers nesting on the East Fork South Fork River may use these streams for foraging during high flows. A single adult dipper was observed on Parks Creek on June 11, approximately 2 km upstream from the East Fork South Fork. Although no nest was found, the distance from the river suggests that this bird was not nesting on the river, and it is possible that a nest exists on Parks Creek. We observed a dipper nest on Fitsum Creek approximately 1.5 km upstream from the South Fork River, with 2 adults feeding an unknown number of nestlings. Stream habitat and aquatic invertebrate data collected on all 5 streams are currently being analyzed.

We sampled for amphibians on August 2-5, 1999. The primary focus of our surveys was on 6 streams along the East Fork of the South Fork Salmon (Williams, Telephone, Dutch Oven, Deadman, Parks and Reagan creeks). We initially sampled each stream to determine if amphibians were present. We began sampling at the downstream end of each stream and proceeded upstream for 1-4 hours, turning over rocks and debris and capturing amphibians by hand or with a dipnet.

Tailed frog tadpoles were abundant enough to justify additional sampling on Parks and Reegan creeks to estimate densities. On each of these two streams, a 10-meter reach was marked off. Width was measured at the beginning, end, and midpoint of the reach and area was calculated based on length and mean width. All substrate was turned over within these 10-meter reaches and all amphibians captured were measured and weighed. Tailed frogs were scarce in 4 of the 6 streams. None were found in Dutch Oven, Telephone, or Deadman creeks, and only 2 tadpoles were found in Williams Creek after roughly 2 hours of searching by 3 people. Tadpoles were somewhat more abundant in the 2 larger streams, Parks and Reegan creeks. Density was slightly higher and total biomass was almost twice as high in Parks than in Reegan. Idaho giant salamanders were detected in 2 of the 6 creeks. Two were captured in Deadman Creek and two in Reegan Creek. Several other streams in the area were sampled for the presence of amphibians. Tailed frog tadpoles were detected on Buckhorn Creek, as well as on Maverick and Cow creeks near the Ponderosa Campground. None were seen in limited sampling on Lick Creek.

PREDATOR-PREY RELATIONSHIP OF CANADA LYNX AND SNOWSHOE HARES ON THE CLEARWATER NATIONAL FOREST AND SURROUNDING AREAS

Principal Investigator: D. Murray
Graduate Investigators: Todd Steury
Aaron Wirsing
Funding Agency: Idaho Department of Fish and Game
Completion Date: 6/30/01

Objectives: 1) To evaluate the likelihood of a successful release of lynx in Idaho using mathematical models of lynx-snowshoe hare population dynamics; 2) To estimate the biomass of snowshoe hare and red squirrels available on the Clearwater National Forest; and 3) To describe the population dynamics of hares and squirrels in Idaho.

Progress: Field operations for this project were completed in May 2000. One paper was published looking at the geographic differences among snowshoe hare populations. One manuscript was submitted to Conservation Biology on the likelihood of a successful release of lynx to Idaho and elsewhere along the southern distribution. In addition, 5 presentations related to this effort were given at various meetings. The two students funded by this project currently are completing laboratory work and are in the process of writing their theses and preparing manuscripts for submission.

EVALUATING FACTORS POTENTIALLY AFFECTING RED WOLF DEMOGRAPHY AND POPULATION RECOVERY

Principal Investigator: D. Murray
Funding Agency: U.S. Fish and Wildlife Service
Completion Date: 9/30/02

Objectives: Formulate and parameterize a simple model depicting the potential effects of coyotes on a recovering red wolf population. This model will include a basic sensitivity analysis of each parameter, and will explore scenarios ranging from those created by an actively

reproducing vs. completely sterile coyote population.

Progress: One presentation related to this work was given at the Society for Conservation Biology meeting and one is to be given later this month at the Carnivores 2000 meeting. The literature review for this project was completed last spring, and we are in the process of completing the model that will serve as the focus of this project.

SAGE GROUSE ECOLOGY

Principal Investigator: K. P. Reese
Student Investigator: Matthew B. Lucia
Funding Agency: Idaho Department of Fish and Game
Completion Date: 6/30/01

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

Progress: Fieldwork was conducted during summer and fall of 1997 and 1998. One hundred eighty-four sage grouse were captured by night-lighting on summer ranges. In 1997, we equipped 26 10-week old juveniles with radio-transmitters and in 1998 we radioed 33 juveniles. Predation is the most common cause of death of juvenile sage grouse and avian predators killed more grouse than did mammalian predators. Hunters killed 0 radioed birds in 1997 and only 1 was harvested in 1998. Analysis of juvenile survival and movement patterns in relation to those of adults is underway. Completion of the thesis is expected in spring 2001.

OWYHEE SAGE GROUSE ECOLOGY

Principal Investigator: K. P. Reese
Student Investigator: Paul Wik
Funding Agency: Idaho Department of Fish and Game
Completion Date: 6/30/01

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

Progress: Fieldwork began during early March 2000. Twenty-eight hens and 13 male sage grouse were radio-marked. Twenty-three hens were followed through the nesting season; 19 nested. Eight hens successfully hatched clutches (hen success = 42%), 2 hens attempted a second nest after the first was depredated (nest success = 38%). Of the 8 hens producing young, 3 raised chicks to 12 weeks of age. Another hen raised 1 chick to 9 weeks when radio contact was lost. Five hens and 4 males died during the field season (78% survival for sexes combined, 82% survival for hens, 69% for males) from mid-March to mid-August. Vegetation was measured at

23 nests and 23 random locations, and brood vegetation variables were measured at 25 brood and 25 random locations. These data have not been analyzed. Seasonal movement data will be analyzed in a GIS program in the next 6 months, as will other data collected this past field season. A second season of data collection will begin in March 2001.

SAGE GROUSE CHICK

Principal Investigator:	K. P. Reese
Student Investigator:	Nathan Burkepile
Funding Agency:	Idaho Department of Fish and Game
Completion Date:	6/30/01

Objectives: To determine the cause- and age-specific mortality of day-old sage grouse chicks.

Progress: We initiated a preliminary project in 1999 in southeastern Idaho. During 2000, we completed the second field season using techniques similar to those of 1999. We monitored radio-marked hens through the nesting season. Thirty hens nested with a nest success of 57%. Most hens nested under sagebrush (n=23), but some nested under rabbitbrush (n=6) and 1 nested under a clump of grass. The major cause of nest failure was predation, but 1 hen abandoned her nest after 400 head of cattle moved into the area and 1 incubating hen was depredated. We radio-marked 44 sage grouse chicks from 15 broods and monitored their survival. The average age of death for sage grouse chicks was 8.9 (\pm 1.2) days and mortalities occurred at 1 to 32 days of age. All deaths were due to predation. Chick survival to 8 weeks was 22%. Along with monitoring mortalities, we observed 5 inter-brood movements, a behavior not before documented in sage grouse.

SHARP TAILED GROUSE

Principal Investigator:	K. P. Reese
Funding Agency:	Idaho Department of Fish and Game
Completion Date:	6/30/01

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

Progress: This continuing project has documented successful reproduction of Columbian sharp-tailed grouse following translocation into the Shoshone Basin of south-central Idaho since 1992. Former graduate student S. Gardner, MS 1997, has continued to analyze monitoring data from 1997-2000, and is completing a manuscript for publication. There currently are at least 4 active leks in the basin, the population is reproducing and survival of radio-marked grouse is high. We will continue to monitor the population over the next few years.

MOUNTAIN QUAIL

Principal Investigator: K. P. Reese
Funding Agency: Idaho Department of Fish and Game
Completion Date: 6/30/01

Objectives: 1) describe characteristics of habitat use by mountain quail in fall and winter, 2) determine daily and seasonal movements and home range size of mountain quail during fall and winter, 3) determine survival rates of mountain quail over the fall and winter, 4) determine mountain quail productivity, 5) describe the physical and vegetal characteristics of spring and summer habitat used by mountain quail, focusing on nest site and brood-rearing habitats, and 6) determine the spring and summer home range and survival of mountain quail.

