

FOCUS

on Renewable Natural Resources



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Volume 9



University of Idaho

Forest, Wildlife and Range Experiment Station
College of Forestry, Wildlife and Range Sciences
Moscow, Idaho

Idaho Research in the 1980s

As Fiscal 1983 began a year ago, the departments of Fishery Resources and Wildlife Resources which had been separate for a decade, were merged into a single entity, the Department of Fish and Wildlife Resources, under Ernest D. Ables, as Department Head. As a single department, Fish and Wildlife represents 40 percent of both graduate and undergraduate students in the College of Forestry, Wildlife and Range Sciences, and an annual one-million-dollar budget in the Forest, Wildlife and Range Experiment Station.

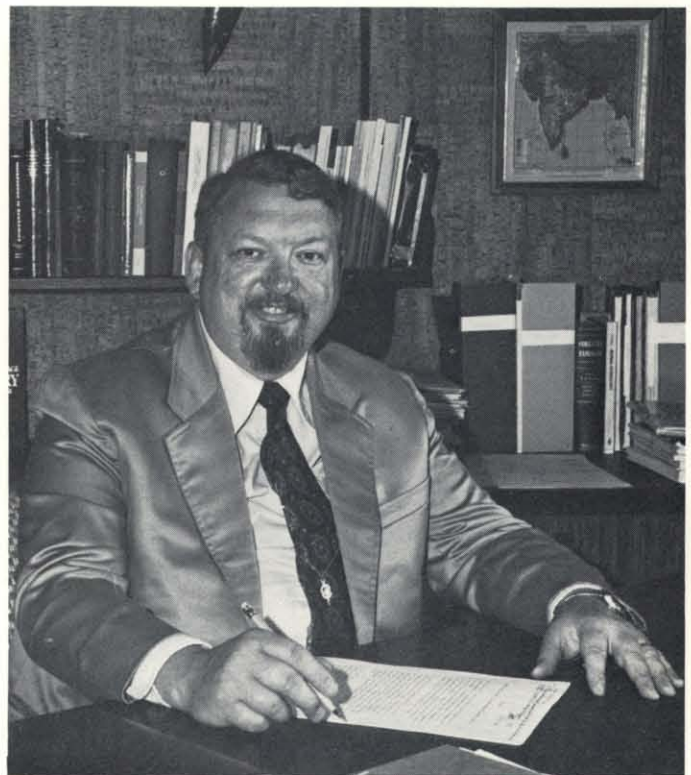
While the change came about primarily as a money-saving measure in a financially tight budget year, there are other benefits as well. Coordination enhances programs with fish and wildlife agencies, and with other educational research stations which operate as a single unit. Administrative contacts at the state level go through the Idaho Department of Fish and Game. At the federal level the U.S. Fish and Wildlife Service also represents a combined program. The Cooperative Fishery Research Unit, Cooperative Wildlife Research Unit, and an arm of the Cooperative Park Studies Unit are housed in the Experiment Station with the Department of Fish and Wildlife Resources. The units contribute a strong research emphasis and provide an avenue for better interaction and cooperation with other research programs at federal, state and university levels. This year's issue of FOCUS features Experiment Station research in the Department of Fish and Wildlife Resources, and through the Cooperative Units. Wildlife was last featured in 1975, and fishery research in 1977.

The importance of fish and wildlife research to the economy of Idaho is evident not only in the numbers of sporting enthusiasts who visit Idaho, but also as oil and gas developers operating in the Overthrust Area in southeastern Idaho look to wildlife research to better understand the ecological requirements of the area (page 9). The lease and renovation of a 15-acre hatchery facility at Hayden Creek, near Salmon, by the Cooperative Fishery Research Unit will aid in assessment of water flow and habitat requirements for fish (page 2). Small birds, which many of us do not consider predators, are proving excellent recruits in the forest pest management war against insects (page 7). The effects of agriculture and other shoreline activities on lakes have been tallied in the study of health of 2200 Idaho lakes (page 6). Research on Idaho bobcat will help management agencies set trapping limits which will preserve the species (page 4).

