

REPORT TO COOPERATORS

1995/96

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- John Ratti - Wildlife Resources
- Kerry Paul Reese - Wildlife Resources
- Dennis Scarnecchia - Fishery Resources
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- Jack Connelly - Wildlife
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- Bart Butterfield - Wildlife

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- Scott Patterson, M.S. Fishery Resources - J. L. Congleton/D. Scarnecchia
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Bjornn 9
Congleton 5
Scott 5

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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

The Idaho Cooperative Wildlife Research Unit was established at the University of Idaho in 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 Forestry, Wildlife and Range Sciences. The Unit is staffed, supported, and coordinated by the National Biological Service, U.S. Fish and Wildlife Service, Idaho Department of Fish and Game, University of Idaho, and Wildlife Management Institute.

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 streams 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. Excellent laboratory facilities are provided by the University, and the Unit maintains a field station on Hayden Creek, near Salmon, Idaho.

Unit research is supported by the State contribution and by contracts from the National Biological Service, 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 - Distribution, abundance, and limiting factors of Hawaiian birds; limiting factors in endangered species; preserve design in North America; use of translocation as a tool for establishing or augmenting animal populations; Gap Analysis. Areas of interest include animal ecology, conservation biology, estimating animal numbers. Specialty course: FW-504 Conservation Biology.

Ted C. Bjornn - Assistant Unit Leader and Professor of Fishery Resources - 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 - 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.

Ongoing Projects - Fisheries Resources

David H. Bennett - Principal Investigator

Fish Interactions in Lower Granite Reservoir, Idaho/Washington, 1995.

Fish Interactions in Lower Granite Reservoir, Idaho/Washington, 1996.

Evaluation of the Substrate Quality in the Snake River for embryo incubation of fall chinook salmon - Fall 95.

Dworshak Reservoir Resident Fish Re-evaluation study.

Benthic invertebrate diversity and abundance on soft and hard substrate habitats and invertebrate drift due to spill in Lower Granite, Little Goose, and Lower Monumental Reservoirs.

North Fork Coeur d'Alene Cutthroat/habitat relationship.

Ted C. Bjornn - Principal Investigator

Effect of Hatchery Supplementation on Stock Productivity and Performance.

Passage of Adult Chinook Salmon and Steelhead at the Lower Snake River Dams and Reservoir Projects and into the Tributaries

Evaluation of Adult Salmon and Steelhead Migration Past Dams and Through Reservoirs in the Lower Columbia River and into Tributaries - Phase 2, 3

Substrate Composition and Trout Survival Relationships.

Synthesis of information on Snake River salmon and wild trout management.

Evaluation of Adult Chinook Salmon Passage at Priest Rapids dam in relation to orifice gate-closures.

Adult salmon and steelhead migration past dams in relation to surface bypass systems for smolts.

Monitoring and evaluation of fall chinook salmon supplementation in the Snake River.

Jim L. Congleton - Principal Investigator

Etiology and Control of Bacterial Kidney Disease in Cultured Salmon.

Development of Methods of Control of Infectious Hematopoietic Necrosis Virus in Commercially Reared Salmonid Fishes.

Evaluation of Facilities for Collection, Bypass, and Transportation of Outmigrating Salmonids.

Evaluation of the procedures for collection, bypass, and downstream passage of outmigrating salmonids - Phase 1

Evaluation of the procedures for collection, bypass, and downstream passage of outmigrating salmonids - Phase 2.

Evaluation of the effects of descaling on short-term survival of migrating juvenile salmonids - year 2.

Evaluation of the effects of descaling on short-term survival of migrating juvenile salmonids - year 3.

Development of design criteria to improve wet separator efficiency and reduce delay of fish in areas of accelerating flows.

Increased Smolt Viability.

George Labar - Principal Investigator

Bull Trout Redd Count Evaluations

Kirk Lohman - Principal Investigator

Juvenile salmon migration feasibility study, Lower Snake River, Washington.

Christine Moffitt - Principal Investigator

FDA Approved Registration of Erythromycin for Treatment of Bacterial Kidney Disease.

Dennis Scarnecchia - Principal Investigator

Habitat use and population dynamics of benthic fishes along the Missouri River, 1996.

FISH INTERACTIONS IN LOWER GRANITE RESERVOIR, IDAHO/WASHINGTON, 1995

Principal Investigator: D. H. Bennett
Funding Agency: U.S. Army Corps of Engineers
Completion Date: 9/30/96
Cost-to-Date: \$277,273

Objectives: 1) To qualify and quantify the predatory influence of smallmouth bass on juvenile chinook salmon in Lower Granite Reservoir; 2) To determine habitat use, fish species associations and overlap in shallow water habitat in Lower Granite Reservoir; 3) To identify factors affecting the abundance of northern squawfish and smallmouth bass in Lower Granite Reservoir; 4) To evaluate food and feeding guilds for resident and juvenile anadromous salmonid fishes in Lower Granite Reservoir; and 5) To determine habitat use and role of crayfish in the Lower Granite Reservoir system.

Progress: We assessed spatial differences in consumption of juvenile salmonids by collecting smallmouth bass (*Micropterus dolomieu*) stomachs from four areas within Lower Granite Reservoir. We examined smallmouth bass stomachs from April through November 1995. Consumption within the reservoir ranged from 0.14 to 0.93 smolts/smallmouth bass/month. The highest consumption (0.93) of juvenile salmonids occurred in the forebay of Lower Granite Dam, followed by the mid-reservoir stratum (0.28). Consumption of salmonids varied monthly for the three size classes of bass examined. Lower juvenile salmonid consumption rates in 1995 are most likely the result of higher flows, increased turbidity, and lower water temperatures.

Small substrata (<2.0mm), presence of aquatic macrophytes, shallow depths, and increased temperatures were habitat characteristics important to northern squawfish, chiselmouth, (*Acrocheilus alutaceus*), (*Lepomis* spp.), (*Pomoxis* spp.), and yellow perch (*Perca flavescens*) during the summer based on analysis using canonical correspondence. Smallmouth bass and bridgelip sucker (*Catostomus columbianus*) were collected in higher abundance in larger substrata (<50.0mm), deeper depths and increased slopes. Small sized substrata, shallow depths and decreases slopes were important during spring 1995 to a majority of the fishes. The lower classification rates for the key species and species complexes examined in Lower Granite Reservoir during summer and fall 1994 and spring 1995 maybe a result of these fishes being habitat generalists or not saturating suitable habitats.

Northern squawfish compose approximately 8.5% of the fish community in the reservoir and consume an estimated 128,000 salmonid smolts annually during the peak migration interval. Strong year classes of larval fishes were produced under reservoir operations at minimum operating pool in 1991 and 1992. We used key factor analysis to create predictive equations for survival of larval and juvenile squawfish in Lower Granite Reservoir. We have shown that duration and timing of temperatures > 15° C are important in predicting survival of juvenile squawfish, whereas density dependence and overwintering conditions are not important components of annual survival.

Laboratory analysis of contents from stomach samples is being conducted to evaluate food and feeding guilds for resident and juvenile anadromous salmonid fishes in Lower Granite Reservoir.

Data analysis is being conducted to determine habitat use and role of crayfish in the Lower Granite Reservoir system.

FISH INTERACTIONS IN LOWER GRANITE RESERVOIR, IDAHO/WASHINGTON, 1996

Principal Investigator: D. H. Bennett
Funding Agency: U.S. Army Corps of Engineers
Completion Date: 3/31/97
Cost-to-Date: \$39,276

Objectives: 1) To assess the magnitude and location of predation on subyearling chinook salmon in Lower Granite Reservoir; 2) To evaluation biotic and abiotic factors affecting subyearling chinook salmon abundance in Lower Granite Reservoir; and 3) To assess habitat use of subyearling chinook to estimate the rearing potential of Lower Granite Reservoir.

Progress: Approval for start of this project received 9/96.

EVALUATION OF THE SUBSTRATE QUALITY IN THE SNAKE RIVER FOR EMBRYO INCUBATION OF FALL CHINOOK SALMON - FALL 95

Principal Investigator: D. H. Bennett
Funding Agency: National Biological Service/Northwest Biological Science Center
Completion Date: 8/14/96
Cost-to-Date: \$28,541

Objectives: 1) Characterize the substrate used for spawning by fall chinook salmon in the flowing portion of the Snake River; and 2) Estimate emergence success of fall chinook salmon embryos in hatching troughs using substrate representative of the flowing portion of the Snake River.

Progress: We evaluated spawning substrate quality for fall chinook (*Oncorhynchus tshawytscha*) from four known spawning locations (river kilometers, RK, 245.1, 259, and 261.3) from the free-flowing reach of the Snake River. Additionally, eight gravel-sand compositions, representative of potential spawning gravels in the Snake River, were used in laboratory troughs to determine emergence success. Mean percent fine substrate particles < 0.85 mm was highest at RK 245.1 (8.5%) and lowest at RK 259 (5.03%). The geometric mean and mean fredle index values were highest at RK 259 ($dg = 26.94$ and $f_i = 11.28$) and lowest at RK 245.1 ($dg = 17.68$ and $f_i = 5.89$). In the laboratory, eyed-fall chinook embryos were placed into gravel filled troughs where dissolved oxygen, temperature, and velocity were monitored. We found an inverse relationship between the amount of fine sediment (<6.4mm) in the troughs and the number of emerging fry. The mean percent survival to emergence was 78.5% in substrata with the least amount of fines, and survival to emergence decreased as the amount of fine sediment increased. Indices of 0.85 and 6.4 mm were used to assess spawning gravel quality, and results from our trough experiments indicate incubation and emergence success of fall chinook in the Snake River should not be impacted by substrate composition. Presently, we are concluding our work on substrate determination and conducting a trough experiment using green eggs to determine emergence success.

DWORSHAK RESERVOIR RESIDENT FISH RE-EVALUATION STUDY

Principal Investigator: D. H. Bennett
Funding Agency: U.S. Army Corps of Engineers
Completion Date: 9/30/96
Cost-to-Date: \$22,727

Objectives: 1) To assess the need for changes in mitigation strategy for resident fishes in Dworshak reservoir; and 2) To prepare a report on mitigation analysis of resident fishes in Dworshak Reservoir.

Progress: We reviewed existing information on Dworshak Reservoir with emphasis on water management effects on resident fishes and their fisheries. Reservoir management for flood control and electrical power production prior to 1992 likely resulted in high entrainment of kokanee *Oncorhynchus nerka* and possibly rainbow trout *O. mykiss* which may congregate near the dam in winter. Since 1992, summer releases reduced the required winter spill which, in conjunction with use of selector gates, has limited winter kokanee entrainment and resulted in record high adult densities (69/ha) but decreased adult size. Estimated survival from ages 0 to 1 and from ages 1 to 2 was significantly correlated to annual discharge. When discharge is partitioned by season, kokanee survival for ages 1 to 2 was better predicted by January-March mean daily releases ($r = -0.92$) than other seasons. Spring flow augmentation April-May may improve survival of juvenile steelhead and spring/summer chinook salmon *O. tshawytscha* migrating downstream although spring releases probably benefit steelhead more than chinook salmon. Summer releases from the reservoir may impact smallmouth bass *Micropterus dolomieu* and rainbow trout fisheries in the reservoir by further reducing the limited food supply. Evidence exists that cool summer releases may enhance downstream survival of juvenile fall chinook salmon. Water management is having a significant affect on resident fisheries, but managers need to address the issue of declining reservoir productivity and retain the limited food supply and nutrient levels before emphasis can be placed on intensive fisheries management.

**BENTHIC INVERTEBRATE DIVERSITY AND ABUNDANCE ON SOFT AND HARD
SUBSTRATE HABITATS AND INVERTEBRATE DRIFT DUE TO SPILL IN LOWER GRANITE,
LITTLE GOOSE, AND LOWER MONUMENTAL RESERVOIRS**

Principal Investigator: D. H. Bennett
Funding Agency: U.S. Army Corps of Engineers
Completion Date: 9/30/96
Cost-to-Date: \$145,454

Objectives: 1) To describe the benthic macroinvertebrate community of hard substrata in Lower Granite, Little Goose, and Lower Monumental reservoirs; 2) To obtain indices of abundance of the benthic macroinvertebrate community of hard substrata in Lower Granite, Little Goose, and Lower Monumental reservoirs; 3) To assess seasonal indices of abundance of the benthic macroinvertebrate community of hard substrata in Lower Granite, Little Goose, and Lower Monumental reservoirs; 4) To qualify benthic macroinvertebrate drift in the tailraces of Lower Granite, Little Goose, and Lower Monumental reservoirs; 5) To assess temporal variation in tailwater of Lower Granite Dam; and 6) To quantify shoreline benthic macroinvertebrate drift in the tailwater of Lower Granite Dam.

Progress: We evaluated the benthic macroinvertebrate community residing on hard substrate in Lower Granite Reservoir from August 1993 through September 1995 using barbecue basket samplers filled with artificial substrate (concrete cones) in shallow (ca. 1.7m) and deep (ca. 8m) waters. The amphipod *Corophium* was the most prevalent in both numbers and biomass for the period of sampling. Midge larvae (*Chironomidae*), caddisfly larvae (*Trichoptera*), and gammarid amphipods showed the greatest seasonal differences in numbers and biomass. Average density (ca. 430/m²) and biomass (ca. 0.6 g/m²) decreased from upstream to downstream. Average density was higher in shallow waters, while average biomass was generally higher in deep waters. Seasonality in density and biomass showed increases in spring and decreases in the early winter. Field studies to qualify benthic macroinvertebrate drift in the tailraces of Lower Granite, Little Goose, and Lower Monumental reservoirs continue this spring and summer. Data from this work will be used to assess temporal variation in the tailwater of Lower Granite Dam and to quantify shoreline benthic macroinvertebrate drift in the tailwater of Lower Granite Dam.