Progress: The spring and summer portion of the work is in progress. We have captured over 300 mountain quail, have collected over 2250 radio-locations and completed over 200 detailed habitat plots at nest, brood and random sites. Expected completion is January 2001.

GAME BIRD RESEARCH

Principal Investigator: K. P. Reese
Funding Agency: Idaho Department of Fish and Game
Completion Date: 6/30/01

Objectives: to provide funds to hire a research associate to assist in conducting research on sage grouse in southern Idaho. Specific duties were to assist in fieldwork and to assemble a statewide database on sage grouse leks, nesting and wintering ranges.

Progress: Research associate was hired for 8 months until IDFG reorganized their efforts and wished to terminate this contract so that the employee could be hired directly by IDFG. Project is completed.

BLUE GROUSE ECOLOGY

Principal Investigator: K.P. Reese
Student Investigator: Hollie Miyasaki
Funding Agency: Idaho Department of Fish and Game
Completion Date: 6/30/01

Objectives: 1) To determine the productivity of blue grouse populations on grazed and lightly grazed sites using clutch size, nest success, and chick survival as measures of productivity, 2) to determine the age ratio of the fall harvest and compare it with observed pre-harvest age ratios, 3) to determine survival rates of radio-marked hens and chicks during brooding, post-brooding, and wintering periods, and 4) to formulate an elasticity model and substitute data from this study for specific life stages in the model.

Progress: During spring and summer of 1996 and 1997, blue grouse were captured in the Cuddy Mountains and West Mountains of southwestern Idaho. Adults and chicks over 200 grams were fitted with leg bands. Hens, some males and chicks weighing at least 500 grams were marked with necklace-attached radios weighing 16 grams. Radioed birds were monitored every 2 weeks to determine habitat use, movements and survival. Harvest data was collected from hunter check stations and from wing barrels in both years. Results indicate that harvest information is a credible approach to estimate productivity, but that wing barrel data were more variable in comparison to check station data. Data analysis is continuing and the thesis is scheduled for completion by January 2001.

JARBRIDGE SAGE GROUSE

Principal Investigator: K. P. Reese
Funding Agency: Idaho Department of Fish and Game
Completion Date: 6/30/01

Progress: New Project

LARGE AREA MAPPING OF BIODIVERSITY

Principal Investigator: J. M. Scott
Funding Agency: USGS/Biological Resources Division
Completion Date: 12/31/02

Objectives: 1) Test three basic tenets of reserve design. a. Capturing 12% of a species range captures the full geographical and ecological expression of the species; b. Protecting umbrella species across the full range of their ecological and geographical expression captures 90% of all biodiversity; and c. The current set of conservation areas in the western United States captures the full spectrum of vegetation types. 2) Translate research protocols for Gap Analysis into Spanish; and 3) Create thematically seamless land cover and land use maps for the 10 western states.

Progress: A seamless vegetation map was completed for the 10 contiguous Western states, exclusive of California. A map analysis of the vegetation types in that data set was completed and has been accepted for publication in "Biological Conservation". Reviewers' comments were addressed and a revised manuscript was returned to the editor for publication. There are three manuscripts addressing questions.

A and B were published. The first found that when full geographical range of four widespread Western vegetation types were analyzed, minimal conservation targets were met in less than 50% of the latitude, longitude elevation cells. Similar results were obtained for three other vegetation types and examination of the occurrence of nature reserves in geophysical space found that their occurrence was strongly biased toward high elevations and poor soils. Those areas least represented in nature reserves were in better soils at lowest elevations and were overwhelmingly in private ownership. Thus completion of a comprehensive nature reserve system in the United States must involve private lands.

Manuscripts

- Wright, R. G., J. M. Scott, M. Murray and S. Mann. 2001. Identification of underprotected and potentially at risk plant communities in the Western United States. *Biological Conservation* 98.
- Scott, J. M., R. Abbitt, and C. Groves. In press. What are we protecting! The United States Conservation portfolio. *Conservation Biology in Practice* 1 (2).
- Scott, J. M. and M. D. Jennings. 1998 Large area mapping of biodiversity. *Annals Missouri Botanical Society* 81:34-47.
- Scott, J. M., E. Norse, H. Arita, A. Dobson, J. Estes, et al. 1999. Considering scale in the identification selection and design of biological reserves. Pp. 19-38 in M. Soule and J. Terborgh (eds.), *Continental Conservation at multiple scales: implications for conservation planning*. *Landscape and Urban Planning* 43:49-63.
- Scott, J. M. 2000. Owning up to our responsibilities. Pp. 275-300 in B. A. Stein, L. S. Kutner and J. S. Adams (eds). *Precious Heritage The Biodiversity of the United States*. Oxford University Press, New York. (nature reserves, endangered species, gap analysis)
- Scott, J. M., F. Davis, et al. In press. Nature reserves: Do They Capture the full range of biodiversity. *Ecological Applications*.

PARTNERS IN FLIGHT

Principal Investigator:	J. M. Scott
Funding Agency:	Idaho Fish and Game
Completion Date:	6/30/01

The Idaho Department of Fish and Game hired Sharon Ritter as the Idaho Partners in Flight (Idaho PIF) Coordinator on 1 July 1995. Dan Svingen, Nez Perce National Forest, replaced Sharon as Coordinator from July through mid-October 1997. Sharon then returned to the position.

Contributors to Idaho Partners in Flight in FY00 included the following organizations and agencies. Because every donation, big and small, is important, I have not put the amounts in this report. Those amounts are available from me upon request:

- Regions 1 and 4 of the U.S. Forest Service provided the original funding under this agreement. Those funds have been used up. However, we received in a roundabout way some funding from the USFS via the American Bird Conservancy to support my position. Also, the USFS paid for some of my travel expenses to attend a USFS/PIF meeting.
- The Idaho Department of Fish and Game provided much of the funding for my position, expenses, and travel and provided supervision.
- The U.S. Fish and Wildlife Service provided funds through their nongame bird program.
- The U.S. Bureau of Land Management provided Cost-Share funds for my position and for reprints of *Birds in a Sagebrush Sea*.
- The University of Idaho Cooperative Fisheries and Wildlife Research Unit absorbed administrative costs by acting as my employer.

- The American Bird Conservancy and the LaSalle Adams Fund donated funds to support my position.
- Boise Cascade Corporation helped pay for printing the *Idaho Bird Conservation Plan*.
- Potlatch Corporation helped with some travel expenses related to my travel to receive a PIF award.
- In addition, the organizations above and others provided people to help prepare the Idaho Bird Conservation Plan, *Birds in a Sagebrush Sea*, and the Idaho Important Bird Areas Program.
- The following organizations donated toward production of the publication *Keeping Birds in the Sagebrush Sea* (shown in alphabetical order): American Bird Conservancy, Idaho Department of Fish and Game, Idaho Fish and Wildlife Foundation, Montana Department of Fish, Wildlife and Parks, National Audubon Society, National Fish and Wildlife Foundation, Point Reyes Bird Observatory, Ravenworks Ecology, Nature Conservancy-Idaho and Washington offices, USDI Bureau of Land Management-Oregon and Idaho state offices, USDI Bureau of Reclamation-Montana and Idaho, USDI Fish and Wildlife Service Region 1, Washington Department of Wildlife, and Wyoming Game and Fish Department.

Accomplishments

The following describes the most significant accomplishments of the Coordinator and Idaho Partners in Flight in FY2000.