Research in other areas of the Experiment Station has resulted in a publication on habitat types for southern Idaho (page 17), and some suggested changes in wild horse management (page 16). A forest products marketing bulletin is now available for companies and individuals in the forest products industry in Idaho (page 14). Research into insect and mistletoe problems in forests is providing help for forest entomologists and timber managers (page 12).

Expertise in all areas of study covered by the Experiment Station has drawn visitors from other countries to Moscow, Idaho, and has prompted exchange visits and shortcourses. Research professors have traveled, and are traveling to the People's Republic of China, India, Korea, to European countries, and to Honduras, Brazil, Peru, Sri Lanka, Morocco, Portugal, Gambia, Senegal, Lesotho, Zimbabwe and Australia to exchange ideas and to learn about the problems faced in other parts of the world. Several delegations from the People's Republic of China have visited the Experiment Station in the past few years as Idaho's reputation in international research has grown. As Idaho and the nation begin to pull out of the economic recession, industries considering a move to Idaho have again and again stressed the importance of an active educational and research climate to their final decision. Research for the 1980s is offering a helping hand to the economy of Idaho and setting a precedent for international cooperation and understanding.

George H. Belt

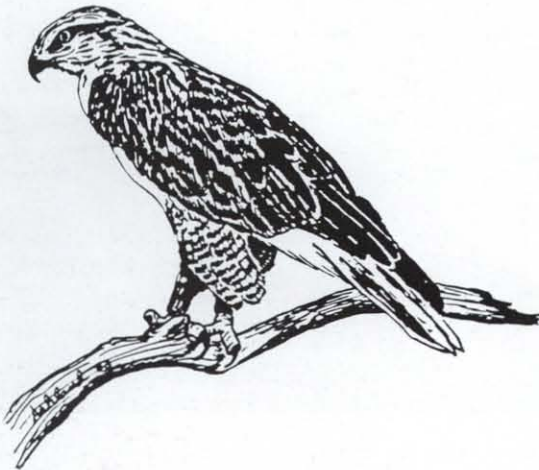


Susan Roberts photo

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FOREST, WILDLIFE AND RANGE
EXPERIMENT STATION

John H. Ehrenreich, Director
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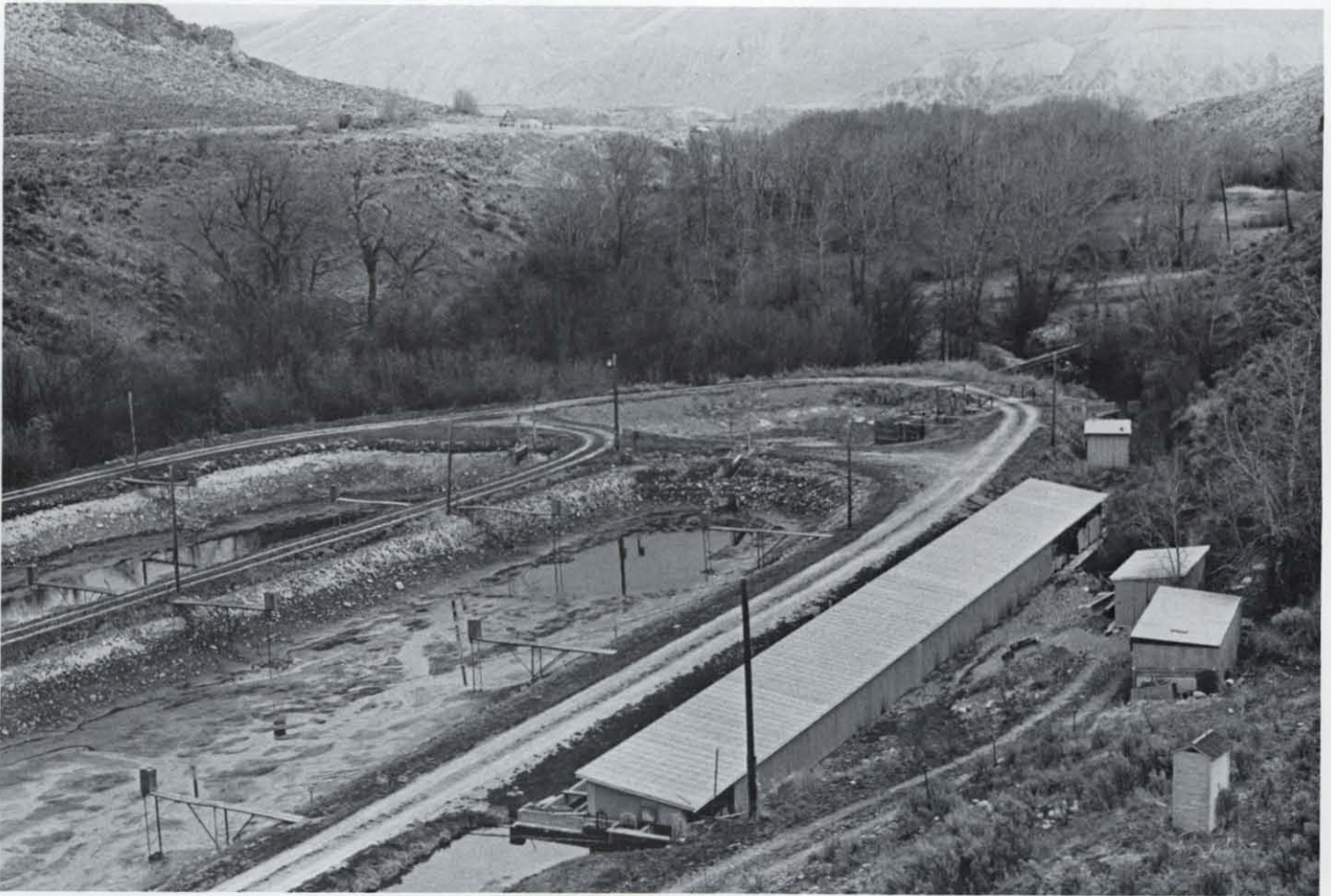
Susan B. Roberts, Editor
Lorraine Ashland, Artist

Cover: Fall tinges the back country with color and the air with the coming chill of winter in the River of No Return Wilderness Area. Big Creek flows through a portion of the Taylor Ranch, the University of Idaho Wilderness Research Center station managed by the Forest, Wildlife and Range Experiment Station. *Ernest Ables photo*

 University of Idaho