NORTH FORK COEUR D'ALENE CUTTHROAT/HABITAT RELATIONSHIPS

Principal Investigator: D. H. Bennett
Funding Agency: Idaho Department Fish and Game
Completion Date: 12/31/96
Cost-to-Date: \$6,314

Objectives: 1) To evaluate the effects of land management activities on westslope cutthroat trout in the Coeur d'Alene.

Progress: Field work is near completion. Data is presently being entered and initial analysis has begun.

EFFECT OF HATCHERY SUPPLEMENTATION ON STOCK PRODUCTIVITY AND PERFORMANCE

Principal Investigator: T. C. Bjornn
Co-Principal Investigator: S. Rubin
Funding Agency: U.S. Fish And Wildlife Service/
Pacific Northwest Natural Science Center
Completion Date: 12/31/98
Cost-to-Date: \$206,543

Objectives: 1) Compare the growth and survival of genetically marked offspring from local wild steelhead and from hatchery steelhead in two tributaries of the Lochsa River; 2) Compare the growth and survival of genetically marked offspring from local wild steelhead and from hatchery steelhead in hatchery ponds at Dworshak NFH and Carson NFH; 3) Compare the growth and survival, in streams and in a hatchery, of juvenile spring chinook salmon from Warm Springs NFH with that from Carson NFH and the Warm Springs River; and 4) Test for selection on genetic marks by comparing the growth and survival of juvenile fish with the different genotypes rearing together in natural streams and in hatcheries.

Progress: This study is in its fifth year. In spring 1992, 1993, 1994, and 1995 we spawned wild and hatchery adult steelhead to create genetically marked groups of HxH, HxW (1995 only), and WxW offspring. Wild adults were trapped at Fish Creek in 1992 and 1993 and at Selway Falls in 1994 and 1995. Hatchery adults were obtained from Dworshak National Fish Hatchery (Dworshak NFH). In 1992 and 1993, a portion of the WxW and HxH offspring were outplanted as unfed fry in Brushy Fork Creek (Lochsa River drainage) and the rest were reared at Dworshak NFH on a one-year rearing program. In 1994, a portion of the WxW and HxH offspring were outplanted as unfed fry in Brushy Fork Creek (Lochsa River drainage) and the rest were reared at Dworshak NFH on a one-year rearing program. In 1994, a portion of the WxW and HxH offspring were outplanted as unfed fry in Crooked River and Twentymile Creek (South Fork Clearwater River drainage) and the rest were reared at Clearwater Hatchery on a two-year rearing program. In 1995, some of the WxW, HxW, and HxH offspring were outplanted as unfed fry in Twentymile Creek. Some were reared at Clearwater Hatchery on a two-year rearing program, and some were reared at Dworshak HFH on a one-year rearing program. Fish residing in the study streams are sampled annually in late summer, and outmigrants are trapped in spring and fall. Fish rearing in the hatchery are sampled in the spring just prior to their release from the hatchery as smolts.

PASSAGE OF ADULT CHINOOK SALMON AND STEELHEAD AT THE LOWER SNAKE RIVER DAM AND RESERVOIR PROJECTS

Principal Investigator: T. C. Bjornn
Student Investigators: Ken Tolotti; Pat Kinery
Funding Agency: U.S. Army Corps Of Engineers
Completion Date: 9/30/96
Cost-to-Date: \$2,962,260

Objectives: 1) Determine the effects of zero flow at night on migration rates, and on the proportion of adult steelhead passing each dam, entering the fisheries, and returning to hatcheries; 2) Determine the effects of quantity of spill and the patterns of spill on the rate of passage, fishway entrance use, and fallback by adult spring and summer chinook salmon at the four lower Snake River dams; 3) Evaluate the effectiveness of picketed leads installed in the fishways at Little Goose and Lower Granite dams for reducing the rate of fallout by adult salmon and steelhead at the fishway entrances; 4) Assess the fishway entrance preferences of adult salmon and steelhead at Lower Granite and Little Goose dams under various conditions of flow, spill, and powerhouse operation; 5) Assess the rate of adult salmon and steelhead migration up the lower Snake River under various, normally occurring conditions of flow, spill, powerhouse operation, and season of the year; 6) Assess the rate and route of fallback of adult salmon and steelhead over or through the lower Snake River dams under various conditions of spill, flow, powerhouse operation, and season of year; 7) Determine the effects of selected in-river activities (yet to be defined) on the upstream migration of salmon and steelhead; and 8) Determine the timing of migration, migration rates, distribution of fish, and survival rates of salmon and steelhead after they leave Lower Granite Dam.

Progress: The field work on this project is completed. We continue to analyze the data working toward the final report.

EVALUATION OF ADULT SALMON AND STEELHEAD MIGRATION PAST DAMS AND THROUGH RESERVOIRS IN THE LOWER COLUMBIA RIVER AND INTO TRIBUTARIES - PHASE 2, 3

Principal Investigator: T. C. Bjornn
Funding Agency: U.S. Army Corps of Engineers
Completion Date: 6/30/97
Cost-to-Date: \$535,472

Objectives: 1) Prepare final work plan for field work to be conducted in 1996; 2) Complete testing of potential receiver sites and antenna setups at each of the dams to determine how and where adequate transmitter signal reception can be obtained; 3) Complete installation of radio telemetry equipment, as needed, at each of the dams and the mouths of tributary streams; 4) Complete preparation of protocols and computer programs for processing fish movement data downloaded from receivers; 5) Capture, tag and track adult salmon and steelhead at the lower Columbia and Snake River dams; and 6) Begin processing and analyzing fish movement data and prepare data summaries and a report.

Progress: In 1996, we entered the first year of monitoring salmon and steelhead movements in the Lower Columbia River. The 1996 field work plan was completed, and new antenna and receiver sites were tested and installed at Bonneville, The Dalles, John Day, and McNary dams, and at major tributary rivers. A total of 81 receiver sites were established, with special emphasis placed at Bonneville and McNary dams. Additional receiver sites were maintained at Snake River dams and tributary streams. Management of data for this project will be handled jointly by Idaho Cooperative Unit and the National Marine Fisheries Service. Data collection, storage, and analysis protocols and procedures were jointly developed.

Tagging of chinook salmon at Bonneville Dam began 4 April 1996 and continued until 27 June 1996. A total of 853 spring and summer chinook salmon were tagged. Tagging of steelhead began at Bonneville Dam on 17 June, and will continue until the middle of October. A total of 700 to 800 steelhead will be outfitted with radio transmitters in 1996. Data from the movement of radio-tagged salmon and steelhead are collected and processed at receiver sites at lower Columbia and Snake river dams. In addition, trucks and boats equipped with antenna and receivers are used to collect information on fish movement in sections of rivers between receiver sites. Movement of tagged salmon and steelhead in the Columbia River between release sites and Bonneville Dam (approximately 8km) have been monitored to determine if fish taken from the north-shore trapping facility are an unbiased sample of the run. We are in the initial stages of analyzing and summarizing the 1996 fish movement data. Data will be used to assess time required by salmon and steelhead to migrate over dams and through reservoirs, and to evaluate how fish use entrances and fishways at dams.

SUBSTRATE COMPOSITION AND TROUT SURVIVAL RELATIONSHIPS

Principal Investigator: T. C. Bjornn
Student Investigator: Laura M. Garman
Funding Agency: USDA Forest Service
Completion Date: 5/31/97
Cost-to-Date: \$30,000

Objectives: 1) Design and conduct laboratory tests at such a level of statistical rigor that hypotheses can be accepted or rejected with a high degree of confidence; and 2) Collect and analyze resulting data to describe the following: a) relations among light, temperature, food abundance, predators, and use of substrate-cover by bull trout, accounting for the confounding effects of these variables, and b) relations between fine sediments and cutthroat trout survival during incubation and overwintering conditions that can be reliably used by decision-makers to establish threshold levels of sediment for protecting trout habitat and for setting goals for land-use management in geologic areas that produce large amounts of very fine sediment when disturbed.

Progress: Data has been collected and analyzed and final project completion report is being prepared.

SYNTHESIS OF INFORMATION ON SNAKE RIVER SALMON AND WILD TROUT MANAGEMENT

Principal Investigator: T. C. Bjornn
Funding Agency: National Biological Service
Completion Date: 6/30/99
Cost-to-Date: \$61,045

Objectives: 1) To prepare a book-length manuscript on the biology, management, 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: Outlines of books have been prepared and collection of historical data has been initiated.

EVALUATION OF ADULT CHINOOK SALMON PASSAGE AT PRIEST RAPIDS DAM IN RELATION TO ORIFICE-GATE CLOSURES

Principal Investigator: T. C. Bjornn
Funding Agency: Grant County Washington, PUD
Completion Date: 12/31/96
Cost-to-Date: \$63,760

Objectives: 1) To evaluate the passage of adult chinook salmon at Priest Rapids Dam with the collection channel's submerged orifice-gates open versus closed.

Progress: Adult chinook salmon with radio transmitters were monitored as they passed Priest Rapids Dam from April-August, 1996 via receivers installed throughout the dam. We have assembled the data and are presently evaluating 1) the path taken by each fish over the dam, and 2) the time for each fish to pass the dam as a function of orifice gate status. We're additionally examining these data to assess the frequency of fallbacks and to evaluate fish migration within the area of the junction pool.

ADULT SALMON AND STEELHEAD MIGRATION PAST DAMS IN RELATION TO SURFACE BYPASS SYSTEMS FOR SMOLTS.

Principal Investigator: T. C. Bjornn
Funding Agency: U.S. Army Corps of Engineers
Completion Date: 12/31/96
Cost-to-Date: \$249,620

Objectives: 1) Finalize a work plan for field work in 1996; 2) Install radio telemetry equipment, as needed, at each of the dams; 3) Trap and tag squawfish as needed to monitor fish movements in the vicinity of the surface collector, and estimate abundance and food consumption; 4) Monitor movements and behavior of adult salmon in the forebays of Ice Harbor and Lower Granite dams in 1996; and 5) Analyze data on fish movements, flows, and temperatures in relation to surface collection facilities, and spill, and prepare report.

Progress: Northern squawfish were outfitted with radio transmitters in the forebay and tailrace of Lower Granite Dam beginning in early April. Efforts to collect squawfish in the forebay of the dam met with limited success possibly due to high flows and low water temperatures during the collection period. Five squawfish were captured and tagged in the forebay of Lower Granite Dam. Forty-two squawfish were captured and tagged in the tailrace of the dam. Tagged fish were monitored for distribution and movements throughout the smolt migration season. Data are being analyzed to attempt to determine the relationship between squawfish movements and operation of the surface bypass collector, spill, and flow.

Adult chinook salmon were outfitted with radio transmitters at Bonneville Dam in 1996 and monitored throughout their migration. Intensive mobile tracking efforts were conducted as they passed through the forebays of Ice Harbor and Lower Granite dams. Thirty-nine chinook were tracked in the Ice Harbor Forebay. Forty-three chinook were monitored during their migration through the Lower Granite Forebay. Data are being analyzed in an effort develop a baseline for migration behavior through the forebay at Ice Harbor Dam and to determine if movements of adult chinook salmon through the forebay of Lower Granite were affected by the operation of the surface bypass collector.

Temperatures in the forebays and fish ladders at Ice Harbor and Lower Granite dams are being monitored in 1996. Temperature profiles are being taken in the forebay approximately 2000 feet upstream

from the face of each dam on a biweekly basis. Data are being analyzed to determine if either temperature barriers to adult salmonid migration or thermal refuges exist in the forebays of the two dams. Temperatures in the fish ladders are being monitored hourly using temperature recorders. Data are being analyzed to determine if temperature barriers to adult salmonid migration exist in the fishways.

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

Principal Investigator: T. C. Bjornn
Funding Agency: National Biological Service
Completion Date: 12/31/96
Cost-to-Date: \$18,699

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: Objective 1: Natural subyearling fall chinook salmon survival estimates, from the point of release to Lower Granite Dam tailrace, were similar for fish released above the Imnaha River confluence (upstream reach; 0.672, s.e. 0.049) and below the Grande Ronde River confluence (downstream reach; 0.657, s.e. 0.071). Survival to Lower Granite Dam tailrace was lowest for natural fish released in the Clearwater River (0.156, s.e. 0.044). Capture probabilities (analogous to Fish guidance Efficiency) at Lower Granite Dam differed among groups of natural fish released in the upstream (0.530, s.e. 0.043) and downstream (0.446, s.e. 0.056) reaches of the Snake River and the Clearwater River (0.313, s.e. 0.226). Differences in capture and survival probabilities appear to be related to early life history timing; early maturing and emigration populations are guided better by the traveling screens and survive better.

Objective 2. Residualism in 1996 of natural and hatchery fall chinook salmon released in 1995 was low. The percentage of natural residuals was 0.2%, 1.5%, and 0.6% for the upstream reach of the Snake River, downstream reach of the Snake River, and the Clearwater River. A total of 2.4% of hatchery fish released in 1995 were detected in the spring of 1996. For Pittsburg Landing and Billy Creek release groups, the proportion detected in 1996 appeared to be related to date of release; late release groups residualize more. For Asotin release groups, the probability of detection in 1996 appeared to depend on size; fish that were larger at release were more likely to be detected in 1996 than those that were smaller.

Objective 3: We made nine releases of hatchery subyearling fall chinook salmon between late may and early June, 1995. Among release groups of hatchery fish, capture probabilities at Lower Granite Dam were similar, averaging 0.484 across all 9 groups. For hatchery subyearling fall chinook salmon, survival estimates from the point of release to Lower Granite Dam tailrace averaged 0.633 (s.e. 0.023) and 0.611 (s.e. 0.023) for Pittsburg Landing and Billy Creek release groups, respectively, only slightly lower than the corresponding survival estimates for release groups of natural fish. Survival was lower for the Asotin release groups (average 0.448, s.e. 0.040) than for the upstream release groups. Survival estimates for hatchery fish decreased with later release date.