Idaho Bird Conservation Plan: We finished the *Idaho Bird Conservation Plan--Version 1.0* and the accompanying Implementation Plan, printed it, and mailed it to Idaho PIF members and biologists and ecologists in other agencies. I also prepared it for inclusion on the PIF website <http://www.partnersinflight.org>.

We started setting up the Pine Task Force Oversight Committee, although we were stymied by the fire season of 2000 that occupied most interested parties.

I worked on other tasks in the plan, and continued to encourage other Idaho PIF members to put the plan to use. To increase the visibility of Idaho PIF and to increase familiarity with the *Idaho Bird Conservation Plan*, I gave talks to the USFS Supervisors in February 2000, the Idaho Department of Lands Range and Minerals Division in March 2000, and the BLM Resource Managers in May 2000.

Birds in a Sagebrush Sea and other publications: We continued to distribute *Birds in a Sagebrush Sea* whenever requested. The BLM and Idaho Fish and Game chipped in to print more copies when we ran out. I reworked the manuscript to prepare a landowner version, called *Keeping Birds in the Sagebrush Sea*. *Wyoming Wildlife* magazine published one version in the March 2000 issue. This version was incomplete and contained errors, so I revised that version into a 16-page, 4-color version that will be printed in November 2000.

I advised the Western Region PIF Coordinator on the funding needed and logistics to prepare a publication similar to *Birds in a Sagebrush Sea*, this time for Pinyon/Juniper habitat. I'm also working with the Montana PIF Coordinator and the Northern Rockies BCR Coordinator to prepare a publication on Ponderosa Pine forest management.

Idaho PIF meetings this year: We conducted one statewide Idaho PIF meeting, in October 1999, and an Idaho PIF Steering Committee meeting. We also held separate Sagebrush Committee

(February 2000) and Pine Committee (March 2000) meetings. Several Idaho PIF members attended the meeting setting up the Idaho Joint Venture. We have Idaho PIF members represented on the statewide steering committee and the regional Bird Conservation Areas of the Idaho Joint Venture. It is through working with the Idaho and Intermountain West Joint Ventures that we hope to create the partnerships needed to conduct habitat restoration projects.

Other Meetings: I attended the following meetings relevant to Idaho PIF, and gave talks at several of them: monitoring meeting in Montana in January 2000; North American Natural Resources Conference and PIF meetings in Chicago in March 2000 (where I accepted a National PIF Award for Leadership); USFS/PIF meeting in Denver in March 2000 to discuss how to obtain PIF objectives; LaGrande, OR, in March 2000 to discuss regional implementation of sagebrush portions of our plans and the use of ICBEMP data; TNC Terrestrial Group meeting on the Canadian Rockies Ecoregional Plan in June 2000 in Montana; and a Yellowstone-to-Yukon meeting of ornithologists in August.

Mailings: Most of the Idaho PIF members are now connected by e-mail, so I frequently passed along information to them. I sent out seven informational mailings that focused on Idaho PIF, plus the Idaho Bird Conservation Plan.

Fund-raising: Fund-raising for this position was informal through phone calls and face-to-face discussions, and formal through grant or cost-share requests to the USFWS, BLM, and NFWF. I also helped Idaho PIF members and western partners by reviewing their proposals and suggesting possible partners and funders. I prepared a list of foundations that may fund projects in Idaho. For the October 2000 Idaho PIF meeting, I arranged for a half-day session on fund-raising.

Monitoring: I worked with the Colorado Bird Observatory to prepare an Idaho Bird Monitoring Plan, and sent it out for review prior to our October 2000 meeting.

Important Bird Areas Program: I contacted people concerning IBA nominations that are still under review to obtain enough information so the IBA Committee can make an informed vote, and I gathered information from other sources. I provided copies of the nominated forms to the CDC to digitize the maps. I also worked with Jon Beals of Idaho Fish and Game to revise the IBA map, and prepared a new Progress Report to be released in November 2000. I talked with National Audubon about getting some funding to hire someone else to run the IBA program so I could concentrate on Idaho PIF.

Western Working Group: I attended the Western Working Group meeting in Tucson, AZ, in April 2000. We were fortunate because other Idaho PIF members also attended this meeting, which gave us an advantage when we worked in Bird Conservation Region breakout sessions. I also entered the Research Needs information from the *Idaho Bird Conservation Plan* into a PIF database, reviewed prioritization lists, and worked on habitat and population objectives for the Northern Rockies and Great Basin Bird Conservation Regions.

International: We are raising funds to purchase books for Panama PIF. Several members donated books and journals. We're working with the Idaho Bird Observatory to handle the funds and order the books.

Conclusion

I'd like to thank all of the agencies and organizations that have supported my position and various Idaho PIF projects, and all of the individuals who have contributed to Idaho PIF's efforts. We have one of the better plans in the nation, with good objectives and tasks already outlined to get us started.

Someone asked me a few years ago if Partners in Flight had peaked and was fading away. I honestly thought then, and have been proven right, that although it may have stalled briefly as we struggled with our plans, it is stronger than ever. There is increasing interest in birds and in protecting, enhancing, and restoring habitat for them both locally and internationally. With that interest, there is increased funding to carry out projects, both from agencies and private foundations. We are in an excellent position to take advantage of this momentum and funding.

USING DNA TO MONITOR GRIZZLY BEAR POPULATION TRENDS

Principal Investigator:	L. Waits
Student Investigators:	David Roon, Melanie Murphy
Funding Agency:	U.S. Geological Survey
Completion Date:	5/30/01

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

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

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

and 3 days in the field, but DNA could be obtained even after two months in the field.

RED WOLF GENETICS

Principal Investigator: L. Waits
Student Investigator: Jennifer Adams
Funding Agency: U.S. Fish and Wildlife Service
Completion Date: 12/31/02

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

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

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

A SURVEY OF AMPHIBIAN ACTIVITY IN PONDS IN THE PALOUSE GRASSLANDS OF IDAHO

Principal Investigator: R. G. Wright
Funding Agency: National Park Service
Completion Date: 12/15/01

Objectives: 1) To describe and map amphibian species occurrences and abundance in ponds of the Idaho Palouse; and 2) to characterize these ponds as to age, depth, surrounding habitat, and other ecological characteristics.

Progress: This project has been expanded in several ways. The geographic area now encompasses the Palouse bioregion as defined by Bailey and therefore includes portions of eastern Washington. The scope of the project has been expanded to identify and map all features of conservation importance within this region, particularly unique habitats that are unprotected and/or are at risk from development or land-use change.

Progress to date:

A vegetation cover map for the study area has been produced from 1999 Landsat 7 and ancillary data and incorporated into an ARC-INFO GIS coverage. We have mapped and are currently digitizing all wetland areas, ponds, and riparian zones. We have initiated an effort to obtain and map all agricultural lands in Latah County contained in the CRP program. A general land status map, identifying public, state, federal, and corporate ownership is also being developed. We have held consultations with Idaho Dept. of Fish & Game and the Latah County planning and zoning commission about what they would like to see in this project.

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

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

Objectives: 1) Illustrate how environments in the Snake River Plain have change or not changed over the course of the past 10 decades; 2) Attempt to identify the reasons for the changes or lack of changes and the consequences of these changes.

Progress: This project, which was funded this year, has not yet been started.

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

Principal Investigator: R. G. Wright
Funding Agency: U.S. Geological Survey
Completion Date: 03/03/02

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

Progress: Fieldwork on this project began in May 2000, directed by graduate student James Wilder and assisted part-time by an NPS 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. Project activities to date have been to more accurately delineate the study area on the ground, establish hair-traps for bears in appropriate areas, collect hair samples, investigate instances in the Chitina River Valley of bear/human conflicts, and collect data from bears that have been killed as a result of conflicts with humans. To date, 204 hair samples have been collected. These were sent to the UI genetic lab for DNA extraction. The success rate for species ID from these samples was 75%. This is lower than on the study underway in Glacier NP, but about the same as hair trapping projects conducted in British Columbia. Of the known IDs,

136 were black bears, 11 were brown bears, and 5 contained DNA of both species. At least three bears involved in conflicts with humans were killed this past summer, all by valley residents. Data from these bears will be compared to samples from the hair traps. In September, James Wilder spent two weeks at Katmai National Park observing the bear management plan in use around Brooks Camp. He will attend the bear/humans conflicts symposium in British Columbia in October.