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Fish and Wildlife Resources



University of Idaho Cooperative Fishery Research Unit members are studying the maturation rates of Kooconusa rainbow trout at the Hayden Creek research station. Leased from the Idaho Department of Fish and Game, the 15-acre hatchery near Salmon offers natural warm and cold-water sources for temperature-regulated experiments. *Ted Bjornn photo*

Fishery Research Unit Gains 15-Acre Hatchery

Investigators:
Ted C. Bjornn

Bruce Burton
James Congleton

Research opportunities for the Idaho Cooperative Fishery Research Unit expanded in the spring of 1982 with the lease from the Idaho Department of Fish and Game of the Hayden Creek research station. The Unit is now in charge of managing the hatchery, which has two large ponds, two raceway systems for raising fish, and a covered area for laboratory stream channels.

Located 40 miles south of Salmon, the 15-acre hatchery was developed in the 1960s for experimental rearing of

steelhead trout and chinook salmon. More recently, the state has used the hatchery for the production of spring chinook salmon. Two warm water springs and Hayden Creek supply water for the hatchery, offering both warm and cold water that can be mixed for temperature-regulated experiments both summer and winter.

One large pond at the hatchery is being used to study growth rate, life span, and time of maturity of Kooconusa rainbow trout, an existing strain from a lake on the Montana-Canada border. Fishery professor Ted C. Bjornn, Leader of the Cooperative Unit, is principal investigator for the stock evaluation project. Researchers are looking for trout stocks

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that mature late in their life cycle, allowing the fish to put energy into growth for a longer period of time before spawning. The Kooconusa strain is now in its second year at the hatchery. Growth of the fish will be compared with that of other hatchery grown trout. Interest has developed recently in finding fish best suited to local conditions before introducing them into streams and lakes, in the hopes that they will adapt and grow well in the new surroundings. The Idaho Department of Fish and Game is providing funding for the project.