ETIOLOGY AND CONTROL OF BACTERIAL KIDNEY DISEASE IN CULTURED SALMON

Principal Investigator: J. L. Congleton
Funding Agency: Western Regional Aquaculture Consortium
Completion Date: 3/31/97
Cost-to-Date: \$63,337

Objective: Determine if soluble or cell-surface factors produced by *R. salmoninarum* can suppress the bactericidal activity of the salmonid macrophage.

Progress: Macrophages isolated from the anterior kidney of juvenile chinook salmon (*Onchorynchus tshawytscha*) were exposed for 72 h to 0, 10^5 , or 10^6 live or heat killed *Renibacterium salmoninarum* cells per well (96-well microtiter plate) or to 0, 0.1, 1.0, or 10 $\mu\text{g mg}^{-1}$ of *R. salmoninarum* soluble proteins. Following treatment, the bactericidal activity of the macrophages against *Aeromonas salmonicida* was determined. Both the live and heat killed *R. salmoninarum* treatments significantly ($P \leq 0.05$) increased macrophage adherence to microtiter wells, as determined by light microscope observations and protein analysis of adherent cells. Bactericidal activity expressed as percent killing per mg adherent protein was significantly increased after treatment with 10^5 but not 10^6 live or heat killed *R. salmoninarum* cells per well. In contrast, although treatment of macrophages with *R. salmoninarum* soluble proteins also increased adherence at all dose levels, killing per mg adherent protein was significantly decreased at the 10 $\mu\text{g mg}^{-1}$ dose level. These results show that the bactericidal activity of chinook salmon macrophages against *A. salmonicida* is stimulated by exposure to *R. salmoninarum* cells at lower dose levels, but inhibited by exposure to *R. salmoninarum* cells at higher dose levels, but inhibited by exposure to the soluble proteins produced by *R. salmoninarum*. A manuscript reporting the results of this study has been submitted for publication.

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

Principal Investigator: J. L. Congleton
Funding Agency: Western Regional Aquaculture Consortium
Completion Date: 3/31/98
Cost-to-Date: \$161,850

Objectives: Develop means for inducing non-specific immunity to IHNV in rainbow trout. 1) Determine ability of non-specific resistance modifiers to induce resistance to IHNV *in vivo* and *in vitro*; 2) Investigate the genetics of interferon in fish and develop detection methods; and 3) Determine the mechanisms by which a nonpathogenic virus can induce protection to IHNV.

Progress: The hematopoietic tissue of the anterior kidney (AK) of rainbow trout is a target tissue for IHN virus, supporting viral replication by the second or third day of infection. Because the capability of target tissues for production of antiviral (interferon-like) cytokines may be a significant factor in non-specific resistance to IHN, we developed an assay for *in vitro* production of interferon-like activity by trout AK cells. The assay was used to study the induction of antiviral activity by IHN virus.

Similar titers of interferon-like cytokines were produced by trout AK leucocytes following stimulation by free infectious IHN virus or by cell-membrane associated (CMA) inactivated IHN virus. Therefore, internalization of IHN virus was not required for production of antiviral cytokines by responding cells. The resistance of the free virus-induced antiviral activity to treatment pH2 was significantly higher than that of the CMA virus-induced activity, suggesting that the two forms of the virus-induced different cytokines, or the same cytokines in different proportions.

Although most mammalian cell types are capable of producing type I interferon when stimulated by viruses, macrophages are especially proficient interferon producers. We found this to also be true of rainbow trout macrophages: enrichment of trout leucocyte cultures for macrophages, but not for neutrophils or lymphocytes, resulted in a significant increase in the antiviral response to both IHN virus and to the synthetic interferon inducer Poly I:C. These results indicate that macrophages are responsible for much of the interferon-like activity produced by anterior kidney leucocytes of rainbow trout. The capacity of macrophages for production of antiviral cytokines may be a significant factor in nonspecific resistance to the virus *in vivo*.

A manuscript reporting the results of this study is in press (Diseases of Aquatic Organisms).

EVALUATION OF FACILITIES FOR COLLECTION, BYPASS AND TRANSPORTATION OF OUTMIGRATING CHINOOK SALMON

Principal Investigators: J. L. Congleton, C. B. Schreck
Funding Agency: U.S. Army Corps of Engineers
Completion Date: 3/31/97
Cost-to-Date: \$350,783

Objectives 1) Review existing literature concerning the effects of collection, handling, and transportation on the stress response and performance of salmonid fishes; 2) Investigate the possible stress response of spring chinook salmon to bypass and collection elements at key Snake and Columbia river dams; 3) Investigate the possible stress associated with spring chinook transport systems and performance of the fish post-release; and, 4) Conduct on-site testing as necessary to assess current facility operations and to evaluate methods to reduce the deleterious effects of collection, handling, and transportation on chinook salmon.

Progress: Migrating smolts entering fish collection facilities at hydroelectric dams on the Snake River are subsampled at regular intervals throughout the day for determination of species and wild or hatchery origin. The fish must be anesthetized prior to examination, a potentially stressful or lethal procedure. Studies were undertaken in 1995 to determine optimum anesthesia doses and exposure times.

Comparison of the effects of MS-222 and benzocaine doses selected to produce deep anesthesia (loss of equilibrium) at similar rates (63 ppm MS-222 and 32 ppm benzocaine) indicated no differences in post-recovery cortisol or chloride concentrations, ventilation rates, or median recovery times for either chinook salmon or steelhead. Under the conditions tested, the two chemicals appeared to be equally effective and safe.

Exposure to doses of 45 and 60 ppm MS-222 resulted in some mortality (5 and 10%) of chinook salmon after 9 min (but not 3 min) exposure. Osmoregulatory function (indicated by plasma chloride concentrations) in both species was unaffected by dose and duration of exposure. We found no evidence of sub-lethal physiological effects that might compromise the viability of smolts exposed to higher doses of MS-222 or longer durations of anesthesia. Therefore, monitoring of fish mortality rates in the daily sample recovery tank should be an adequate method for determining when adjustment of anesthetic dose or duration of exposure is needed. MS-222 doses resulting in some mortality after 9 min exposure (45 and 60 ppm) are representative of the range of doses routinely used by SMP, indicating that it is unsafe to extend exposure times to 9 min.

As water temperatures increased from 10 to 19 C at the fish collection facility, recovery times decreased and plasma cortisol and ventilation rates increased. These results indicate that a fixed dose of MS-222 (45 ppm in this trial) is less effective at higher than at lower temperatures. The working dose of anesthetic can be increased at higher temperatures to maintain the desired plane of anesthesia, but the margin of safety will be narrowed. Under these conditions, it may be particularly important to limit the duration of exposure to 3-4 min.

EVALUATION OF PROCEDURES FOR COLLECTION, BYPASS AND TRANSPORTATION OF OUTMIGRATING CHINOOK SALMON - PHASE 1

Principal Investigators: J. L. Congleton, C. B. Schreck
Funding Agency: U.S. Army Corps of Engineers
Completion Date: 9/30/96
Cost-to-Date: \$42,712

Objectives: 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; and 3) Prepare report of preliminary results; present results at Annual Research Review Meeting of Corps of Engineers.

Progress: Little baseline information is available on the response of wild chinook salmon or steelhead smolts to collection and transportation from the Snake River fish facilities. Although previous studies have examined the response of migrating smolts to transportation, 1993 was the first year that hatchery smolts were fin-clipped so that they could be distinguished from wild fish. Because of concern about minimizing transportation effects on wild fish, it is important to determine if the responses of wild and hatchery fish to collection and transportation differ. In addition, information on the physiological function and health status of wild and hatchery fish arriving at the Snake River dams may provide insight into physiological or nutritional deficiencies of hatchery-reared fish and suggest improvements in hatchery rearing practices.

Data collected in 1993, 1994, and 1995 indicated that wild and hatchery chinook salmon smolts differ in stress and smoltification indices, organ weights, and muscle and liver energy reserves. Wild and hatchery fish respond differently to collection procedures, and physiological indices in both groups change during the course of the outmigration in ways that are somewhat consistent from year to year. These data help to explain previous observations of high variation in physiological indices among groups of smolts sampled at the fish collection facilities at different times during the spring. Sampling in 1995 indicated that stress indices are similar in wild and hatchery fish transported from Lower Granite Dam to Bonneville Dam by barge, with both groups showing partial or complete recovery except during the peak outmigration, when stress indices remained elevated.

EVALUATION OF THE PROCEDURES FOR COLLECTION, TRANSPORTATION, AND DOWNSTREAM PASSAGE OF OUTMIGRATING SALMONIDS - PHASE 2

Principal Investigator: J. L. Congleton
Funding Agency: U.S. Army Corps of Engineers
Completion Date: 12/31/96
Cost-to-Date: \$21,001

Objectives: 1) Determine the cumulative physiological response to passage through multiple dams; 1) Analysis of blood and tissue samples taken.

Progress: Little baseline information is available on the response of wild chinook salmon or steelhead smolts to collection and transportation from the Snake River fish facilities. Although previous studies have examined the response of migrating smolts to transportation, 1993 was the first year that hatchery smolts were fin-clipped so that they could be distinguished from wild fish. Because of concern about minimizing transportation effects on wild fish, it is important to determine if the responses of wild and hatchery fish to collection and transportation differ. In addition, information on the physiological function and health status of wild and hatchery fish arriving at the Snake River dams may provide insight into physiological or nutritional deficiencies of hatchery-reared fish and suggest improvements in hatchery rearing practices.

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EVALUATION OF THE EFFECTS OF DESCALING ON SHORT-TERM SURVIVAL OF MIGRATING JUVENILE SALMONIDS - YEAR 2

Principal Investigators: J. L. Congleton
Funding Agency: U.S. Army Corps of Engineers
Completion Date: 9/30/96
Cost-to-Date: \$91,989

Objectives: 1) Determine the response of migrating fish to descaling; and 2) Determine the rate at which descaled fish recover ability to resist stress-related osmotic disturbance; and 3) Determine if certain enzymes are elevated by descaling, stress, or strenuous exercise.

Progress: Concentrations of transaminase enzymes (alanine aminotransferase, aspartate aminotransferase) in the blood of chinook salmon and steelhead smolts obtained from the daily sample at Lower Granite Dam were elevated in proportion to the degree of descaling. Elevation of transaminase concentrations indicates leakage from cells, usually as a consequence of tissue damage. This suggests that scoring of descaling severity may provide a reasonably accurate index of overall recent physical traumata in the collection system, including internal damage (muscle or organ bruising, etc.) not directly detectable by visual inspection.

A correlation between descaling and internal injuries was shown directly by performing necropsies on descaled and non-descaled juvenile chinook salmon and steelhead trout collected at Lower Granite Dam. Most injuries consisted of bruising of the muscle tissue. In non-descaled chinook salmon smolts, only 8.3% of individuals showed evidence of internal damage, but in smolts with more than 10% of the body surface descaled, 26.9% of individuals showed signs of damage. In steelhead smolts, 13% of non-descaled fish had muscle or organ damage compared with 29.5% of descaled (> 10% scale loss) individuals.

Chinook salmon and steelhead smolts partially descaled in the collection system at the Lower Granite facility were individually identified with visual implant tags and held in tanks for two to three weeks of observations. The descaled areas on these fish usually began to heal without overt signs of infection. A few fish were infected by fungus, which almost always first appeared on the fins rather than the body. Most fish that developed fungus infections subsequently died.

EVALUATION OF THE EFFECTS OF DESCALING ON SHORT-TERM SURVIVAL OF MIGRATING JUVENILE SALMONIDS - YEAR 3

Principal Investigator: J. L. Congleton
Funding Agency: U.S. Army Corps of Engineers
Completion Date: 12/31/96
Cost-to-Date: \$14,819

Objectives: 1) Perform laboratory experiments to determine effect of smoltification on response of steelhead trout of descaling; 2) Perform laboratory and field experiments to determine effect of location and extent of scale loss on physiological response of steelhead trout; 3) Perform experiments to correlate descaling injury with alternative measures of physical damage; 4) Stain skin samples; and 5) Analyze plasma samples.

Progress: Concentrations of transaminase enzymes (alanine aminotransferase, aspartate aminotransferase) in the blood of chinook salmon and steelhead smolts obtained from the daily sample at Lower Granite Dam were elevated in proportion to the degree of descaling. Elevation of transaminase concentrations indicates leakage from cells, usually as a consequence of tissue damage. This suggests that scoring of descaling severity may provide a reasonably accurate index of overall recent physical traumata in the collection system, including internal damage (muscle or organ bruising, etc.) not directly detectable by visual inspection.

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DEVELOPMENT OF DESIGN CRITERIA TO IMPROVE WET SEPARATOR EFFICIENCY AND REDUCE DELAY OF FISH IN AREAS OF ACCELERATING FLOWS

Principal Investigator: J. L. Congleton
Funding Agency: U.S. Army Corps of Engineers
Completion Date: 12/31/96
Cost-to-Date: \$26,092

Objectives: 1) Evaluate response of fish to alternative hydraulic conditions in existing fish separator at Lower Monumental Dam; and 2) Analysis of blood and tissue samples taken.

Progress: Video tapes were made of juvenile salmonids passing through the fish separator at Lower Monumental Dam under several different hydraulic conditions. Video tapes were also made of fish entering the Aqua Life fish pump at Lower Granite Dam. Unit personnel participated in planning workshops for development of new fish separator concepts.

INCREASED SMOLT VIABILITY

Principal Investigator: J. L. Congleton
Funding Agency: Idaho Department of Fish and Game
Completion Date: 6/30/97
Cost-to-Date: \$10,056

Objectives: Convene workshop on nutritional requirements of smolting salmonids. Now planned for late winter 1997; 2) Initiate sampling from 3 or 4 IDFG hatcheries (both anadromous and resident) for comparison of oxidative stress indices.

Progress: Funding and approval for this project received 7/96.