BREEDING BIRD AND RAPTOR INVENTORIES, NEZ PERCE NATIONAL HISTORICAL PARK

Principal Investigator: R. G. Wright
Funding Agency: National Park Service
Completion Date: 12/30/00

Progress: The second year of field work on this project was completed this summer under the direction of Rita Dixon. All areas of the Nez Perce NHS extending from sites in eastern Oregon to Big Hole Battlefield and Bear Paw in Montana were thoroughly sampled for breeding birds, raptors, owls, woodpeckers, and waterfowl. A long-term monitoring protocol has been developed for the park based on the sampling methods used. The project was also extended to include breeding bird surveys of Whitman Mission NHS in Washington. It is anticipated that a final report on the project will be produced this winter.

NATURAL RESOURCE BIBLIOGRAPHIC DATABASE PROJECT

Principal Investigator: R. G. Wright
Funding Agency: National Park Service
Completion Date: 12/30/00

Progress: This project is nearing completion with the final editing of several park bibliographic databases from the National Park Service units in the southeastern US. Projects associated with NPS Midwest, Western, Northwest, and Southwest regions have been completed under the direction of Lisa Garrett. A draft final report has been prepared for the Southeast work. Currently, as a result of this project, over 100,000 records of park-specific resource studies have been entered into our electronic bibliographic databases. We are now working with the National Park Service to implement access to these databases from a web site.

**SYNTHESIS OF SCIENTIFIC INFORMATION – VOYAGUERS NATIONAL PARK,
MINNESOTA**

Principal Investigator: R. G. Wright
Funding Agency: National Park Service
Completion Date: 12/30/00

Progress: This project is currently underway. The principal investigator has made one trip to Voyageurs National Park to get a better understanding of the ecological characteristics of the parklands. During that trip he used the Voyageurs NRBIB database to search the park library and resource management files for appropriate information to be used in the synthesis and brought that material back to the UI. Since then work has been progressing on synthesizing information about the various resource components of the park using tropic levels and ecological processes as a basis for organizing information. Sections on herbivores, primarily, beaver, moose, and white-tailed deer have been completed and well as the role of fire on parklands.

INTERPRETIVE TRAINING

Principal Investigator: R. G. Wright
Funding Agency: National Park Service
Completion Date: 12/30/00

Progress: Under the direction of Lisa Garrett, we are compiling information on the distribution, impacts, control measures, and restoration techniques for exotic plant species on national park lands throughout the US. These materials are to be compiled into course materials for a workshop to be given to park interpreters and educators about the role of exotic plant species in parks. Originally this workshop was to be organized in the early fall of 2000. However, the intense involvement of National Park Service contacts on the project with fires in the parks has delayed this until at least the early winter of 2000-2001.

Completed Projects - Wildlife Resources

E. O. Garton - Principal Investigator

- Assessment of the ecological value of Snake River islands on Deer Flat National Wildlife Refuge to neotropical migrant birds

John Giudice - Principal Investigator

- Recruitment and survival of dabbling ducks using irrigation-created habitats in Central Washington.

Dennis Murray - Principal Investigator

- Elk condition and reproductive physiology

Kerry P. Reese - Principal Investigator

- Curlew Valley Habitat Mapping

J. Michael Scott - Principal Investigator

- Small and/or declining populations: implications for management and recovery - a workshop
- Clearwater River Basin

R. Gerald Wright – Principal Investigator

- Identify at risk plant communities in the Western United States
- Axis deer ecology and distribution: Kaluapapa National Historic Park, Hawaii

ASSESSMENT OF THE ECOLOGICAL VALUE OF SNAKE RIVER ISLANDS ON DEER FLAT NATIONAL WILDLIFE REFUGE TO NEOTROPICAL MIGRANT BIRDS

Principal Investigator: E. O. Garton
Funding Agency: U.S. Fish and Wildlife Service
Completion Date: 5/30/00

Objectives: 1) To measure avian abundance, richness, and diversity for island riparian habitats on the Snake River portion of Deer Flat NWR and adjacent mainland riparian habitats; 2) To monitor avian nest success on islands and adjacent mainlands, and assess physiographic and ecological factors related to success rates; 3) To determine actual and potential nest predators of nesting birds; and 4) To compare mainland nesting populations with island nesting populations to assess the relative importance of island habitats.

Results: The Deer Flat National Wildlife Refuge (NWR) is located along a 193-kilometer section of the Snake River in southwestern Idaho. The refuge section of the Snake River includes approximately 94 islands administered by the U.S. Fish and Wildlife Service. These islands provide critical riparian habitat for wildlife, especially neotropical migrant birds, which have exhibited significant population declines throughout North America. The importance of riparian areas for birds in the arid and semi-arid West has been well documented.

To achieve these objectives, we conducted bird and habitat surveys on 44 islands and 44 mainland sites. Each island was paired with a mainland site, located within 1.6 kilometers and in comparable vegetation. Half of the island/mainland pairs were studied in 1998 and half in 1999. We detected 91 species and 15,701 birds. We calculated the density of ten common bird species. Song sparrow had the highest density, followed by red-winged blackbird, yellow warbler, American robin, and brown-headed cowbird. We could detect no statistical difference in densities of these species between islands and mainland sites; however, densities of American robin and yellow warbler were approximately two times higher on islands. We also tested the difference in species densities between sites above and below the confluence with the Boise River. We suspected bird densities would change with the increase in trees below the Boise River. Brown-headed cowbird and red-winged blackbird had higher densities above the Boise River. American goldfinch and house wren had higher densities below the Boise River.

We calculated densities of four groups of birds that nest in similar substrates (i.e., nesting guilds). These guilds were cavity, shrub, tree, and emergent-vegetation nesters. Shrub nesters had statistically higher densities on islands. Cavity nesters had higher densities below the Boise River.

We could detect no difference in overall bird density, species richness (number of species), or species diversity (a measure of species abundance and evenness in a community) between islands and mainland sites or between sites above and below the Boise River.

To examine habitat differences among sites, we measured various habitat and vegetation characteristics in an 11.3-meter-radius circle around each bird station. Trees and shrubs tended to be more abundant and taller on mainland sites. Bittersweet nightshade and greasewood were more abundant on the mainland. Grass cover, shrub cover, and shrub height were higher above the Boise River. Salt cedar and Russian olive were more abundant above the Boise River. Forb cover, forb height, number of trees, tree height, and the abundance of Siberian Elm were higher below the Boise River.

We compared the relative value of islands or mainland sites versus habitat characteristics for predicting species densities. Although islands were an important predictor of density for five of ten species, other habitat features were equally important.

We found 1,356 nests of 36 species. We calculated survival rates and nest success for all nests combined, all open-cup nests, American robin, brown-headed cowbird, mourning dove, northern oriole, red-winged blackbird, song sparrow, and yellow warbler. Overall nest success was 8.9% higher on islands; success for open-cup nests was 6.1% higher. However, we could detect no differences in nest success for individual species. Brown-headed cowbirds eggs and/or chicks were found in 132 nests of three species (red-winged blackbird, song sparrow, and yellow warbler). We also examined differences in habitat and vegetative characteristics between successful and unsuccessful nests.