New Channel Constructed

For a number of years, the Unit has had an agreement with the state allowing use of an artificial stream channel area for research. In the year since the lease began, the Unit has removed channels used in the past and replaced them with a new, 6-foot wide channel. This facility will be used to study trout behavior, habitat selection, predator avoidance, overwintering behavior, and habitat alteration. The enlarged channel will also be used for other projects, including physiological stress testing.

Because the hatchery is a full day's drive from Moscow, Bruce Burton, a fishery graduate student, is managing the facility while working on his own research project at the hatchery. Burton is working with chinook salmon to determine the effects of physiological stress in the salmon's avoidance of predators. Burton's advisor on the project is fishery professor James Congleton, assistant leader of the Cooperative Unit. Four 8-foot wading pools under protective cover are used for the experiment. The larger channel will also be useful for this study. The Bonneville Power Administration is funding the project.



Boreal owls, discovered during a 1980 census, are new residents of Idaho. *Greg Hayward photo*

Eavesdropping on Owls Leads to Research Grant

Investigators:

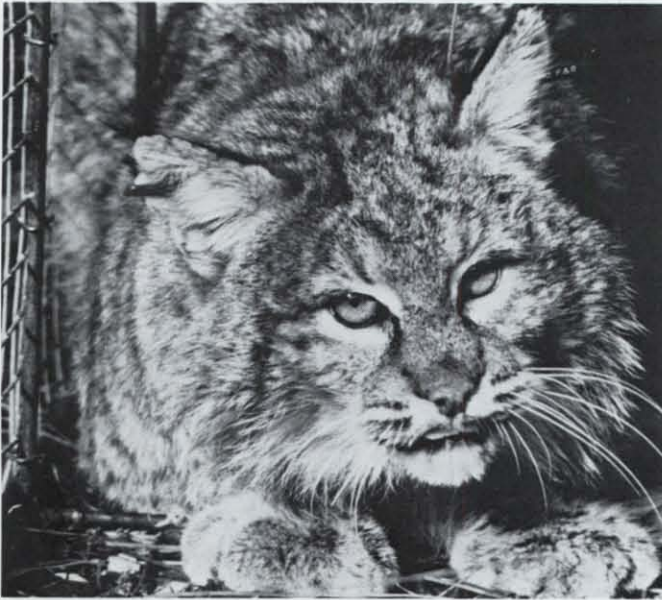
Edward Garton
Greg Hayward

Wildlife researchers in Idaho have been listening in on conversations in the wild with some surprising results. While playing tapes of calling owls in 1980, Wildlife graduate student Greg Hayward and Wildlife professor Edward O. Garton of the University of Idaho found four male boreal owls, a new species for Idaho, in a study area near the Chamberlain Basin Ranger Station in the River of No Return Wilderness. Prior to that time, boreal owls had not been found in Idaho since the turn of the century when non-breeding males were discovered in the far northern part of the state.

The males heard in 1980 were calling, trying to attract mates. A female boreal owl radiotagged in 1981 was later found brooding two young owls in the cavity of a ponderosa

pine. A male was also captured in the study area in 1981. Boreal owls responded to taped calls in the study area again in 1982. With tapes and sightings of boreal owls in consecutive years from 1980 through 1982, researchers can document a resident population of an owl which has been found breeding south of Canada on only four occasions. Scientists suspect that the owls might be found throughout the Rockies along the Continental Divide.

The new Idaho species was discovered in the mountains of central Idaho during a census of owls in the River of No Return Wilderness Area sponsored by the College of Forestry, Wildlife and Range Sciences and the University of Idaho Wilderness Research Center. Researchers also recorded flammulated, pygmy, saw-whet, and great-horned owls in the Chamberlain Basin area. On the basis of the earlier findings, the USDA Forest Service has funded a three-year study on the status of the boreal owl in central Idaho. Wildlife scientists will be listening to more owls in the future.