BULL TROUT REDD COUNT EVALUATIONS

Principal Investigator: G. W. LaBar
Funding Agency: Idaho Department of Fish and Game
Completion Date: 6/30/97
Cost-to-Date: \$8,370

Objectives: 1) To evaluate the sampling error of bull trout redd count surveys as currently practiced by the Idaho Department of Fish and Game; 2) To test the variability of redd counts taken by a single observer under varying physical conditions; and 3) To suggest ways, if any, of changing the approach Fish and Game currently uses, to reduce the sampling error referred to by Reiman and McIntyre (1996).

Progress: To address the first objective, we will examine redd count data from six streams in the Pond Orielle drainage for which there is a minimum of nine years of counts, as well as several other streams for which the information is more intermittent. The second objective will be addressed by counting the same streams over several days, with varying conditions of light and water clarity. Although final stream selection has not yet taken place, we will probably work on Trestle and Gold Creeks in the Pond Orielle drainage, and then two streams on the St. Joe drainage, if access permits.

Literature Cited

Rieman, B.E. and J.D. McIntyre. 1996. Spatial and temporal variability in bull trout. North American

This new study is just getting under way; we will be carrying out field work in the latter part of September and in October. Mr. Joseph Boneau, a Ph.D. candidate at the UI who has substantial experience with bull trout redd counting will be coordinating and carrying out most of the field work. We have been in touch with Idaho Fish and Game personnel in the Coeur d'Alene office, and will be working with Chip Corsi to coordinate our activities with theirs.

JUVENILE SALMON MIGRATION FEASIBILITY STUDY, LOWER SNAKE RIVER, WASHINGTON.

Principal Investigators: K. Lohman,
Funding Agency: U.S. Army Corps of Engineers
Completion Date: 9/30/96
Cost-to-Date: \$21,231

Objectives: 1) To determine amphibian and reptile species richness in riparian habitats along the Lower Snake River; and 2) To determine the relative abundance of amphibian and reptiles in riparian habitats along the Lower Snake River.

Progress: Site selection and field sampling was begun in September 1995. Drift fences with pitfall traps were installed at 10 riparian sites along the Lower Snake River. Traps were opened for two weeks in October 1995 and checked every third day for amphibians and reptiles. In addition, visual encounter surveys were conducted at 10 sites in October. Eight species of amphibians and reptiles were found during fall sampling. Additional surveys and trapping during 1996 will estimate relative abundance and species richness among-all sites and between riparian and upland sites.

FDA APPROVED REGISTRATION OF ERYTHROMYCIN FOR TREATMENT OF BACTERIAL KIDNEY DISEASE

Principal Investigators: C. M. Moffitt,
Funding Agency: U.S. Fish and Wildlife Service
Completion Date: 12/31/96
Cost-to-Date: \$150,000

Objectives: 1) Analyze data, prepare summaries of analysis of experiments, and submit all necessary data needed to satisfy the requirements of drug registration of erythromycin injectable and feed additive; 2) Follow-up submittals with direct dialog with FDA to clarify necessary elements; 3) Arrange for archival storage of data for the required 5 years post project; and 4) Prepare final reporting for the project.

Progress: We continue final analysis and assembly of data for submission to the U.S. Food and Drug Administration (FDA) on residues, toxicity, efficacy field trials, and environmental assessments. The Principal Investigator (PI) met with FDA's Center for Veterinary Medicine reviewers to discuss the University of Idaho submissions on techniques for analysis of data from residue field trials. We will use meta-analysis to review and examine results from hatchery field trials of feed additive and injectable erythromycin. The average annual amount of active erythromycin base in fish feeds used at all hatcheries participating in INAD 4333 from 1992 to 1994 was 1,593 kg. We have assembled data on replication rates of bacteria from a variety of environments in marine and freshwater ecosystems to demonstrate that the bacterial doubling time increases with decreased temperature. These are somewhat intuitive assumptions, but we refined these relationships into a series of models.

The PI received notification in December that Rhone-Merieux was withdrawing its support of the commercial development of the erythromycin feed additive. The PI immediately began working to assume responsibilities of the manufacturing portion under our INAD until a new source (or manufacturing sponsor) of the drug could be located. Rhone-Merieux will assist this transition and will continue to support the injectable product label.

HABITAT USE AND POPULATION DYNAMICS OF BENTHIC FISHES ALONG THE MISSOURI RIVER, 1996

Principal Investigator: D. Scarnecchia
Funding Agency: U.S. Army Corps of Engineers
Completion Date: 12/31/96
Cost-to-Date: \$80,845

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: We began sampling 22 July and have been alternating weeks between sections. Our field work should be completed mid-September. We have captured 19 species in segment 10 with good numbers of some of our target species being collected. Eighty-seven percent of the total number of fish captured were target benthic fish. We have captured almost 3 times as many fish in segment 12, but only 308 are target benthic fish. We have not taken any fish in the trammel net drifts or the benthic trawls. 602 of the 641 fish (94%) were taken with the bag seine.

Completed Projects - Fisheries Resources

David H. Bennett - Principal Investigator

IDFG-Dworshak Fish Mitigation Study

IDFG-Dworshak Fisheries Evaluation

Projected Effects of Drawdown on Resident Fishes and Shallow Water Habitat in John Day Reservoir

Ted C. Bjornn - Principal Investigator

An Evaluation of Supplementation of Natural Chinook Salmon Stocks.

Dennis Scarnecchia - Principal Investigator

Investigation of Bull Trout (*Salvelinus Confluentus*) Ecology in Tributaries of the South Fork Clearwater River.

Habitat use and population dynamics to benthic fishes along the Missouri River.

DWORSHAK FISH MITIGATION STUDY

Principal Investigator: D. H. Bennett
Funding Agency: U.S. Army Corps of Engineers
Completion Date: 3/15/96
Total Cost: \$23,199

Objectives: 1) To develop a historical perspective on resident fish mitigation; 2) To evaluate the effects of the operations of Dworshak Dam on wildlife and anadromous fishes with emphasis on resident fishes; and 3) To develop a mitigation strategy and plan for resident fishes in Dworshak Reservoir.

Results: A literature review of published and unpublished information about the resident fishery in Dworshak Reservoir was completed. Operations at Dworshak Dam were consistent from the early 1970's and included fall and winter drawdowns that entrained numerous kokanee (*Oncorhynchus nerka*.) In 1991, late summer drawdowns were initiated to improve downstream conditions for returning all chinook salmon. Changes in operations resulted in higher kokanee recruitment to the reservoir and decreasing size but higher catch rates. The change in operations has been considered beneficial for most fishes, although access to the reservoir has been affected by the late summer-fall drawdowns.

We are currently working with biologists from various agencies with interests in the management of Dworshak Reservoir to develop a mitigation strategy that satisfies all interests in the system.

IDFG - DWORSHAK FISHERIES EVALUATION

Principal Investigator: D. H. Bennett
Funding Agency: Idaho Department of Fish and Game
Completion Date: 12/31/95
Total Cost: \$5,500

Objectives: Asses, from existing available information, the effects of various water level management strategies in Dworshak Reservoir on resident fisheries above and below the dam.

Results: Operations at Dworshak Dam have changed as a result of increased flow needs downstream in the Snake and Columbia rivers. We reviewed reports generated by Idaho Department of Fish and Game and verified their interpretation of the effects of the revised water management program on fishes in the reservoir. We also projected effects of a revised operation scenario on fishes and accessibility of the reservoir to both shore and boat fisherman.

AN EVALUATION OF SUPPLEMENTATION OF NATURAL CHINOOK SALMON STOCKS

Principal Investigator: T. C. Bjornn
Student Investigator: Chris A. Peery
Funding Agency: Idaho Department of Fish and Game
Completion Date: 12/31/95
Total Cost: \$259,574

Objective: To determine if natural chinook salmon can be supplemented with hatchery fish without reducing the longer-term productivity of the naturally reproducing stocks.

Results: We completed three years of field data collection for this project in 1994, and the final report has been completed and published as a Coop technical report. We found that under some fish size and density conditions, that interaction between hatchery and natural chinook salmon juveniles can result in negative effects on natural salmon behavior. We also found that natural rainbow and brook trout and hatchery steelhead smolts can effectively prey on hatchery chinook salmon juveniles and can significantly lower their survival and growth rates, especially salmon less than 80mm fork length. Hatchery chinook salmon parr dispersed slowly from release sites in four tributary streams of the Lochsa River, but the distribution and growth of hatchery salmon improved significantly with the use of multiple release sites within streams.

INVESTIGATION OF BULL TROUT (*SALVELINUS CONFLUENTUS*) ECOLOGY IN TRIBUTARIES OF THE SOUTH FORK CLEARWATER RIVER

Principal Investigator: D. Scarnecchia
Student Investigator: R. Spangler
Funding Agency: Idaho Department of Fish and Game
Completion Date: 12/31/95
Total Cost: \$47,747

Objectives: 1) Describe current distribution of bull trout within the Johns Creek and Tenmile Creek drainages; 2) Determine the efficiencies of day versus night snorkeling for bull trout, and; 3) Describe the Autumnal shift in preferred microhabitat characteristics selected by different ages classes of bull trout and cutthroat trout within Moores creek and Tenmile Creek.

Results: Distribution and habitat use of bull trout were studied in four central Idaho streams during the summer of 1992 and 1993. Bull trout occurred from 1,472 to 2,182 m elevation and were sympatric with brook trout, bull trout x brook trout hybrids, and rainbow trout. Water temperatures where bull trout occurred ranged from 0.8 to 20.5 C. Average daily temperatures recorded at fish distribution limits were between 2.0 and 12.0 C. Visual identification of bull trout, brook trout and hybrids were compared with protein gel electrophoresis results. Visual identifications were correct for 94 percent of the 63 fish examined.

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: 12/31/95
Total Cost: \$27,492

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 257 and 210 ft elevation on fishes and associated habitat in John Day Reservoir; 3) To develop recommendations for future studies to provide necessary data and monitor effects of drawdown; and, 4) To prepare a report on the effects of drawdown on water quality and the biota including invertebrates, plankton, and resident and anadromous fishes.

Results: We have reviewed information on the resident fishes in John Day Reservoir and related habitat conditions to various water levels. All resident fishes in the reservoir are introduced and affected by reservoir operations. A thorough examination of factors limiting the abundance of resident fishes was completed using published and unpublished reports. Increased velocities in the reservoir would result from decreased water levels. The greater the drawdown, the higher the velocities. Higher water velocities would decrease recruitment of resident fishes and result in poorer fisheries as a result of reduced recruitment and reduced food abundance to early life history stages.

We are using Geographical Information System to evaluate substrate and the quantity of shallow water habitat under various water levels in John Day Reservoir. Our analysis indicates the upper portion of the reservoir would be reduced to riverine conditions and all of the current shallow water habitat would be eliminated by drawdown.

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

Principal Investigator: D. Scarnecchia
Student Investigator: T. Welker
Funding Agency: U.S. Army Corps of Engineers
Completion Date: 12/31/95
Total Cost: \$13,915

Objectives: 1) To gain information to assist in planning a broader study that will help the Army Corps of Engineers in complying with the Endangered Species Act.

Results: We conducted preliminary work for the Missouri River Benthic Fish Study in the summer and fall of 1995 which included section-segment delineation and macrohabitat quantification and fish sampling.

Section-segment Delineation and Macrohabitat Quantification: The Missouri River in North Dakota can be divided into two sections: the section above Lake Sakakawea and the section below the lake to the headwaters of Lake Oahe. For the purposes of this study, we separated each section into an upper riverine segment and a lower river-lake transition segment. Six macrohabitat types (main channel, outside bend, inside bend, tributary mouth, secondary channel connected, and secondary channel not connected) identified by the Missouri River Benthic Fish Consortium as important ones for fish were enumerated for each segment using aerial videos and USGS maps (scale=1:24000). River sections and segments are the experimental units that will be statistically compared in the study and macrohabitats are the sample unit or replicate.

Fish sampling: In July 1995, we collected benthic fish in main channel, secondary channel connected, and secondary channel not-connected macrohabitats. We used a benthic trawl (0.5-m x 2.0-m frame, chafe net with 4.8mm mesh liner) to sample main channel habitat in the riverine segments above and below Lake Sakakawea. We collected few fish below the lake with the benthic trawl. Forty-eight trawls yielded one johnny darter, one spottail shiner, and one walleye. Greater species richness was found in main channel habitat above Lake Sakakawea, and representatives of the following fish species were collected: sicklefin chub, sturgeon chub, sauger, burbot, stonecat, channel catfish, and sturgeon (*Scaphirhynchus* spp.).

Ongoing Projects - Wildlife Resources

E. O. Garton - Principal Investigator

Mule Deer Ecology

Patricia Heglund - Principal Investigator

Accuracy of Presence Absence Predictions for Terrestrial Vertebrates: Issues of Behavior, Demographics, and Habitat Selection

Jim M. Peek - Principal Investigator

Bighorn Sheep Study at Taylor Ranch

Mule Deer Ecology

Investigating the Biology and Ecology of Reintroduced Wolf Population in Central Idaho

John T. Ratti - Principal Investigator

The Impact of Land-Use Practices on Vertebrates of Western States

Kerry P. Reese - Principal Investigator

Evaluation of Habitat Suitability Index Model for Translocated Sharp-Tailed Grouse

Chukar Ecology

Seasonal Habitat Use, Population Characteristics, and Management of Mountain Quail in North/Central Idaho

Pheasant Ecology

Sharp Tailed Conservation Assessment

Sage Grouse Movements

Sage Grouse Model

Sage Grouse Population Trends

Sage Grouse Ecology

Blue Grouse Ecology

Upper Snake Fire and Sage Grouse

Sage Grouse Survival

J. Michael Scott - Principal Investigator

Gap Analysis: A Guide to Protecting Biodiversity in the United States.

Remote Sensing-Supported Mapping of Vegetation.

Idaho Gap Analysis

Aquatic Gap Analysis.

Setting Conservation Priorities: An Evaluation of Theory and Method

Palouse Bioregion LUHNA Project

Development of a Bioinformation Node in Wyoming: NBS Gap Analysis Program Component

Accuracy of Presence Absence Predictions for Terrestrial Vertebrates: Issues of Scale

Taxonomic and Discipline Review of Ornithological Literature.