We placed cameras on artificial nests to identify potential nest predators on islands and mainland sites. We used Trailmaster© infrared-triggered cameras and mechanical-trip cameras. One or two Japanese quail eggs, and one clay egg were placed in each nest. We monitored 88 nests with cameras, half on islands and half on the mainland. Six predator species were captured on film at 13 nests. These were deer mouse, fox squirrel, domestic cat, black-billed magpie, black-capped chickadee, and northern oriole.

Snake River islands provided valuable habitat for breeding songbirds. However, we detected few statistical differences in bird densities between islands and mainland sites. We speculate that the lack of more obvious differences was due to the presence of relatively few patches of quality-riparian habitat on the mainland, and that birds were “packing” into these sites. It appeared birds were keying in on particular habitat features, regardless of whether they were on islands or the mainland. Islands also offered some protection from large mammalian predators, although other smaller predators, such as fox squirrels and deer mice were resident on many islands. Black-billed magpies were a significant nest predator, and were abundant throughout the study area. Given the low amount of available mainland-riparian vegetation on the study area and the potential further encroachment of farms and urbanization, Snake River islands are critical for breeding birds in this region.

We recommend continuing to monitor bird populations on the Deer Flat NWR, and in particular to examine the relationship between nest success and water level. We observed that nest predation tended to increase when the water level decreased. In addition, we recommend that bird populations be studied during fall and spring migration. The value of Western riparian zones may be equally high or higher during migration.

RECRUITMENT AND SURVIVAL OF DABBLING DUCKS USING IRRIGATION-CREATED HABITATS IN CENTRAL WASHINGTON.

Principal Investigator:	J. Giudice
Advisors:	J. T. Ratti and E. O. Garton
Funding Agency:	Washington Department of Fish and Wildlife
Completion Date:	5/30/00

Objectives: (1) Estimate survival and recruitment of waterfowl using irrigation-created habitats in the wasteway stratum of central Washington; (2) model the population dynamics of breeding

waterfowl in this landscape; and (3) evaluate the response of waterfowl to wetland enhancements by testing specific predictions about habitat selection and survival of nesting hens and waterfowl broods.

Results: Giudice, J. H., M. J. Monda, and J. T. Ratti. 2000. Recruitment and survival of dabbling ducks using irrigation-created habitats in central Washington. Project completion report, Washington Department of Fish and Wildlife, Ephrata, WA. 73pp.

To better understand the population dynamics of waterfowl using irrigation-created habitats in central Washington, we studied the reproductive ecology of mallards (*Anas platyrhynchos*), cinnamon teal (*A. cyanoptera*), blue-winged teal (*A. discors*), and gadwalls (*A. strepera*) on the Desert Wildlife Area (DWA) and Columbia National Wildlife Refuge (CNWR) during 1997-99. We monitored nest, egg, brood, and duckling survival on 28 quarter sections on DWA and 1 16-km²-study block on CNWR. We used band-recovery data to estimate annual-survival rates, recovery rates, and distribution of recoveries.

We monitored 150 duck nests on DWA and 20 nests on CNWR. Mallards and teal comprised 69% of the sample. Sixty-four percent of the nests were unsuccessful. Avian species probably caused most nest and egg losses, but positive identification of nest predators was not possible in most cases. The daily-survival rate of duck nests was higher ($P < 0.001$) in nesting cylinders and on islands (0.987 ± 0.006) than in other covertypes (0.933 ± 0.008). Estimated nest success was 10.8% for teal, 10.7% for mallards, and 10.1% for gadwalls. Thirty-day brood-survival rates were 0.750 ± 0.217 (SE) for gadwalls, 0.356 ± 0.186 for mallards, and 0.200 ± 0.179 for teal. Thirty-day duckling-survival rates were 0.457 ± 0.181 for gadwalls, 0.155 ± 0.084 for mallards, and 0.114 ± 0.132 for teal. Estimated recruitment rate (females fledged/adult female) was 0.559 for gadwalls, 0.151 for mallards, and 0.124 for teal. Annual-survival rates of mallards were sex-specific (F: 0.618 ± 0.020 , M: 0.672 ± 0.014) and recovery rates were sex-, age-, and year-specific (range: 0.016-0.138). In the most plausible model, first-year recovery rates (0.059 ± 0.011) were different from recovery rates of previously banded cohorts (0.039 ± 0.008). Seventy-two percent of all mallards banded in eastern Washington were recovered in the Columbia Basin of central Washington. Estimated survival and recovery rates of gadwalls were 0.576 ± 0.049 and 0.054 ± 0.009 , respectively.

Based on estimated vital rates, mallard and teal populations on DWA and CNWR during 1997-99 would likely have declined without annual immigration from other populations (average $\lambda = 0.749$ and 0.777 , respectively). The gadwall population may have exhibited positive growth ($\lambda = 1.360$) but our estimates of λ contained moderate-to-high levels of uncertainty. Furthermore, if published estimates of homing rates are reasonably accurate and applicable to populations in central Washington, then dabbling-duck recruitment (including gadwalls) probably was insufficient to maintain local breeding populations during 1997-99. The long-term decline in breeding-pair counts on DWA supported this conclusion. Our data suggests that in addition to meeting spatial needs of breeding pairs (i.e., through wetland excavations); more attention should be given to management actions that increase nest and brood survival.

ELK CONDITION AND REPRODUCTIVE PHYSIOLOGY

Principal Investigator: D. Murray
Funding Agency: Idaho Department of Fish and Game
Completion Date: 6/30/00

Objectives: To evaluate the role of nutritional state of captive female elk on 1) reproductive physiology and 2) body condition and nutritional assays.

Results: We assessed and calibrated indices of nutritional condition for live and dead Rocky Mountain elk (*Cervus elaphus nelsonii*). Live animal indices included serum and urine chemistry, a body condition score (BCS), ultrasonography of subcutaneous fat and muscle, bioelectrical impedance analysis (BIA), and body mass. Dead animal indices included marrow fat, kidney fat, and several carcass scoring methods. Forty-three captive-raised cows (1.5 to 7-years old) were divided into 3 seasonal groups (September, December, and March) and were maintained on different nutritional levels to induce a wide range of condition. All were placed on identical diets 7 days prior to sampling to eliminate short-term nutritional effects. Cows were euthanized and homogenized for chemical analysis of fat, protein, water, and ash content. Estimates of fat and gross energy (GE) were compared to each of the condition indicators using regression analysis, with age and season covariates. Thyroxine (T₄) and insulin-like growth factor (IGF-1) exhibited significant seasonal effects and mandible marrow fat had a significant age effect. Nearly all serum and urine indices, bone marrow indices and BIA were either poorly correlated with condition or exhibited highly non-linear relations, restricting their value to a narrow range of condition. In contrast, BCS and subcutaneous fat depth were the best predictors of fat and GE for live animals ($r^2 > 0.87$, $P < 0.001$); kidney fat and carcass/muscle scores were the best predictors for dead animals ($r^2 > 0.77$, $P < 0.001$); and IGF-1 and T₄ were the only useful serum and urine predictors ($r^2 > 0.54$, $P < 0.001$). Six wild cows were used to assess suitability of condition-index models for free-ranging elk. Although the range of condition for wild elk was limited, there was no difference in the ability of models to predict fat and GE between wild and captive cows. These results will enhance assessment of nutritional condition of free-ranging elk using practical and affordable techniques that were previously untested in elk.

CURLEW VALLEY MAPPING

Principal Investigator: K. P. Reese
Funding Agency: Idaho Department of Fish and Game
Completion Date: 6/30/00

Objectives: To ground truth vegetation maps of the Curlew Valley in southern Idaho which were created previously through GIS application of remotely sensed data.