Information on Idaho's spotted cat will aid wildlife agencies in managing the species. *Gary M. Koehler photo*

Some Seek Bobcat for Fur, Others Would Manage Population

Investigators:

Maurice Hornocker
Gary M. Koehler

The price of fur from a single Idaho bobcat escalated from \$50 in the early 1970s to over \$300 by the mid-1970s because of demand for its spotted fur. By the early 1970s excessive harvesting to satisfy world-wide demand for garments made from spotted cats threatened extinction for the jaguar and ocelot of Central and South America, and for the leopard and cheetah of Asia and Africa.

Many fur-importing countries and concerned countries where the spotted cats were being threatened signed an international treaty in 1973, calling for protection of jaguars, ocelots, leopards and cheetahs. With the export of spotted furs curtailed, the fashion industry had to look elsewhere to satisfy the demand for coats made from spotted cats. The answer was the bobcat of North America.

The bobcat, also known as the wild cat or lynx cat in Idaho, is a small elusive predator. But it is easy to trap. Concerned for the welfare of the spotted cat, the Idaho Department of Fish and Game set seasons and limits on the harvesting of bobcats and initiated studies to determine how many bobcat could safely be harvested without harming the population.

Fish and Wildlife professor Ernest Ables and graduate student Donna Rounds surveyed Idaho trappers and houndsmen in 1977 to assess the population status of bobcats in Idaho. The Idaho Department of Fish and Game also needed information on the biology of these animals in order to

manage bobcat harvests. How well do bobcats reproduce? How many can an area support? What natural factors influence bobcat numbers? Graduate student Gary M. Koehler and Maurice Hornocker, Leader of the Idaho Cooperative Wildlife Unit, began field work in 1980 to supply answers to many of these questions. They selected the mountainous River of No Return Wilderness of central Idaho, typical of Idaho's terrain, as the study site. It is hoped that principles of bobcat biology from the central mountains of Idaho can be applied elsewhere. The researchers also believed it would be easier to isolate natural factors which affect a bobcat population where human influence was minimal. With basic information about naturally occurring bobcat populations, managers can provide harvesting and management prescriptions which best meet their goals and which maintain viable bobcat populations.

In the first two years of a four-year project, Koehler and his assistants have walked over 3000 miles, capturing and marking 16 bobcats and fitting them with radio transmitting collars in order to follow their movements from the air. Monitoring bobcat movements will allow the researchers to determine bobcat densities, habitat use and productivity. They have also captured and radio-collared coyotes and mountain lions to study the influences these predators may have on bobcats.

Koehler and Hornocker are assessing food habits of bobcat, coyote, and mountain lion from analysis of scats and observations of predation. They are also sampling the forest habitats in the study areas for rodents, deer, elk, and bighorn sheep to determine abundance of prey species. This information will provide data on the prey populations needed to support a bobcat population.

The University of Idaho Wilderness Research Center's Taylor Ranch provides the base of operations in the River of No Return Wilderness. The Idaho Department of Fish and Game provides financial and personnel assistance. Additional support comes from the U.S. Fish and Wildlife Service, the Boone and Crockett Club, and the National Geographic Society. Through the research support of these organizations, wildlife agencies can obtain the biological and ecological information necessary for managing Idaho's little spotted wild cat.

Wild, Hatchery Trout Competition Explored

Investigators:

Ted C. Bjornn
Charles Petrosky

One factor which sets science apart is the continual testing of what is considered common knowledge. In 1979, Fishery graduate student Charlie Petrosky designed an experiment to test whether, in fact, introducing hatchery-raised trout into a river affects the wild trout population of that river. Fishery managers have assumed for the past decade that hatchery fish compete to the detriment of

wild fish. The design, and questions raised in the project proposal won Petrosky the Curt Burklund graduate research award, enabling him to carry out the project. The Idaho Cooperative Fishery Research Unit provided additional funding. Unit leader Ted Bjornn is Petrosky's advisor and principal investigator on the project.

To test the hypothesis that hatchery fish compete to the detriment of wild fish, Petrosky chose Big Springs Creek, an 8-mile-long tributary of the Lemhi River in east-central Idaho. Taking advantage of the limited summer movement of most stream trout, he set up fifteen 135-meter sections along the stream, with three sections in each of five stream zones, so that control and test sections would be matched over areas of varying environmental conditions. Each section encompassed three pools. Testing was conducted for three years.