Wildlife-habitat relationship models for craig mountain wildlife mitigation area.

MULE DEER ECOLOGY PROJECT

Principal Investigator: E. O. Garton
Funding Agency: Idaho Department of Fish and Game
Completion Date: 9/30/97
Cost-to-Date: \$25,000

Objectives: 1) To determine and compare mule deer fawn mortality rates among three separate winter ranges in Southwest Idaho. 2) To determine the specific causes of mortality; thus evaluating the impacts of predation, early winter fawn weight, nutrition, and weather on fawn survival. 3) To develop a mortality model to potentially predict mule deer fawn susceptibility during winter.

Progress: Sixty-two mule deer fawns were radio-collared in December, 1995. Fifteen of these fawns have died. The number of collared fawns and mortalities within each study area are as follows: Bennett Mountain Study area - 21 collared fawns; 9 mortalities (57% survival), Blacks Creek Study area - 20 collared fawns; 4 mortalities (80% survivals), Owyhee Study area - 21 collared fawns; 2 mortalities (90% survival). Coyote predation on nutritionally stressed fawns represents a majority of the mortalities. Fawns were located 153 times from the ground. From each location, latitude and longitude, elevation, activity, group size, habitat data, and weather data were recorded. Approximately 365 aerial locations have been obtained on the fawns. Flights are usually conducted once a week for each study area. Each of these locations will be associated with a nutritional value derived from nutrition samples. Bitterbrush (*Purshia tridentata*) was randomly from each of the study areas using a simple random sample. In the Bennetts and Owyhees, b samples were obtained from 6 different habitat components totaling 36 samples in each study area. In Black's Creek, 7 samples were obtained from 5 different habitat components totaling 35 samples. Therefore, 107 different bitterbrush samples were collected to be analyzed for percent protein and percent digestibility. In the near future, cheatgrass brome (*Bromus tectorum*) will be randomly sampled from each study area in a similar manner. When the deer have left the winter range, Geographic Information Systems (GIS) data will be developed for each study area.

ACCURACY OF PRESENCE ABSENCE PREDICTIONS FOR TERRESTRIAL VERTEBRATES: ISSUES OF BEHAVIOR, DEMOGRAPHICS, AND HABITAT SELECTION

Principal Investigator: P. Heglund
Funding Agency: National Biological Service
Completion Date: 9/30/98
Cost-to-Date: \$67,000

Objective: 1) To test the accuracy of Gap Analysis project predictions of species occurrence at landscape (Gamma level diversity) and site specific (Alpha level diversity) for northern Idaho.

Progress: Literature search is half way done. Data sets for 200 study sites from the U.S. Forest Service, Region 1 Landbird Monitoring Program as well as 100 study sites from the Northern Idaho Land Bird Project have been acquired and are being evaluated. Results of 142 intensive surveys of land management areas in California for which predictions of species occurrence have been made by the Gap Analysis Program and detailed avian survey results from Craig Mountain Game Management area. Results of all these field surveys findings will be analyzed for behavioral and ecological differences among species at varying levels of spatial and thematic resolution.

BIGHORN SHEEP STUDY AT TAYLOR RANCH

Principal Investigator: J. M. Peek
Funding Agency: Idaho Department of Fish and Game
Completion Date: 6/30/97
Cost-to-Date: \$21,000

Objectives: 1) To determine what naturally regulated bighorn sheep populations are not subject to human interference; and 2) To determine why these sheep occupy a range without overgrazing it.

Progress: Collection of pellets and forage continue to determine what is being eaten and what levels of protein and energy are being acquired. Field work continues with use of Rustrad recorders to obtain activity patterns of radio-collared bighorn. A series of six macroplots with individual plants of all grass species located are being followed at intervals to determine production, phenology, and timing and intensity of grazing. Population data, including distribution numbers and lamb survival, is obtained on a continuing basis.

MULE DEER ECOLOGY PROJECT

Principal Investigator: J. M. Peek
Funding Agency: Idaho Department of Fish and Game
Completion Date: 9/30/96
Cost-to-Date: \$16,500

Objectives: Research has focused on determining mule deer habitat selection patterns relative to: environmental variables, the nutritional value of habitats (quantity and quality), sex and age, season, and to the large scale fire that occurred on the study area during the first field season. GIS generated data is also being incorporated into the data set in order to further investigate landscape level patterns of selection.

Progress: From January 1994 to January 1996, two summer-fall field seasons have been completed. A total of 920 ground locations were obtained during these two seasons. An additional 1650 aerial locations were obtained from January 1993 to January 1996 as a supplement to summer locations and to determine migration patterns. GIS data sets are being created from all deer location home range data. Nutritional analysis lab work on 250 serviceberry samples has also been completed. The data set should be ready for complete analysis by mid-May 1996.

INVESTIGATING THE BIOLOGY AND ECOLOGY OF REINTRODUCED WOLF POPULATION IN CENTRAL IDAHO

Principal Investigator: J. M. Peek
Funding Agency: U.S. Fish and Wildlife Service
Completion Date: 9/30/96
Cost-to-Date: \$10,000

Objectives: 1) Determine home range size and configuration for pairs of wolves which have produced pups; 2) Determine den and rendezvous site characteristics; 3) Determine prey selection of paired, reproducing wolves; 4) Compare characteristics of home range, prey selection, and occupation of wolf pair occupying the North Fork of the Clearwater with a pair occupying the Salmon River drainage; and 5) Develop predictions of wolf occupation of the central Idaho region using GIS-based mapping of terrain, vegetation pattern, and prey distribution.

Progress: Approval for start of this project received 8/96.

THE IMPACT OF LAND-USE PRACTICES ON VERTEBRATES OF WESTERN STATES

Principal Investigator: J. T. Ratti
Funding Agency: National Biological Service
Completion Date: 3/31/97
Cost-to-Date: \$50,000

Objective: 1) To construct a matrix for western vertebrate species of land- use practices that potentially impact population abundance and distribution, and to write a interpretive report from the data.

Progress: Approval for start of this project received 8/96. The review of literature has been initiated.

EVALUATION OF HABITAT SUITABILITY INDEX MODEL FOR TRANSLOCATED SHARP-TAILED GROUSE

Principal Investigator: K. P. Reese
Student Investigator: Scott Gardner
Funding Agency: Idaho Department of Fish and Game
Completion Date: 6/30/97
Cost-to-Date: \$20,800

Objectives: 1) To determine if Columbian sharp-tailed grouse can be successfully reintroduced into areas with suitable habitat, based on the results of the habitat suitability index model developed by Meints et al. (1992), a) determine movement, home range sizes, survival, and reproduction of reintroduced Columbian sharp-tailed grouse, b) test the applicability of the habitat suitability index model to the birds, c) if necessary, modify the existing model to reflect differences in habitats used by reintroduced birds, d) develop management recommendations based on the previous objectives.

Progress: We reintroduced 104 birds (66 males and 38 females), of which 79 (43 males and 36 females) were radio-marked, into the Shoshone Basin of south central Idaho from 1992-1994. We determined survival, productivity, movements, home ranges, and habitat use for the first 17-19 weeks following release. Survival was relatively high for this period in 1992 (0.48) and 1994 (0.67) but was lower in 1993 (0.30) following a hard winter ($p < 0.001$). Cox's proportional hazards regression analysis revealed a negative relationship with flock size and a positive relationship with mean movements and mean distance from the release site. We also tested a recently developed Habitat Suitability Index (HSI) model as a tool for evaluating release habitat. Logistic regression correctly classified 87% of bird use versus random sites with a full model of HSI variables. Additional comparisons between survivors and mortalities at bird use sites correctly classified 92% and 87% of raw data and HSI variables, respectively.

CHUKAR ECOLOGY

Principal Investigator: K. P. Reese
Funding Agency: Idaho Department of Fish and Game
Completion Date: 6/30/97
Cost-to-Date: \$44,400

Objectives: 1) Determine chukar seasonal habitat use, movement patterns, and nesting ecology in west-central Idaho; 2) Assess chukar productivity and mortality; and 3) Develop land-management guidelines that will maintain or enhance chukar habitat and population.

Progress: Thirty-three chukar partridge (*Alectoris chukar*) were trapped between 07 January 1996 and 09 May 1996. Birds were baited into walk-in modified cloverleaf traps, of which 54 were set. Twenty-nine chukar were sexed, banded, and collared with backpack-mounted radio transmitters, while 2 chukars died from depredation in the traps and 2 from handling stress. A modification of a quail restraining device was developed, tested, and proven successful for mounting backpack transmitters on chukars. The use of backpack-mounted radio transmitters proved to be more suitable for chukar partridge than the necklace-mounted transmitters used the previous field season.

Fifty-six percent of radio-collared birds were depreciated, and the survival rate from mid winter to late summer was 32 percent. By mid-August, 7 radioed birds remained in the field. Habitat use data was gathered on 274 bird locations, of which 177 were seasonal flush sites, 46 brood sites, 16 nest sites, and 35 trap sites. Micro-habitat data was gathered on 14 nests.

The availability of yellow starthistle was determined and mapped on 7.5 minute series topographic maps. All data analyses will begin in the Fall of 1996 and should be completed by the summer of 1997.

SEASONAL HABITAT USE, POPULATION CHARACTERISTICS, AND MANAGEMENT OF MOUNTAIN QUAIL IN NORTH/CENTRAL IDAHO

Principal Investigator: K. P. Reese
Student Investigator: Patricia E. Heekin
Funding Agency: Idaho Department of Fish and Game
Bureau of Land Management
Completion Date: 12/31/96
Cost-to-Date: \$100,135

Objectives: 1) Determine seasonal and daily habitat use patterns of mountain quail. Primary focus will be on winter habitat, security cover requirements, nest sites, and brood-rearing habitat; 2) Determine mountain quail seasonal movements and home ranges; 3) Assess mountain quail productivity and mortality; 4) Assess the importance of riparian/brush habitats and the use of such as avenues for dispersal and movement between seasonal habitat use areas. Assess the importance of fragmentation of these "avenue" habitats and the corresponding impacts on isolated mountain quail populations; and 5) Develop management guidelines that will maintain or enhance mountain quail populations and habitat. This will include strategies to restore mountain quail habitat and minimize conflicts with logging, grazing, and other land uses.

Progress: Field work ended in March 1996, completing 60 months of field work, which included collection of data on age and sex ratios, body measurements, movements, productivity, and habitat use in all seasons. During the Fall 1995 trapping session, 72 mountain quail were captured, including the recapture of 7 individuals first captured in a prior trapping period, with an age ratio of 4.5:1 (J:A). While we are able to identify age class (juvenile or adult) in the field by examination of wing features, it is difficult to reliably identify sex by visual examination, particularly in the fall when the birds are molting. Therefore, we collected blood samples, which will be analyzed by a lab with experience in identifying sex of monomorphic birds through DNA hybridization techniques. Sex ratio information will be reported in the final report, after the blood has been analyzed. Selected mountain quail were radio-collared, and relocated on a weekly or bi-weekly basis to collect information on timing and distance of seasonal movements or dispersal, home range, survival, and habitat use patterns. During this period, we completed several hundred locations, often involving more than one bird per location, and including both diurnal and nocturnal locations. At each location information on bird's behavior and covey size, as well as physical and vegetal characteristics was recorded. More detailed physical and vegetal characteristics were measured at nest sites, randomly-selected brood-use sites, covey-use sites, and at randomly-selected independent sites.

Communications and Service Activities: During the past year, I gave presentations related to the mountain quail research project to students in the Wildlife Professions class at the University of Idaho (December 1995); to members of the Mountain Quail Technical Committee (September 1995); at the Idaho Academy of Sciences Annual Meeting in Moscow (April 1996); and at the National Quail Unlimited Convention in Nashville (June 1996). I also reviewed and commented on several documents and plans, prepared press releases, and responded to requests from mountain quail researchers in Oregon and California for miscellaneous information, reports, protocols, and forms, and met with California Fish and Game biologists to discuss trapping methods (November 1995). During this period, I also participated in, or led, mountain quail habitat field trips and field surveys in Idaho and Oregon.

Publications and Reports:

Heekin, P. E., and K. P. Reese. 1995. Validation of a mountain quail survey technique. Unpublished report prepared for Idaho Power Company and Idaho Department of Fish and Game, Boise, and Bureau of Land Management, Cottonwood, Idaho. 49pp.

Heekin, P. E., and C. A. Vogel. 1995. Mountain quail: high jumpers. *Idaho Wildlife, Fall 1995*:2.

Heekin, P. E., C. A. Vogel, and P. Zager. 1995. In quest of the mountain quail. *Idaho Wildlife, Fall 1995*:4-8.

Work Remaining: All field work for this study has been completed. Data entry and analysis remain, as well as writing the thesis, final report, and manuscript(s). I will also investigate further the possibility of using molecular techniques to extract DNA from eggshell membranes, which might be used to determine maternity and paternity. I will give presentations in Grangeville and Riggins in September, participate in the field trip and meeting of the next Mountain Quail Technical Committee (September 1996), and lead a mountain quail field trip for landowners in the Little Salmon River Canyon (November 1996).

PHEASANT ECOLOGY

Principal Investigator:	K. P. Reese
Funding Agency:	Idaho Department of Fish and Game
Completion Date:	6/30/98
Cost-to-Date:	\$109,300

Objectives: 1) To identify research needed to improve pheasant management and enhance pheasant populations in Idaho; 2) Develop techniques or combination of techniques that will ultimately provide landowners and wildlife managers with reliable methods for increasing pheasant populations within the current agricultural systems of southern Idaho; 3) Assess the response of pheasant populations to intensive habitat enhancement efforts; and 4) Document the effects of predator management techniques on pheasant populations.