Results: Project completed in January 2000. Data on 900 vegetation transects were collected during the summer of 1999 near the Curlew Valley National Grasslands. Copies of all data were sent to the Bureau of Land Management, Idaho Department of Fish and Game, and Utah State University. Completion report filed as Commons, M.L. 2000. Curlew Valley Vegetation Mapping Project: Summer 1999. Final Report to BLM, IDFG, Utah State U., and University of Idaho.

SMALL AND/OR DECLINING POPULATIONS: IMPLICATIONS FOR MANAGEMENT AND RECOVERY - A WORKSHOP

Principal Investigator: J. M. Scott
Funding Agency: USGS/Idaho Fish and Game
Completion Date: 10/15/00

Objective: 1) We will identify recovered small populations as those threatened or endangered species that the U.S. Fish and Wildlife Service has de- or down-listed or proposed for de-listing or down-listing. These species will be compared with 156 species that were listed in 1983 or before and have recovery plans.

Results: Workshop was held in McCall, Idaho during the period of August 28-31,2000. The workshop was attended by 29 individuals from four states, five Federal agencies and three universities. The workshop resulted in identification of more than 50 funding sources for research on small populations. Six possible collaborations were initiated among workshop participants and one new research project has been funded. The results from the workshop were compiled and distributed to all Cooperative Research Units and placed on the Idaho Cooperative Research Unit website at: <http://www.its.uidaho.edu/coop/SmallPops/smlpops.htm>. References on small populations were provided to all the attendees and are available on our website. Questions addressed included:

1. What constitutes a small population?
2. Is being rare the same thing as having a small population?
3. Give their small average size, what kind of management and persistence challenges do nature reserves present in relation to small populations?
4. How do we manage small populations of game species?

CLEARWATER RIVER BASIN

Principal Investigator: J. M. Scott
Funding Agency: Idaho Department of Fish and Game
Completion Date: 6/30/00

Objectives: 1) Map the distribution of 24 species of terrestrial vertebrates; 2) Assess accuracy of predictions of occurrence; and 3) Predict response to changes in fire disturbance regimes.

Results: Habitat association models have been built and predictions from those models made at two scales of spatial resolution. Species occurrence data independent of model building are being used to test accuracy of model predictions. All areas burned since 1997 have been mapped.

IDENTIFYING AT RISK PLANT COMMUNITIES IN THE WESTERN US

Principal Investigator: R. G. Wright
Student Investigator: Shannon Mann
Funding Agency: USGS/Biological Resources Division
Completion Date: 12/31/99

Objectives: 1) develop a common vegetation classification for the gap vegetation maps for the 12 state region west of the continental divide; 2) calculate the spatial area occupied by each plant community type and measures of the spatial distribution and average patch size for each community; 3) using gap land ownership and land stewardship maps, identify those plant communities that lack sufficient protection according to standard conservation criteria; 4) using county scale census data and measures of distribution and patch size, identify those communities selected in objective 3 as being inadequately protected that may be at the greatest risk for land conversion; and 5) examine the correspondence between our findings and those of other studies which have identified threatened plant communities or ecosystems.

Results: This project has been completed. We analyzed the conservation status of 73 vegetation cover types distributed across a 1.76 km² region in 10 states of the western US. We found that 25 vegetation cover types had at least 10% of their area in nature reserves. These were generally plant communities located at high elevations and thus more commonly associated with national parks and wilderness areas. All but three of the remaining 48 types occurred with sufficient area on public ally owned lands in the region to imply that transforming land management intent on this land could also increase their protection. We also analyzed the level of protection afforded each cover type across its entire geographic distribution in the region. Most cover types that were at least minimally protected in total across the region were also at least minimally protected in most areas of their occurrence. Our results show that there is a realistic opportunity to design a system of biodiversity reserves in this region that represent the full range of environmental conditions in which the various plant communities occur. Conducting this type of broad-scale analysis is a necessary first step in that process and provides a database for others to work from.

AXIS DEER ECOLOGY AND DISTRIBUTION: KALUAPAPA NATIONAL HISTORIC PARK, HAWAII

Principal Investigator: R. G. Wright
Funding Agency: National Park Service
Completion Date: 12/30/01

Progress: This project was terminated following six months of fieldwork. The termination was the result of actions by the Kaluapapa NHP resource manager to begin a fencing program that would bisect the Kaluapapa Peninsula, essentially dividing the study area, and to undertake a substantial control program that would eliminate axis deer within the fenced area. We anticipated that many of the deer that had been marked and radio-collared would be trapped within the fenced area and therefore eliminated. We considered that these actions compromised the integrity of the study and by mutual agreement it was terminated. Andrew Yost directed the field study while it was active. The protocols developed for immobilizing and handling the deer were done under the supervision of Maui veterinarian Alan Kaufman, who has provided consultation on a similar project at Haleacola NP. During the brief study, 20 deer were immobilized and fitted with radio collars and followed for up to 5 months. All relocations were placed into an ARCVIEW GIS file.

We collected all rumens that were available from deer harvested by local residents within the park (n=137). It was our intention to have the contents of these rumens analyzed for dietary components. This data could then be compared with visual and radio locations of deer within specific habitats on the peninsula. This part of the study was not completed because of its termination. A final report on the study and its management implications was produced:

Yost, A. and R. G. Wright. 1999. A preliminary study of axis deer distribution, movements, and food habits at Kalaupapa National Historic Park.

Summary of Activities

Honors and Awards Received by Unit Staff and Students.

Dmitri Videgar, M.S. Student. Outstanding Student Paper Award. Montana Chapter of the American Fisheries Society, February 2000.

Aaron Wirsing, M.S. Student. Outstanding Research Presentation. Idaho Chapter of the Wildlife Society, March 2000.

J. Michael Scott, Outstanding Faculty Member, Department of Environmental Science, University of Idaho.

Publications and Professional Papers presented - Unit Staff and Students

Scientific Papers:

Abbitt, R. F., J. M. Scott, and D. S. Wilcove. 2000. The geography of vulnerability: Incorporating species geography and human development patterns into conservation planning. *Biological Conservation* 96:169-175.

Congleton, J. L., W. J. LaVoie, C. B. Schreck, and L. E. Davis. 2000. Stress indices in migrating juvenile chinook salmon and steelhead of wild and hatchery before and after barge transportation. *Transactions of the American Fisheries Society* 129:946-961.

Foster, J.T., J.M. Scott, and P.W. Sykes Jr., Akikiki (*Oreomystis bairdi*). ²⁰⁰⁰ *The Birds of North America*. No. 552. in A. Poole and F. Gill (eds.). The Birds of North America, Inc. Philadelphia, PA.

Garrett, L. and R. G. Wright. 2000. Prioritizing research and monitoring needs of terrestrial mammals in national parks. *The George Wright Society Forum* 17:80-93.

Gergely, K., J. M. Scott and D. Goble ²⁰⁰⁰ A new direction for the U.S. National Wildlife Refuges: The National Wildlife Refuge System Improvement Act, 1997. *Natural Areas Journal* 20:107-118.

Groves, C.R., L. Kutner, D.M. Stoms, M.P. Murray, J.M. Scott, M. Schafaer, A.S. Weakley, and R. Pressey. 2000. Owning up to our responsibilities: who owns the land important for diversity. Pp.275-300. *In Precious Heritage*. B. Stein (eds.). Oxford University Press. Cambridge, England.

Karl, J.W., P.J. Heglund, E.O. Garton, J.M. Scott, N.M. Wright, and R.L. Hutto. 2000. Sensitivity of species habitat-relationship model Performance to factors of scale. *Ecological Applications* 10:1690-1705.

Karl, J.W., N. M. Wright, P. J. Heglund and J. M. Scott. 1999. Obtaining environmental measures to facilitate habitat modeling. *Wildlife Soc. Bull.*:27:357-365.