Before introducing hatchery rainbow trout into Big Springs Creek in July of each test year, Petrosky used electrofishing to count the wild rainbow trout in the stream sections and to tag yearling or older fish. Electrofishing sends an electrical charge through a limited area of water, stunning the fish for ease of handling. In 1979 and 1980, Petrosky used two different stocking regimes, making a single plant of 50 fish in one section of each stream zone, a single plant of 100 fish in a second section, and keeping a third section in each stream zone as a control. Each of the treatment sections received four biweekly plants of 100 fish, exceeding the typical planting density. "Introducing 100 fish into a stream section at a time essentially doubled the biomass in the section," Petrosky said.

Knowing the beginning wild population and the number of introduced fish each year of the study, Petrosky

again counted the fish each fall, testing for effects of stocking. The density of fry and oversummer change in abundance of yearling and older fish was determined for each section.

From recaptures of tagged wild trout, Petrosky looked at whether more wild trout died or emigrated from the sections after hatchery trout were introduced. So few hatchery trout survived the winter season that the testing virtually began as a new experiment each year, Petrosky said. Of the catchable sized hatchery fish, only one percent survived annually. About 13 percent of wild fish lived for a one-year period after tagging.

Petrosky earlier had weighed and measured each wild and hatchery fish at the time of tagging. As tags were recovered, he recorded growth and condition factors for each fish. The condition factor ratio represents the relationship of fish weight to length, or general plumpness of the fish.

Petrosky found that stocking had surprisingly little effect on wild fish in 1979 and 1980, when fewer hatchery fish were introduced. The density of young and the mortality of yearling and older wild trout were only slightly affected in 1981 by the higher stocking density. No important effects on wild trout emigration, growth rate or condition factor occurred at any stocking level.

Petrosky's study does not necessarily point toward more widespread use of hatchery trout. Waters managed for wild trout would continue to be managed that way. Rather, it tends to relieve one of several concerns in existing mixed wild-hatchery trout fisheries. Managers might now shift their attention to harvesting mixed stock populations in such a way as to avoid over harvest of the wild fish.

Researchers collect fish through electrofishing during a counting and tagging procedure at Big Springs Creek, a tributary of the Lemhi River. Charles Petrosky photo





Waha Lake, one of Idaho's 2200 lakes inventoried for the Idaho clean lakes study mirrors a passing cloud. Data collected in the survey will help scientists determine the health of each lake and predict its future productivity.

C. Michael Falter photo

Predictive Model Sought For Health of Idaho Lakes

Investigators:

James Milligan
C. Michael Falter
Edwin Krumpe

John Carlson
Tim Holmes
Ashley Lyman

Trying to find common factors which will account for productivity in Idaho lakes of all sizes, in a variety of terrain and altitude settings, has been a knotty problem for University of Idaho scientists involved in the Idaho clean lakes study.

Researchers spent the spring and summer of 1981 collecting sample data from 90 of the 2200 Idaho lakes, and creating an enormous computer file of over 200 lake and watershed variables. According to Fish and Wildlife professor C. Michael Falter, the physical, biological and chemical data recorded include depth, total acreage, surface mixing layer, thickness, key plant nutrients, watershed geochemistry, and watershed use factors. However, Falter said that in terms of building a computer model to indicate productivity and trophic status of lakes, other factors, such as chlorophyll A might be more directly important.

Chlorophyll A is a vital substance present in most algae and used in photosynthesis. In computer analysis, deeper lakes, and lakes at higher elevations produced less chlorophyll A. To a large extent, the low-lying lakes mirror the activities of the watershed. The number of total animal units and the amount of fertilizer applied throughout the

watershed showed strong negative correlations with the health of lakes. Dryland and irrigated agriculture also adversely affect the lakes within the watershed. Study results have shown that for Idaho, more lakes are adversely affected by agriculture than by their immediate shoreline use. Total phosphorus might offer a better estimate of productivity, Falter said, but is also more expensive to run. "We are trying to develop expressions of these relationships which use the less expensive, readily available watershed information to estimate lake health," he said.