Progress: The second field season resulted in the capture and radio-marking of 75 pheasants. Depredation due to raptors and canids accounted for the largest percentage of mortalities during the field season. In addition, radio collars were also placed on 6 red fox (*Vulpes vulpes*) in the Gooding County area in an attempt to assess daily movements and food habits. Approximately 1200 total locations were made on the radio-marked pheasants and fox. This year data is currently being entered in spread sheets for future analysis.

SHARP TAILED GROUSE CONSERVATION ASSESSMENT

Principal Investigator: K. P. Reese
Funding Agency: Idaho Department of Fish and Game
Completion Date: 6/30/97
Cost-to-Date: \$14,720

Objective: To develop a Conservation Assessment for Columbian Sharp-tailed grouse in Idaho to aid in their management and restoration.

Progress: A complete Conservation Assessment has been submitted to Idaho Department of Fish and Game for internal review.

SAGE GROUSE MOVEMENT

Principal Investigator: K. P. Reese
Funding Agency: Idaho Department of Fish and Game
Completion Date: 6/30/97
Cost-to-Date: \$5,000

Objective: To assess movements of sage grouse in southeastern Idaho to determine if migration patterns of present birds is consistent with historical movement patterns of the birds in the 1950's.

Progress: The sage grouse population on the Upper Snake River Plain has declined over the past 40 years. We seek to identify causes of this decline and of the subsequent failure of the species to recover. We hypothesize that changes in land use and/or management since 1950 have been detrimental to the birds. Data from radio-collared birds, including movement and habitat use, will be compared to data collected on the study area in the 1950's. We are also conducting lek and brook counts and will compare results to past data. Trends in these and other population indices, including harvest data, will be examined. In addition, we will evaluate changes in land use over time. The study is in its second season, and no conclusions have yet been reached. However, preliminary data indicate that grouse mortality is high, and availability of good, quality habitat may be limiting.

SAGE GROUSE MODEL

Principal Investigator: K. P. Reese
Funding Agency: Idaho Department of Fish and Game
Completion Date: 6/30/97
Cost-to-Date: \$12,000

Objectives: To develop a habitat model for sage grouse addressing yearlong habitat requirements. Our model will relate habitat characteristics to population fitness parameters.

Progress: We will first determine the influence of individual population parameters on lambda (λ), intrinsic rate of increase with a stochastically-generated sensitivity/elasticity analysis. This quantifies relationships between vital rates and λ . The most important vital rates will be related to habitat components. The first model will combine habitat characteristics that predict vital rates and vital rates would predict λ as an estimate of habitat quality.

A review of sage grouse literature to obtain vital rates and habitat relationships is completed. Published estimates of vital rates have been used to parameterize the stochastic model used in the sensitivity analysis. Preliminary results indicate that λ is most significantly influenced by nest success, brood survival, and yearling survival. Relating vital rates to specific habitat variables is underway.

SAGE GROUSE POPULATION TRENDS

Principal Investigator: K. P. Reese
Funding Agency: Idaho Department of Fish and Game
Completion Date: 6/30/97
Cost-to-Date: \$5,000

Objectives: To compile data on lek attendance and distribution, productivity, and survival of sage grouse from the 1950's to the present, in the Upper Snake River Plain of southeastern Idaho. This phase of the project is to document historical trends in sage grouse population overtime.

Progress: Sage grouse (*Centrocercus urophasianus*) are closely tied to sagebrush (*Artemisia* spp.) habitats. Despite the fact that this relationship has been well understood for many years, sagebrush habitats are still being degraded, lost, and fragmented. In the upper Snake River Valley, >76,000 ha of sagebrush were eliminated or badly degraded from 1980-94. Sage grouse were relatively abundant during the 1960's and 1970's but populations declined precipitously in the 1980's and 1990's. Details can be found in "Sage Grouse Population and Habitat Trends in Southeastern Idaho and Southwestern Montana" by Caroline M. Crowley and John W. Connelly. 1996. Idaho Department of Fish and Game. 205pp.

SAGE GROUSE ECOLOGY

Principal Investigator: K. P. Reese
Funding Agency: Idaho Department of Fish and Game
Completion Date: 6/30/97
Cost-to-Date: \$32,400

Objectives: 1) To compile historical data on the study area and on sage grouse within the area to provide a basis for comparison with current data; 2) To determine present seasonal and annual ranges (including winter, breeding, and summer areas) used by a representative sample of this sage grouse population; 3) To describe the amount and quality of seasonal habitats of this population and identify potential problems within these habitats; 4) To document current seasonal migration routes, distances, and timing for this population; 5) To assess current productivity and mortality; 6) To identify factors possibly limiting the sage grouse population through an examination of past and present data; and 7) To use this information to develop management recommendations to help maintain or increase the sage grouse population of the Upper Snake River Plain.

Progress: In 1995, 43 sage grouse were captured and banded, and 28 of these birds received radio collars. These birds were tracked from May through November 1995, and some were located during the 1996 field season as well. In 1996, 29 sage grouse were captured, and 25 of these received radio collars. These birds have been tracked since May 1996, and are still being followed. Vegetation measurements (shrub cover and height, forb and grass cover, grass height) were also taken at nest sites, brood use sites, and randomly selected radio location sites during both field seasons. Four brood count routes were also run in June, July, and August of both seasons. Available historical information has also been collected.

BLUE GROUSE ECOLOGY

Principal Investigator: K. P. Reese
Funding Agency: Idaho Department of Fish and Game
Completion Date: 6/30/98
Cost-to-Date: \$16,400

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; 4) to formulate an elasticity model and substitute data from this study for specific life stages in the model.

Progress: Completed first field season. Captured a total of 45 blue grouse using interception traps and noosing poles. Of these, 25 blue grouse hens and chicks were radio-marked using 10 gram radios with a necklace attachment. These radio-marked birds were located approximately every 2 weeks to determine the number of chicks per brood that survived until mid-August (just prior to the grouse hunting season). In addition, 1 yearling male was also radio-marked and periodically located. At capture and relocation sites vegetation heights, percent cover, grazing intensity (ocular estimate), and dominant shrub and tree species were recorded. This information was also recorded at permanent transects located in different cover types which will be used as reference points.

UPPER SNAKE FIRE AND SAGE GROUSE

Principal Investigator: K. P. Reese
Funding Agency: Idaho Department Fish and Game
Completion Date: 6/30/98
Cost-to-Date: \$15,500

Objectives: To investigate the effects of prescribed fire and wildfire on sage grouse nesting habitat and brood rearing habitat in the Upper Snake River Plain.

Progress: Fourteen different areas were sampled over the course of the summer (June to August 1996). Each area was characterized as either a prescribed burn or a wildfire, and according to the year and season in which it was burnt. Within each burn, four random points were selected and a 50m long vegetation transect was laid at each point, along which % canopy cover, grass height and forb abundance was measured. At the same site, 16 test tubes were sunk into the ground, in a 4x4 grid, to act as pitfall traps for insects. The traps were opened for a 24-hour period and each site was run twice, once in July and once in August. The vegetation transects were run twice, once in June and again at the end of July. Use transects were also run concurrently with the pitfalls. A 100m² area was searched for any sign of sage grouse and sign of any other use was noted (ungulates, sheep, cattle, etc.). Sage grouse sign was removed on the first run to check for new use in the second run.

SAGE GROUSE SURVIVAL

Principal Investigator: K. P. Reese
Funding Agency: Idaho Department of Fish and Game
Completion Date: 6/30/98
Cost-to-Date: \$5,375

Objective: To determine causes and timing of sage grouse mortality..

Progress: New project with first field season just underway.

GAP ANALYSIS: A GUIDE TO PROTECTING BIODIVERSITY IN THE UNITED STATES

Principal Investigator: J. M. Scott
Funding Agency: National Biological Service
Completion Date: 12/01/98
Cost-to-Date: \$1,749,235

Objectives: 1) Identify areas of high species richness by major ecoregion for: a. rare species, b. neotropical migrants, c. endangered and threatened species, d. declining bird species, e. sensitive species; 2) Determine what percent of each vegetation type by ecoregion occurs within existing preserves; 3) Determine what percent of each area of species richness falls within existing preserve areas; 4) Determine location of areas of high species richness for each vegetation type; 5) Identify areas of potential conflict for areas of species richness; 6) Prepare map with preserves selected as to protect areas of biodiversity into the 22nd century; and 7) Coordinate research activities on Gap Analysis project throughout the US.

Progress: Gap projects in Utah, California, Arkansas, Nevada, Washington, Arizona, New Mexico, Wyoming, Idaho and Oregon have been completed. Second generation updates to obtain greater spatial and thematic resolution are underway in Oregon, Arizona, and Idaho with half of the Idaho update completed. Some 45 refereed publications are in press or published since 1995, including a major symposium on GAP sponsored by the American Society of Photogrammetry and Remote Sensing. More than 200 different uses of GAP have been made, including open space planning in a seven-county area of California: projected growth and siting issues for a compensation area of California, evaluation of biodiversity, protection afforded by different wilderness, national park proposals as well as identification of potential sawmill sites in Utah, and preparation of a state wide biodiversity plan in Oregon, among many others.

REMOTE SENSING-SUPPORTED MAPPING OF VEGETATION

Principal Investigator: J. M. Scott
Funding Agency: U.S. Fish and Wildlife Service
Completion Date: 6/30/97
Cost-to-Date: \$50,000

Objective: To obtain uniform, consistent, baseline data on the composition and distribution of vegetation using remote sensing-supported mapping of natural communities based on The Nature Conservancy/National Heritage Program integrated inventory, classification, and mapping approach to support inventory, management, and planning on refuges.

Progress: Atlases of vegetation types for the northeastern and western United States have been completed, and draft copies of those for the southern and midwestern states are available. When completed, this will represent the first documented list of cover types at the alliance level described and nested in a single vegetation classification system. The results of the completed atlases for the western and northwestern states have already contributed to more complete land cover maps for those areas of the country.

IDAHO GAP ANALYSIS

Principal Investigator: J. M. Scott
Funding Agency: National Biological Service
Completion Date: 12/01/98
Cost-to-Date: \$581,811

Objectives: 1) Identify areas of high species richness by major ecoregion for: a. rare species, b. neotropical migrants, c. endangered and threatened species, d. declining bird species, i.e. sensitive species endemic species, and those unprotected species not adapted to man and his environments; 2) Determine what percent of each vegetation type by ecoregion occurs within existing reserves; 3) Determine what percent of each area of species richness falls within existing preserve areas; 4) Determine location of areas of high species richness for each vegetation type; 5) Identify areas of potential conflict for areas of species richness; 6) Prepare map with preserves selected as to protect areas of biodiversity into the 22nd century; and 7) Coordinate research activities on Gap Analysis project throughout the U.S.

Progress: The second generation land cover map for the northern half of Idaho has been completed with a minimum mapping unit of two hectares and 52 landcover types identified. Additional ground truthing of one scene resulted additional thematic resolution of riparian and upland habitats on Craig Mountain. There have been 50 refereed journal articles in the last two years, treating such diverse subjects as management status of vegetation types, effectiveness of umbrella species to protect biodiversity; appropriateness of different algorithms for setting conservation priorities, identification of endangered ecosystems nation wide, potential biases in presence absence maps for vertebrates and evaluation of added benefits to biodiversity protection from proposed new wilderness and national parks.

AQUATIC GAP ANALYSIS

Principal Investigator: J. M. Scott
Funding Agency: National Biological Service
Completion Date: 12/01/98
Cost-to-Date: \$76,000

Objectives: 1) Identify areas of high species richness by major ecoregion for: a. rare species, b. neotropical migrants, c. endangered and threatened species, d. declining bird species, e. sensitive species; 2) Determine what percent of each vegetation type by ecoregion occurs within existing preserves; 3) Determine what percent of each area of species richness falls within existing preserve areas; 4) Determine location of areas of high species richness for each vegetation type; 5) Identify areas of potential conflict for areas of species richness; 6) Prepare map with preserves selected as to protect areas of biodiversity into the 22nd century; and 7) Coordinate research activities on Gap Analysis project throughout the US.

Progress: The opportunity to advance the state of the information, as well as the practice of holistic systems-based conservation, by including the aquatic component of GAP was recognized in the GAP FY 1994 and FY 1995 budgets. In FY 1994, \$500,000 was allocated to develop the aquatic component of GAP, and in FY 1995, \$361,000 was allocated for this purpose. In FY 1994, the funding was re-directed to meet the administrative needs of the NBS, and in FY 1995, all but \$90,000 for a pilot project was rescinded. Within these constraints, however, substantial progress has been made in developing the conceptual basis for the aquatic component. That pilot project, being carried out in the Allegheny River Basin of Western New York by the New York Cooperative Fish and Wildlife Research Unit at Cornell University, is now completing its first phase, with results that validate many primary assumptions and providing for direct technical experience in the application of methods.

In addition to this pilot project, \$76,000 in FY 1995 discretionary funds were spent through the Idaho Cooperative Fish and Wildlife Research Unit at the University of Idaho to develop the conceptual and scientific basis for conducting Gap Analysis in aquatic environments as well as the basic approach and methodologies to be used. To this end, a workshop of national experts was held, resulting in the articulation of the following goal: "To characterize aquatic biodiversity in the U.S. on a landscape scale in a way that will allow for effective management of land and water resources so as to maintain this biodiversity, preserving the widest variety of management options for the future." As of this writing, a set of scholarly papers describing the concepts and methods for a state-by-state Gap Analysis of aquatic environments has been produced and is under peer review.

Finally, a second pilot project is presently in the development phase, this one covering the state of Missouri, under the Missouri Resources Assessment Partnership (MORAP), which is also conducting the terrestrial Gap Analysis Project for Missouri in partnership with the Missouri Cooperative Fish and Wildlife Research Unit at the University of Missouri. This project is receiving start-up funding from the U.S. Geological Survey's National Water Quality Assessment Program.