Kleiman, D., G. R. P. Reading, B. J. Miller, T. W. Clark, J. M. Scott, J. Robinson, R. Wallace, R

- Cabin, and F. Fellman. 1999. Improving Evaluation of Conservation Programs. *Conservation Biology* 14:356-365.
- Peery, C. A. and T. C. Bjornn. 2000. Dispersal of hatchery-reared chinook salmon parr following release into four Idaho streams. *North American Journal of Fisheries Management* 20:19-27.
- Scott, J.M., D. Murray, R.G. Wright, B. Csulti, P. Morgan, and R. L. Pressey. 2000. Representation of natural vegetation in protected areas: Capturing the geographic range. *Biodiversity Conservation* 5:1-5.
- Scott, J.M., E. Norse, H. Arita, A. Dobson, J. Estes, M. Foster, B. Gilbert, D. Jensen, R. Knoght, D. Mattson and M. Soule. 1999. Considering scale in Identification selection and design of biological reserves. Pp. 19-38. *in M. Soule and J. Terborgh (eds.). Continental Conservation Scientific foundations Of regional reserve networks.* Island Press. Washington, D.C.
- Scott, J.M., E.A. Norse, H. Arita, A. Dobson, J.A. Estes, M. Foster, B. Gilbert, D.B. Jensen, R.L. Knight, D. Mattson, and M.E. Soule. 2000. The issue of Scale in selecting and designing biological reserves. Pp. 19-34. *in M.E. Soule and J. Terborgh (eds.). Continental Conservation: Scientific Foundations of Reginal Reserve Networks.*
- Scott, J. M. and P. C. Banko. 2000. The Hawaiian Goose. Pp.142-146 *in B. J Miller and R. P. Reading (eds.). Endangered Animals Reference Guide to conflicting issues.* Greenwood Press, Westport, CT.
- Scott, J. M. and P. C. Banks. 2000. R. P. Reading and B. Miller (Eds.). *Endangered Animals: A reference guide to conflicting issues.* Greenwood Press Westport, CT.
- Scott, J.M. and R. Sparrowe. 1999. Review a whooping crane research program at Pantexent Science Center. Idaho Cooperative Research Unit. Moscow, ID
- Sykes, P., A.K. Kepler, C. B. Kepler, and J. M. Scott. 2000. The Melaphagids. *In The Birds of North America No. 535 (A. Poole and F. Gill, Editors).* Philadelphia: The Birds of North America, Inc., Washington, D.C.
- Wright, R. G. 1999. Fuzzy logic and National Park Service policy. *The George Wright Society Forum* 16:4-8.
- Wright, R.G., J.M. Scott, S. Mann, and M. Murray. 2000. Identifying unprotected and potentially at risk plant communities in the western United States. *Biological Conservation* 96:310-320.

Technical and Semi-technical papers:

- Miller, C. A. and R. G. Wright. 2000. An assessment of visitor satisfaction with public transportation services at Denali National Park and Preserve. *Park Science* 18:18-19.
- Yost, A. and R. G. Wright. 1999. A preliminary study of axis deer distribution, movements, and food habits at Kalaupapa National Historical Park. Final Report, UICFWRU.
- Congleton, J. 2000. "Energy reserves and nutritional status of juvenile chinook salmon

emigrating from the Snake River Basin.” Pp. 21-23 *In* Editors J. Cech, S. McCormick, and D. MacKinlay, Proceedings of Fish Migration and Passage Symposium, Fourth International Congress of Fish Biology, Aberdeen, Scotland.

Congleton, J. L. and W. J. LaVoie. “Evaluation of procedures for collection, transportation, and downstream passage of outmigrating salmonids. Annual Report to Walla Walla District, U. S. Army Corps of Engineers, 1998. 28pp.

Schreck, C.B., D. Lerner, C. Seals, T. Stahl, L. Davis, G. Oosterhout, and J. Congleton. 2000. “Interaction of stress, pathogens, and development on behavior of teleosts.” Pp. 1-3 in Editors B. Barton, T. Pottinger, G. Iwama, and D. MacKinlay, Proceedings of Stress in Fish Symposium, Fourth International Congress of Fish Biology, Aberdeen, Scotland

Theses and Dissertations:

Abbitt, Robbyn. 1999. The geography of extinction and vulnerability: Distribution of restricted-range species and development patterns in the United States. M.S. Thesis, University of Idaho, College of Forestry, Wildlife and Range Sciences, Moscow, Idaho. 35 pp.

Gokhelaskvili, R. 2000. Biodiversity assessment for the Caucasus. M.S. Professional Paper, University of Idaho, College of Forestry, Wildlife and Range Sciences, Moscow, Idaho.

Lyons, C. Land use impacts of imperiled species in Idaho. M.S. Professional Paper, University of Idaho, College of Forestry, Wildlife and Range Sciences, Moscow, Idaho.

Miller, J. K. 2000. Suburban sprawl and the three-toed crawl: A box turtle population across 35 years of land transformation. M.S. Thesis, University of Idaho, College of Forestry, Wildlife and Range Sciences, Moscow, Idaho. 95 pp.

Porter, P. 1999. Interactions of cutthroat trout (*Oncorhynchus clarki*) and coho salmon (*O. kisutch*) in field and laboratory studies. Ph. D. Dissertation, University of Idaho, College of Forestry, Wildlife and Range Sciences, Moscow, Idaho. 164 pp.

Presentations:

Co-chaired breakout session on landscape ecology at the annual meeting of The American Institute for Biological Sciences. Washington, DC. March 2000.

Chaired 69th started meeting of the Cooper Ornithological Society. Portland, Oregon. April 29 through May 2, 2000.

Moderator, Society for Conservation Biology: “Large area assessments of conservation status of biodiversity:bridging the gap between theory and practice”. Society for Conservation Biology meeting. June 2000.

Invited speaker, “National Wildlife Refuge Improvement Act of 1997”: Meeting the challenge. Defenders of Wildlife Workshop. Society for Conservation Biology. Missoula, MT. July 2000.

Session Chair, papers session. Society for Conservation Biology. Annual Meeting. Missoula, MT. July 2000.

Moderator, “Applying GAP to conservation planning at multiple scales. Annual Gap Analysis Meeting. All day session. San Antonio, TX. August 2000.

Invited paper "A representative set of biological reserves for the United States: Assessment and strategy". Presented at the 8th Biennial Conference of the International Association for the Study of Common Property Symposium "Constituting the Commons: Crafting Sustainable Commons for the New Millennium". Bloomington, Indiana. June 2000.

Papers Presented:

Bjornn, T. C., M. L. Keefer, C. A. Peery. October 1999. Adult salmon and steelhead passage through transition pools at Columbia and Snake river dams, 1996-1997. Fish Passage, Operations, and Maintenance Committee, Portland OR.

Karl, J. W., L.K. Bomar, P. J. Heglund, N. M. Wright, J. M. Scott. October 1999 A sensitivity analysis of wildlife habitat relationship model performance to the effects of scale. Predicting Species Occurrences Symposium, Snowbird, Utah.

Wright, N., P. Heglund, J. Karl, J. M. Scott. October 1999. Probability of detection models for North Idaho passerines using GIS. Predicting Species Occurrences Symposium, Snowbird, Utah.

Reischel, T. S., and T. C. Bjornn. November 1999. Depth and Temperature Profiles for Steelhead and Fall Chinook Salmon that Migrated Through the Lower Snake River. 1999 Corps of Engineers Research Review, Walla Walla, WA.

Peery, C. A., and T. C. Bjornn. November 1999. Testing Lamprey Passage in the Ladder Flume at Bonneville Dam. 1999 Corps of Engineers Research Review, Walla Walla, WA.

Keefer, M. L., and T. C. Bjornn. November 1999. Summary of Recent Analyses of Adult Salmon and Steelhead Passage Data at Columbia and Snake River Dams. 1999 Corps of Engineers Research Review, Walla Walla, WA.