For purposes of model building, model fitting, and developing correlations, researchers need to select lakes with several sampling points. Predictive models, which indicate the health of a lake and its prospects for the future, are important to landowners and agencies throughout the state for planning. In addition to a final report to the Idaho Department of Health and Welfare, which funded the project, the research team plans a hardbound publication on Idaho lakes.

Civil Engineering professor James Milligan has served as coordinator for the project, and has collected hydrologic data on the flow of water into and out of lakes. While Falter has worked with the lakes themselves, concentrating on aspects of lake productivity, socio-economic pressures on lakes were also examined. Professors Edwin Krumpe of Wildland Recreation Management, John Carlson of Agricultural Economics, and Ashley Lyman of Economics, along with sociology graduate student Tim Holmes, evaluated the influence of lakes for industry, recreation, pumping and water supply.

Insects May Develop Immunity To Pesticides—Not to Being Eaten

Investigators:
Edward Garton

Lisa Langelier
John Takekawa

Intensive forest management provides ideal growing conditions for forest trees. Unfortunately, the same conditions which encourage tree growth often promote heavier, and more frequent outbreaks of insect pests. As pesticide use has received more attention relating to side effects, researchers have directed more interest toward biological methods of insect control.

Biological control means using natural enemies of the insects to regulate their numbers and to keep damage below a certain level. Use of birds to control insects is often highly successful. While many insects have evolved with an immunity to pesticides, healthy insect larvae and beetles are preferred fare for birds, which consume an enormous number of insects daily.



Where birds, such as this chickadee, are encouraged, insect outbreaks may be less severe. *John Takekawa photo*

Wildlife Resources professor Edward O. Garton and wildlife graduate students John Takekawa and Lisa Langelier have recently completed a project examining predation by birds as a useful approach to insect pest management. The U.S. Forest Service Western Spruce Budworm Program, through CANUSA, provided funding for the project.

The research team has determined that increased insect consumption occurs in two ways—as birds raise their young to the insect-eating stage, or as birds which travel in flocks move into an area. Regions which have encouraged birds through the placement of nesting boxes often have less severe insect outbreaks. In Europe, where forests are predominantly in private ownership and intensively managed, nesting boxes are used to encourage natural predation by birds far more than in North America. Insecticides, largely produced in the United States, find more use in this country.

Other successful methods of habitat manipulation which bring birds to outbreak areas include leaving snags as nesting habitat for woodpeckers and creating semi-open areas to bring about an increase in predation. Researchers have found that some bird species eat more insects where

forests include well-developed shrub layers than where timber is densely stocked. Trimming brush, providing water in drought-prone areas, making salt available, and supplementing winter food are methods which increase predation among different species of birds.

Fishing Regulations Tested On Coeur d'Alene River

Investigators:
Ted C. Bjornn
Victor Lewynsky

Special fishing regulations on test sections of the Coeur d'Alene River have increased the catch of fish per hour, but have not produced the larger, trophy-sized cutthroat trout hoped for by the Idaho Department of Fish and Game, according to a University of Idaho survey.

The Department initiated special fishing regulations on the upper portion of the river in 1975 to increase trout abundance and to improve angling quality after a 1973 survey found westslope cutthroat trout critically low in abundance. Anglers fishing the test section of the river from 1975 on were restricted to use of artificial bait, keeping only fish over 330 mm (13 inches), and a maximum catch of three legal-sized fish per day.

Fishing pressure increased on the lower control portion of the Coeur d'Alene River from 1973 to 1980 and 1981, as anglers using bait, and others shifted from the special regulation section of the river. Those fishing the control section were allowed six fish per day, regardless of size.