SETTING CONSERVATION PRIORITIES: AN EVALUATION OF THEORY AND METHOD

Principal Investigator: J. M. Scott
Funding Agency: National Biological Service
Completion Date: 12/31/97
Cost-to-Date: \$25,000

Objectives: 1) Categorize the conservation status of major ecosystems in the Northwestern U.S. using Kuchler's potential natural vegetation and ownership and management status; 2) Categorize the conservation status of major ecosystems in the Northwestern U.S. using the existing vegetation and ownership and management status maps; 3) Evaluate whether areas identified as under-represented in conservation areas by both approaches should be given higher priority in future conservation planning; and 4) Compile a bibliography of relevant literature.

Progress: Approval for start of project received 9/96.

PALOUSE BIOREGION LANDUSE HISTORY OF NORTH AMERICA PROJECT

Principal Investigator: J. M. Scott
Funding Agency: National Biological Service
Completion Date: 3/31/97
Cost-to-Date: \$9,609

Objectives: 1) To develop a mid-scale (1:100,000) map of pre-European land-cover (ca 1870) for the region; and 2) Develop and test the utility to resource managers of a time-series of land cover maps that relate changes in pre-settlement land cover to changes land use/activities at defined intervals.

Progress: Approval for start of this project received 8/96. Data sets documenting potential and actual vegetation for the area have been acquired and a detailed study plan developed.

DEVELOPMENT OF A BIOINFORMATION NODE IN WYOMING: NBS GAP ANALYSIS PROGRAM COMPONENT

Principal Investigator: J. M. Scott
Funding Agency: National Biological Service
Completion Date: 3/1/98
Cost-to-Date: \$30,000

Objectives: 1) Establish an NBII "bioinformation node" with the State of Wyoming; and 2) Develop a prototype state bioinfomation node design that can be ported to other states.

Progress: Approval for start of this project received 8/96.

ACCURACY OF PRESENCE ABSENCE PREDICTIONS FOR TERRESTRIAL VERTEBRATES: ISSUES OF SCALE

Principal Investigator: J. M. Scott
Funding Agency: National Biological Service
Completion Date: 9/30/98
Cost-to-Date: \$40,000

Objective: 1) To test the accuracy of Gap Analysis project predictions of species occurrence at landscape (Gamma level diversity) and site specific (Alpha level diversity) levels of spatial organization for northern Idaho.

Progress: Previously conducted surveys of the vertebrate fauna of Craig Mountain game management area have been acquired and are being placed in a spatially explicit format. The original 200 hectare minimum mapping unit landcover map has been upgraded to two hectares with increased thematic resolution of riparian and grassland cover types. Presence absence predictions of the Idaho Gap Analysis Project will be tested against observed species occurrences over a two-year period.

TAXONOMIC AND DISCIPLINE REVIEW OF ORNITHOLOGICAL LITERATURE

Principal Investigator: J. M. Scott, J. T. Ratti
Funding Agency: Idaho Department of Fish and Game
Completion Date: 6/30/96
Cost-to-Date: \$2,000

Objective: 1) Assess the taxonomic and discipline coverage of different bird species in the ornithological literature

Progress: The primary ornithological literature was queried for all species covered by the 5th edition of The American Ornithologists Union check-list of North American Bird. We found that the coverage of species was very uneven with less than 5% of the species accounting for more than 80% of the literature. Many widely distributed and common species, e.g. Canyon Wren, Lewises Woodpecker, were found to have 10 or fewer papers written about them. Frequently all papers were notes.

ECOSYSTEMS DEFINED AT THE COVER TYPE LEVEL: ANALYSIS OF TWO ECOREGIONS

Principal Investigator: J. M. Scott
Student Investigator: Alicia Lyons
Funding Agency: Idaho Department of Fish and Game
Completion Date: 12/31/96
Cost to Date: \$15,000

Objective: 1) Identify those anthropogenic factors within the ecoregions of interest habitats associated with the greatest number of imperiled species, check the logic of the selections, and provide a summary and report to document the conclusions.

Progress: A Spearman correlation analysis of imperiled species numbers and acreage of cropland (on a per county basis in Idaho) revealed no significant correlation. This is what one might expect, given the fact that significant land conversions into agricultural fields began roughly 70 years ago. In the past 20 years (at the very least), there have been no significant changes in acreage of cropland throughout the state. Therefore, loss or displacement of species probably occurred over 20 years ago, before in depth monitoring and protection programs of imperiled animals and plants were underway in the U.S.

A Spearman correlation of analysis of numbers imperiled bird species and acreage of pastureland (on a per county basis in Idaho) revealed a significant correlation. Further analysis is underway to interpret this finding.

A Spearman correlation analysis between numbers of imperiled birds only and numbers of imperiled mammals only acreages of privately owned land revealed a significant correlation. A significant correlation was also found when Spearman's analysis was used to determine whether or not there is a relationship between acreage of federal land and 1) all taxa groups 2) birds only 3) mammals only 4) and vascular plants only. When these same analyses were conducted to relate BLM acreage and FS acreage to birds only, and vascular plants only, a significant correlation was revealed. Additional analyses are underway to help understand these findings.

WILDLIFE-HABITAT RELATIONSHIP MODELS FOR CRAIG MOUNTAIN WILDLIFE MITIGATION AREA.

Principal Investigator: J. M. Scott
Student Investigator: Nancy Wright
Funding Agency: Idaho Department of Fish and Game
Completion Date: 12/31/96
Cost to Date: \$7,500

The development of predictive wildlife-habitat relationship models for Craig Mountain includes establishing patterns of existing vegetation, determining the zones of temperature variance, and delineating stream and wetland characteristics. A habitat range for each predicted vertebrate species within the mitigation area is established by relating the land characteristics to the needs of the individual species. The vegetation and species range maps are developed on ARC/INFO

7.04 and will be used in ArcView as wildlife mitigation management tools by Idaho Department of Fish and Game.

End products of this contract will be:

- 1) A full report on methods used to develop WHR models.
- 2) A description and map of the WHR for each species, including accuracy assessment.
- 3) An Arc/Info GIS layer showing predicted distribution of all species for which a WHR was developed.
- 4) Assistance in developing Arc View applications which facilitate the use of the GIS in decision support.

Completed Projects - Wildlife Resources

E. O. Garton - Principal Investigator

Coeur d'Alene Elk Ecology

Big Game Harvest Survey Audit

Application of A Rapid Assessment Program for Inventorying Species Richness of Neotropical Migrant Songbirds on National Forest System

Sam Ham - Principal Investigator

Social Marketing to Select Ecologically Significant Wildlife Species for Monitoring Programs in Southern U.S. and Meso-American Protected Areas: A Delphi Study of Expert Ecologists' Opinions

John T. Ratti - Principal Investigator

Assessment of Resource Information for Inland Waters and Wetland Environments

Snake River Wildlife Studies

J. Michael Scott - Principal Investigator

Mountain Goats : Why They Have Declined.

Molly Stock - Principal Investigator

The Fire Monitoring Navigator (An Expert System) .

COEUR D'ALENE ELK ECOLOGY PROJECT

Principal Investigator: E. O. Garton and S.G. Hayes
Funding Agency: Idaho Department of Fish and Game
Completion Date: 6/30/96
Total Cost: \$20,000

Objectives: 1) Develop a Geographical Information System database of vegetation, topography, and roads in the Coeur d'Alene river basin of northern Idaho; 2) Use the database and elk radio-location data to test elk habitat use hypotheses during 1988-1994; 3) Develop a winter habitat use model for the study area; and 4) Develop an elk mortality model for the study area.

Results: An abstract of the elk habitat use manuscript follows. Most elk (*Cervus elaphus*) habitat research in the western U.S. has focused on cow elk, resulting in the development of management guidelines that may not provide habitat use/selection differences, at patch and home range scales, occur between cow and bull elk in the upper Coeur d'Alene basin of Idaho. Bulls used habitats with more hiding and thermal cover than cows in every season. During the hunting season, bulls selected patches from their home range areas that had lower open road densities and greater hiding and thermal cover. Cows, during the hunting season, selected patches that had greater hiding and thermal cover. Removal of hiding and thermal cover, and failure to close newly built forest roads, will result in reductions in habitat that bull elk select during the hunting season. If these habitat changes were to occur, higher harvest rates, especially for bulls, should be expected.

BIG GAME HARVEST SURVEY AUDIT

Principal Investigator: E. O. Garton
Funding Agency: Idaho Department Fish and Game
Completion Date: 12/31/95
Total Cost: \$20,000

Objectives: 1) Evaluate Idaho Department of Fish and Game's current survey; 2) Compare phone and postcard surveys; and, 3) Compare results to current standards and practices.

Results: We evaluated the main survey methods currently used in the western U.S. by wildlife agencies for collecting big game harvest information. They were: 1) voluntary report cards; 2) mandatory report cards; 3) mailed questionnaires; 4) telephone surveys; 5) combination surveys; and 6) check station. We asked game harvest specialists in each state 23 question pertaining to the operation of survey methods in their state, both for general deer and elk hunts and one representative controlled species.

Fifty-eight percent of the wildlife agencies used mailed questionnaires, and 50% used telephones to collect general hunt information. Only one state, Nevada, exclusively used a report card system. For controlled hunts, 42% of the states regularly used a report card system, 33% a mailed questionnaire, and 25% used a telephone survey. However, 75% of the states used telephones for at least some aspect of their controlled hunt surveys.

We also conducted a cost/benefit analysis for Idaho Department of Fish and Game (IDFG) using the four main survey methods used by western states. The methods considered were: 1) voluntary report cards; 2) mandatory report cards; 3) mailed questionnaires; 4) telephone surveys. We based our evaluations on several factors which we considered important when selecting an appropriate survey methods: 1) The quality of the information obtained; 2) the timeliness of the information; and 3) the cost of operating the survey. We used 1993 tag sale information provided by IDFG to estimate costs.

Report cards had the lowest cost per returned card, but this did not translate into the lowest cost for an entire survey in Idaho. The telephone survey method had the lowest overall cost. In addition, several studies (Nellis 1979, Steinert et al. 1994, Rachael and Kuck 1995) demonstrated the accuracy of data collected from telephone surveys. Telephone surveys also provide the opportunity to collect some information on all game species.

Recommendations were made to continue with IDFG's telephone survey with the added employment of a qualified statistician to deal with the problems we found with the current sampling design of the telephone survey. The IDFG switched to a point-of sale database in December 1995. This should improve the timeliness and quality of the telephone information if it is designed properly in consultation with a statistician. Even with this added expense, we do not expect the cost of conducting a well designed-survey to differ significantly from the cost of conducting the current survey, but will improve the quality of the information collected.

APPLICATION OF A RAPID ASSESSMENT PROGRAM FOR INVENTORYING SPECIES RICHNESS OF NEOTROPICAL MIGRANT SONGBIRDS ON NATIONAL FOREST SYSTEM LANDS

Principal Investigator: E. O. Garton
Student Investigator: Ann Rocklage
Funding Agency: USDA Forest Service
Completion Date: 5/31/95
Total Cost: \$56,730

Objectives: 1) Apply a rapid assessment program (RAP) to inventory landbird populations and vegetative features along an elevational gradient within the Payette National Forest; 2) Test the relationships of avian species and community densities to elevation and vegetation communities with analysis of variance tests; 3) Determine avian-habitat associations via principle component analysis and gradient analysis. Patterns of vegetation and avian species abundance and community similarities along the elevational gradient will be identified through cluster and moving window analyses; 4) Based on the above analyses, we will attempt to build a predictive model of landbird distributions and abundance for application throughout the Payette National Forest; and 5) Test the relationships of avian species densities to patch size and distance to edge with linear regressions.

Results: I investigated the landscape ecology, elevational distributions, and microhabitat associations of landbirds on Council Mountain in West Central Idaho. The study area was divided into 21 elevation zones from 914 to 2377 meters, with 12 to 15 census stations per zone. Birds were surveyed with the variable circular plot method during the breeding season in 1993 and 1994. Densities were calculated with the ordered distance method. Eight cover types were recognized. Landscape features were measured at each station on aerial photographs. Habitat variables were collected within a 0.25 hectare plot at each station. Twenty-nine out of 31 species had a significant difference in densities between cover types (Analysis of Variance $P < 0.05$). Tukey's HSD was used to find a species preferred cover type or types. I tested species relationships to six landscape features with linear regression. Twenty-nine out of 37 species had a significant relationship ($P < 0.05$) with at least one landscape variable. Next, I graphed species densities versus elevation. Kruskal-Wallis tests on elevation groups identified the preferred elevation range of 31 species. I also examined plant and avian distributions along the elevational gradient through cluster analysis. To examine species microhabitat associations, I used two sets of stepwise multiple regressions: one at the full range of elevations and cover types, and the other at each species preferred elevation range and cover type. I produced a significant model for 39 species for the full range, and for 32 species at their preferred range ($P < 0.05$). Thirty-two species provided a significant model at their preferred range. Finally, principal components identified habitat gradients. I used linear regression to test species relationships to nine components. Thirty-eight species had a significant regression ($P < 0.05$) with at least one component. This study offers insight into avian habitat selection at different scales, and emphasizes the need for a match between the management and observational scales. Since avian populations fluctuate in time and space, I recommend that research continue on avian landscape ecology and habitat associations. Furthermore, density may not be an adequate indicator of habitat quality for some species. Therefore, I recommend research on avian demography.

SOCIAL MARKETING TO SELECT ECOLOGICALLY SIGNIFICANT WILDLIFE SPECIES FOR MONITORING PROGRAMS IN SOUTHERN U.S. AND MESO-AMERICAN PROTECTED AREAS: A DELPHI STUDY OF EXPERT ECOLOGISTS' OPINIONS

Principal Investigator: S. Ham
Funding Agency: National Biological Service
U.S. Fish and Wildlife Service
Completion Date: 9/30/95
Total Cost: \$5,000

Objectives: 1) To determine what impacts on terrestrial vertebrates can be expected from different levels of tourism pressure; and 2) To determine what species are most important to monitor in order to answer this question.