Reischel, T., T. C. Bjornn, R. R. Ringe, M. Heinrich, C. A. Peery, and T. Dick. March 2000. Evaluation of a pressure and temperature data storage tag with a radio transmitter in adult salmon and steelhead in the Snake River. Idaho Chapter AFS meeting, Coeur d'Alene, ID.

Schreck, C. B., T. Stahl, L. Davis, C. Seals, D. Lerner, G. Oosterhout, and J. Congleton. March 2000. Endocrinology and assessment of salmon health: Application to endangered species act decisions. Western Regional Conference on Comparative Endocrinology, Oregon State University

Bjornn, T. C. April 2000. The science of salmon survival. Science Writers Workshop, University of Idaho, Moscow, ID

Bjornn, T. C., and M. L. Keefer. June 2000. Information on adult salmon and steelhead passage and fallbacks at Bonneville and McNary dams. Turbine Passage Workshop, Portland, OR.

Bjornn, T. C. June 2000. Passage of salmon and survival at dams in the Columbia River basin. Bureau of Reclamation Fish Passage Workshop, Hood River, OR.

Congleton, J. July 2000. Energy reserves and nutritional status of juvenile chinook salmon emigrating from the Snake River Basin. Fish Migration and Passage Symposium, International Congress of Fish Biology, Aberdeen, Scotland.

Schreck, C. B., D. Lerner, C. Seals, T. Stahl, L. Davis, G. Oosterhout, and J. Congleton. July 2000. "Interaction of stress, pathogens, and development on behavior of teleosts." Stress in Fish

Symposium, International Congress of Fish Biology, Aberdeen, Scotland.

Workshop and Symposium sponsored. Predicting Species Occurrences: Issues over accuracy and scale. Snowbird, Utah. October 1999. Co-hosted with Boise Cascade Corp., Potlatch Corp., U.S. Forest Service, U.S. Fish & Wildlife Service, U.S. Geological Survey and Bureau of Land Management.

Small population workshop. McCall, ID. August 2000. Twenty-five participants.

Publications and Professional Papers presented - Unit Cooperators

Chipps, S. R. and D. H. Bennett. 2000. Zooplanktivory and nutrient regeneration by invertebrate (*Mysis relicta*) and vertebrate (*Oncorhynchus nerka*) planktivores: Implications for trophic interactions in oligotrophic lakes. Transactions of the American Fisheries Society 129:569-583.

Connelly, J. W., K. P. Reese, R. A. Fischer, and W. L. Wakkinen. 2000. Response of a sage grouse breeding population to fire in southeastern Idaho. Wildlife Society Bulletin 28:90-96.

Murray, D. L. 2000. A geographic analysis of snowshoe hare population demography. Canadian Journal of Zoology 78:1207-1217.

Murray, D. L. 2000. A critical review of the effects of marking on the biology of vertebrates. Research Techniques in Animal Ecology: Controversies and Consequences. Columbia University Press, Pp. 15-64.

Technical and Semi-technical papers:

None.

Theses and Dissertations:

Allen, L. R. The effects of 115 years of vegetation change on woodland caribou habitat in the Selkirk Mountains of Idaho. M.S. Thesis, University of Idaho, College of Forestry, Wildlife and Range Sciences, Moscow, Idaho. 39 pp.

Cook, R. C. 2000. Studies of body condition and reproductive physiology in Rocky Mountain Elk. M.S. Thesis, University of Idaho, College of Forestry, Wildlife and Range Sciences, Moscow, Idaho. 119 pp.

Hiner, M. 1999. Epidemiological modeling of *Myxobolus cerebralis* in Idaho. M.S. Thesis, University of Idaho, College of Forestry, Wildlife and Range Sciences, Moscow, Idaho. pp.

Vidergar, D. 2000. Population estimates, food habits, and estimates of consumption of selected predatory fishes in Lake Pend Oreille, Idaho. M.S. Thesis, University of Idaho, College of Forestry, Wildlife and Range Sciences, Moscow, Idaho. 111 pp.

Papers Presented:

Waits, L. October 1999. Use of genetic techniques in management. Red Wolf Program Workshop, Manteo, NC.

Lucia, M. B., K. P. Reese, and J. W. Connelly. March 2000. Cause-specific mortality of juvenile sage grouse. Annual Meeting of the Northwest Section of The Wildlife Society, Post Falls, ID.

Giudice, J. H., M. J. Monda, and J. T. Ratti. April 2000. Survival, recruitment, and population dynamics of waterfowl using irrigation-created habitats in central Washington. Northwest Chapter of The Wildlife Society, Post Falls, ID.

Kendall, K., L. Waits, D. Roon, M. Murphy, K. Peterson. April 2000. Use of DNA to monitor grizzly bear population status. Northwest Chapter of the Wildlife Society, Post Falls, ID.

Murphy, M., L. Waits, K. Kendall. April 2000. Impact of preservation method on PCR amplification success for brown bear fecal DNA. Northwest Chapter of the Wildlife Society, Post Falls, ID.

Murray, D. April 2000. A test of indices of elk body condition. Northwest Chapter of The Wildlife Society, Post Falls, ID.

Murray, D. April 2000. Dynamics of a peripheral snowshoe hare population. Northwest Chapter of The Wildlife Society, Post Falls, ID.

Murray, D. April 2000. Recovering lynx populations through translocation. Northwest Chapter of The Wildlife Society, Post Falls, ID.

Kendall, K., L. Waits, D. Roon, M. Murphy, K. Peterson. June 2000. Grizzly bear population status in northwestern Montana. Society for Conservation Biology, Missoula, MT.

Murphy, M., L. Waits, K. Kendall. June 2000. Impact of diet and field conditions on PCR amplification success for brown bear fecal DNA samples. Society for Conservation Biology, Missoula, MT.

Murray, D. June 2000. Survival in a recolonizing red wolf population. Society for Conservation Biology, Missoula, MT.

Murray, D. June 2000. Snowshoe hare ecology in relation to lynx conservation in Idaho. Society for Conservation Biology, Missoula, MT.

Murray, D. June 2000. Modeling carnivore translocations: An example using the Canada lynx. Society for Conservation Biology, Missoula, MT.

Roon, D., L. Waits, and K. Kendall. June 2000. Genetics of Glacier National Park Brown Bears: Demographics and Population Structure through Non-invasive Genetic Sampling. Western Black Bear Conference, Coos Bay, OR.

Roon, D., L. Waits, and K. Kendall. June 2000. Non-invasive genetic sampling, genotyping error, and bias potential in demographic studies. Society for Conservation Biology, Missoula, MT.

Waits, L., K. Kendall, M. Murphy, D. Roon. June 2000. Non-invasive genetic sampling of wildlife populations: Promise and Pitfalls. Northwest Chapter of the Wildlife Society, Post Falls, ID.

Waits, L. June 2000. Exploring the ESU concept using mtDNA and nDNA data sets from brown

bears. Society for Conservation Biology, Missoula, MT

Burkepile, N.A., K. P. Reese, J. W. Connelly, and D. Stanley. July 2000. The attachment of microtransmitters to day-old sage grouse chicks. Western States Sage and Columbian Sharp-tailed Grouse Workshop, Redmond, OR.

Reese, K.P. July 2000. Future research needs for effective sage grouse management. Sage and Columbian Sharp-tailed Grouse Technical Committee Meeting, Lakeview, OR. (invited presentation)

Adams, J. August 2000. Red Wolf Genetics Project update. Red Wolf Captive Breeding Workshop, Tacoma, WA.

Waits, L. August 2000. Conservation Genetics Basics. Red Wolf Captive Breeding Workshop, Tacoma, WA.