Results: The study produced a substantial list of U.S. and neotropical ecologists. A total of 165 ecologists/biologists are represented in the participant list. The list includes: 26 mammalogists, 73 ornithologists, 22 herpetologists, 30 community/forest ecologists (15 ecologists did not specify their specific area of expertise).

ASSESSMENT OF RESOURCE INFORMATION FOR INLAND WATERS AND WETLAND ENVIRONMENTS

Principal Investigator: J. T. Ratti
Funding Agency: U.S. Fish and Wildlife Service
Completion Date: 12/31/95
Total Cost: \$140,974

Objectives: 1) Conduct a literature review to identify the following information: a) available classification schemes currently in use for identification and characterization of inland waters and wetland environment; b) the extent and availability of statistical data and information on the populations and ranges of biological resources inhabiting inland waters and wetland environments; c) the extent and availability of statistical data on commercial and recreational uses provided by the biological resources and the economic values of those respective uses; and d) available methods for the restoration, rehabilitation, replacement, and/or acquisition of the equivalent resources inhabiting the inland waters and wetland environments and to identify available cost data for the performance of the respective actions.

Results: Only preliminary investigations were completed when this study was interrupted by discontinuation of funding. This study was discontinued shortly after the following progress report was submitted.

Guidice, J. H., and J. T. Ratti. 1994. Assessment of resource information for inland waters and wetland environments: Phase 1, upper Mississippi River. Report to the Office of Environmental Affairs, U.S. Department of Interior, Washington, D.C. 234pp.

SNAKE RIVER WILDLIFE STUDIES

Principal Investigator: J. T. Ratti
Funding Agency: U.S. Army Corps of Engineers
Completion Date: 12/31/95
Total Cost: \$34,666

Objectives: 1) To conduct a preliminary inventory of riparian habitats along Snake River reservoirs between Clarkston, Washington, and Ice Harbor Dam to establish study sites and survey transects; purchase necessary equipment; review sampling methodology, and consider logistic operation and time constraints; and 2) To prepare a preliminary report and detailed study plan for Phase 2 of the project which will begin in FY96

Results: Only preliminary investigations (i.e., visits to potential study areas, development of methodology, etc.) were completed when this study was interrupted by discontinuation of funding.

MOUNTAIN GOATS : WHY THEY HAVE DECLINED

Principal Investigators: J. M. Scott
Funding Agency: Idaho Department of Fish and Game
Completion Date: 6/1/95
Cost to Date: \$3,000

Objective: 1) To review literature and unpublished reports on population dynamics of mountain goats in Western States as well as conduct interview of mountain goat researchers with the intent of identifying and testing the hypotheses that have been put forth to explain recent declines of mountain goat numbers in the West.

Results: Four-hundred plus references in the literature have been found and abstracted. Visits to gather additional data and interview research biologists have been made to Idaho Department of Fish and Game and Oregon Department of Fish and Wildlife.

THE FIRE MONITORING NAVIGATOR (AN EXPERT SYSTEM)

Principal Investigator: M. Stock
Funding Agency: U.S. Fish and Wildlife Service
Completion Date: 7/15/95
Total Cost: \$49,100

Objectives: 1) Develop a knowledge-based system that can be used to select appropriate monitoring techniques, select and assemble the appropriate monitoring techniques into an optimal monitoring system, check the logic of the selections, and provide a summary and report to document the decision.

Results: The prototype program is near completion. The program can be run in either instruction mode or without instructions, depending on the familiarity of the user with the program. After selecting the type of vegetation being monitored, the user can approach selection of an appropriate monitoring technique by several different avenues. The series of decisions made during the session is recorded and posted so the user can see the consequences of various decisions. When several techniques are available, the user can explore the effect of different constraints (e.g. available funding, crew size, terrain) on the various options, targeting a technique or techniques that are best suited to the particular situation.

Summary of Annual Activities

Publications and Professional Papers presented - Unit Staff and Students

Scientific Papers:

- Caicco, S., J. M. Scott, B. Butterfield, and B. Csuti. 1995. A Gap Analysis of the management status of the vegetation of Idaho (U.S.A.). *Conservation Biology* 9(3): 498-511.
- Hedrick, R. P., S. E. LaPatra, S. Yun, K. A. Lauda, G. R. Jones, J. L. Congleton, P. De Kinkelin. 1994. Induction of protection from infectious hematopoietic necrosis virus in rainbow trout *Oncorhynchus mykiss* by pre-exposure to the avirulent cutthroat trout virus (CTV). *Diseases of Aquatic Organisms* 20:111-118.
- Machlis, G. E., J. M. Scott, D. J. Forester, and C. B. Cogan. 1994. The application of Gap Analysis to decision making in the U. S. National Wildlife Refuge System. Pp 66-574 in *Transactions of the 59th North American Wildlife and Natural Resource Conference*.
- Merrill, T., R. G. Wright, and J. M. Scott. 1995. Using ecological criteria to evaluate wilderness planning options in Idaho. *Environmental Management* 19 (6):815-825.
- Noss, R. F., T. E. Laroe III, and J. M. Scott. 1995. Endangered ecosystems of the United States: A preliminary assessment of loss and degradation. National Biological Service Biological Report 28:58pp.
- Scott, J. M., E. T. LaRoe III, and M. D. Jennings. 1995 Gap Analysis: A geographic approach to planning for biological diversity. Pp. 462-463 in: E. T. LaRoe, G. S. Farris, C. E. Puckett, P. D. Doran, and M. J. Mac, editors. *Our living resources: a report to the nation on the distribution, abundance, and health of US plants, animals, and ecosystems*. US Department of Interior, National Biological Service, Washington, DC.
- Scott, J. M., T. H. Tear, and L. S. Mills. 1995. Socioeconomics and the recovery of endangered species: Biological assessment in a political world. *Conservation Biology* 9(1):214-216.
- Tear, T. H., J. M. Scott, P. H. Hayward, and B. Griffith. 1995. Recovery plans and the Endangered Species Act: Are criticisms supported by data? *Conservation Biology* 9(1):182-195.
- Zhang, Y. And J. L. Congleton. 1994. Detection of infectious hematopoietic necrosis (IHN) virus in rearing units for steelhead before and during IHN epizootics. *Journal of Aquatic Animal Health* 6 (4):281-287.

Technical and Semi-technical papers:

Bjornn, T. C., J. P. Hunt, K. R. Tolotti, P. J. Keniry, and R. R. Ringe. 1995. Migration of adult chinook salmon and steelhead past dams and through reservoirs in the Lower Snake River and into tributaries - 1993. Annual Report. U.S. Army Corps of Engineers, Walla Walla District, Walla Walla, WA. 228 pp.

Theses and Dissertations:

Adams, Susan. 1994. Summer bull trout distribution and habitat use in relation to available stream habitat, temperature, and species composition in the Weiser River drainage, Idaho. Thesis, University of Idaho, College of Forestry, Wildlife and Range Sciences, Moscow, Idaho. 84pp.

Isaak, Daniel. 1994. Movements and distributions of northern squawfish downstream of a Lower Snake River dam in relation to the migration of juvenile salmonids. Thesis, University of Idaho, College of Forestry, Wildlife and Range Sciences, Moscow, Idaho. 141pp.

Mosey, Thaddeus. 1995. Effects of stressors on leukocyte composition and oxidative burst capacity of neutrophils in the peripheral blood of juvenile chinook salmon *Oncorhynchus tshawytscha*. Thesis, University of Idaho, College of Forestry, Wildlife and Range Sciences, Moscow, Idaho. 94Pp.

Sankovich, Paul. 1995. Distribution and spawning behavior of hatchery and natural chinook salmon in the upper end of Idaho's South Fork Salmon and Salmon Rivers. Thesis, University of Idaho, College of Forestry, Wildlife and Range Sciences, Moscow, Idaho. 91Pp.

Siegel, Deborah. 1995. Bacterial activity of macrophages from juvenile chinook salmon following exposure to stress, cortisol, *Renibacterium salmoninarum* and soluble proteins produced by *R. Salmoninarum*. Thesis, University of Idaho, College of Forestry, Wildlife and Range Sciences, Moscow, Idaho. 164Pp.

Tolotti, Kenneth R. 1995. Radio telemetry methods for monitoring adult chinook salmon migrations at Lower Snake River dams and reservoirs: 1991-1993. Thesis, University of Idaho, College of Forestry, Wildlife and Range Sciences, Moscow, Idaho. 175pp.

Papers Presented:

Garman, L., and T. C. Bjornn. March, 1995. The effects of fine sediments on the survival of almonid embryos. Annual Meeting of Idaho Chapter of American Fisherires Society, Boise, Idaho.

Peery, C., and T. C. Bjornn. March, 1995. Interactions between hatchery and natural juvenile chinook salmon in artificial streams. Annual Meeting of Idaho Chapter of American Fisherires Society, Boise, Idaho.

- Peery, C., and T. C. Bjornn. March, 1995. Distribution and growth of hatchery juvenile chinook salmon released in Lochsa River tributaries. Annual Meeting of Idaho Chapter of American Fisheries Society, Boise, Idaho.
- Rocklage, S. and J. L. Congleton. March 1995. Energy stores of naturally and artificially reared juvenile chinook salmon migrating through the lower Snake River corridor, Washington. Annual Meeting of Idaho Chapter of American Fisheries Society, Boise, Idaho.
- Scott, J. M. March, 1995. Gap Analysis: Issues of scale. American Society of Photogrammetric Engineers, Charlotte, North Carolina.
- Congleton, J. L. June, 1995. Potential of immunomodulators for control of infectious hematopoietic necrosis (IHN). Western Regional Aquaculture Center Workshop on IHN Control, Buhl, Idaho.
- Hunt, J. P. September, 1995. Cutthroat trout management in Idaho. Wild Trout IV Symposium, Mammoth Hot Springs, Yellowstone National Park, Montana.
- Siegel, D. and J. L. Congleton. July, 1995. Bactericidal activity against *Aeromonas salmonicida* of juvenile chinook salmon phagocytes following exposure to live or heat killed *Renibacterium salmoninarum* or to soluble proteins produced by *R. salmoninarum*. Annual Meeting of American Fisheries Society Fish Health Section and Eastern Fish Disease Workshop, Syracuse, New York.
- Scott, J. M. July, 1995. Habitats at risk in the western United States. Society for Conservation Biology. Ft. Collins, Colorado.
- Congleton, J. L., C. Schreck, and D. Elliott. September, 1995. Effects of descaling on the short-term viability of juvenile salmonids. Annual Research Review, Pacific Northwest Division of Corps of Engineers, Walla Walla, Washington.
- C. Schreck, J. L. Congleton, and R. Pascho. September, 1995. Evaluation of procedures for collection and transport of juvenile salmonids from Snake River dams. Annual Research Review, Pacific Northwest Division of Corps of Engineers, Walla Walla, Washington.
- Scott, J. M. September, 1995. Status of ecosystems in the west. The Wildlife Society 2nd Annual National Meeting. Portland, Oregon.

Publications and Professional Papers presented - Unit Affiliates and Unit Affiliated Students

Technical and Semi-technical papers:

- Heekin, P. E., and K. P. Reese. 1995. Validation of a mountain quail survey technique. Completion Report to Idaho Power Company, Boise, Idaho. 49Pp.

- Heekin, P. E., and C. A. Vogel. Mountain quail: high jumpers. Idaho Wildlife Magazine 15(5):2.
- Heekin, P. E., C. A. Vogel, and P. Zager. 1995. In quest of the mountain quail. Idaho Wildlife Magazine 15(5):4-8.
- Vogel, C. A., and K. P. Reese. 1995. Mountain quail status report: a document preliminary to a habitat conservation assessment for mountain quail. Completion Report, Eastside Ecosystem Management Project. 33pp.

Theses and Dissertations:

- Deal, Jerry Wade. 1994. An analysis of breeding bird population trends in the western United States, 1968-1991. Thesis, University of Idaho, College of Forestry, Wildlife and Range Sciences, Moscow, Idaho. 121pp.
- Edelmann, Frank B. 1995. Ecology of Merriam's wild turkeys in west-central Idaho. Thesis, University of Idaho, College of Forestry, Wildlife and Range Sciences, Moscow, Idaho. 168pp.
- Lepla, Kenneth B. 1994. White sturgeon abundance and associated habitat in Lower Granite Reservoir, Washington. Thesis, University of Idaho, College of Forestry, Wildlife and Range Sciences, Moscow, Idaho. 77Pp.
- Schneider, James W. 1994. Winter nutritional ecology and intestinal morphology of Columbian sharp-tailed grouse. Thesis, University of Idaho, College of Forestry, Wildlife and Range Sciences, Moscow, Idaho. 118Pp.
- Ulliman, Mark Joseph. 1995. Winter habitat ecology of Columbian sharp-tailed grouse in southeastern Idaho. Thesis, University of Idaho, College of Forestry, Wildlife and Range Sciences, Moscow, Idaho. 119pp.

Papers Presented:

- Gardner, S. C., K. P. Reese, and J. W. Connelly. March, 1995. Ecology of reintroduced Columbian sharp-tailed grouse in southern Idaho. Idaho Chapter The Wildlife Society, Idaho Falls, Idaho.
- Reese, K. P., J. W. Schneider, and J. W. Connelly. March, 1995. Do Columbian sharp-tailed grouse substitute hard seeds for grit in winter? Idaho Chapter The Wildlife Society, Idaho Falls, Idaho.
- Reese, K. P. June, 1995. Sage grouse ecology and research in Idaho. Shoshone Basin Planning Team Meeting, Twin Falls, Idaho.
- Schneider, J. W., K. P. Reese, J. W. Connelly, J. H. Klott, and B. B. Davitt. September, 1995. Winter food habits of Columbian sharp-tailed grouse in southeastern Idaho. The Wildlife Society Annual conference, Portland, Oregon.

Ulliman, M. J., K. P. Reese, and J. W. Connelly. March, 1995. Winter ecology of Columbian sharp-tailed grouse in southeastern Idaho. Idaho Chapter The Wildlife Society, Idaho Falls, Idaho.