Fisheries graduate student Victor Lewynsky and Fisheries professor Ted C. Bjornn, Leader of the Idaho Cooperative Fishery Research Unit, conducted field surveys in 1980 and 1981 to evaluate changes in the fishery since the special regulations were put into effect in 1975. In 1973, 81 percent of the anglers fishing the upper river rated the fishing fair to good, compared with only 62 percent of the anglers fishing that same area in 1980 under special regulations. More of the anglers fishing the upper river in 1980 (27%) thought fishing had improved recently, compared with those fishing in 1973 (11%). In other findings, the researchers determined that most anglers were not drawn to the test sections by the special regulations, but because of the proximity of the river to their homes. More non-resident anglers used the special regulation section of the river after 1975.

The Idaho Department of Fish and Game supported the project, with funding from the program for Federal Aid to Fish and Wildlife Restoration. The study was conducted to measure angler use, catch, and fish abundance, and to assess angler behavior and attitudes. Trout were counted in river sections by snorkeling to determine abundance, while data from creel surveys and project fishing were used to establish mortality rates. Fish were tagged so that movement between the test and control sections of the river could be monitored. Anglers were encouraged to report where they had caught tagged fish.

Restaurants Now Can Fish by Computer

Investigators:

G.W. Klontz
William Fairgrieve, Jr.

Richard Focht
Christopher Herr
Tom McArthur

Producing a reliable supply of fresh fish for market, home and restaurant use is now a reality with computer technology, according to Fishery Professor G.W. Klontz. After working with fish production data, Klontz has developed computer programs which coordinate fish raising and processing with market needs. He finds the programs highly reliable and highly predictable. "Fish growers using them should be able to produce fish of a certain size by a given day," Klontz said. With such flexibility at the aquaculture end, fish processors can order fish from the growers on a staggered schedule, enabling them to distribute fresh, rather than frozen fish, and to avoid a glut of harvested fish arriving for processing at one time.

Restaurants are now requesting more fresh fish—trout and catfish in the United States, and trout and salmon in Europe—for their customers, said Klontz. Fish growth can be regulated by the quantity and quality of feed, and by water temperature, among other factors. Fishery managers can let fish processors know four or five months in advance if their hatchery waters are not conducive to producing fish of a desired size on schedule. Processors can then contact other sources to maintain an adequate supply. The integrated management system is working in Europe, with independent processors, distributors, fish growers, egg and fingerling producers, and feed manufacturers all timing their efforts to market demand, Klontz said.

While production is not a problem in this country, timing is, Klontz said. When several aquaculturists harvest fish simultaneously, the processor is unable to handle all the fish that are brought in, or must turn to freezing fish to keep them from spoiling. Up to 85 percent of trout and catfish

produced in this country are now frozen by the processor, and stored. Coordinating fish growth and harvest by computer would save on freezer storage, which costs 75 cents per hundredweight per month, Klontz said. The grower would definitely benefit, as payment is often not made to the grower until the distributor sells the fish.

Klontz sees another major benefit from the computer programs as helping the fish farmer to obtain the most from the production dollar. Aquaculturists can use the programs to predict when they will need to order feed, when to start eggs, or to buy fingerlings. They can also use the computer to keep track of the economic set up for their business. The computer program includes 50 different factors, each of which individually can affect fish growth, or create a domino effect. A fishery manager who wants to double the growth rate of fish by doubling their feed can run a simulated program first to find out whether the results of such a project would turn out as expected. The program can also be used for troubleshooting, Klontz said, to create a model showing what the fishery manager has done, and to determine how he or she can correct problems.

Two years of production data have been used in developing the computer program. Graduate students William Fairgrieve, Jr., Tom McArthur, Richard Focht, and Christopher Herr are working on the project with Klontz to prepare production programs for intensive aquaculture systems with funding from the Idaho Water Research Institute and the National Sea Grant program through the University of Washington. Original testing of the model has been conducted at the University of Idaho, with two years of field testing through agencies.

Klontz expected to spend part of the summer setting up programs for 64K personal computers in England, Italy, Bavaria (West Germany) and Switzerland.

Data Collected on Use Of Seven Idaho Rivers

Investigators:

William J. McLaughlin

Edwin E. Krumpe
James R. Fazio

Sections of seven Idaho rivers which provide a variety of recreation opportunities will be observed for two to three years to determine use patterns in a cooperative project of the Idaho Department of Parks and Recreation Management at the University of Idaho. In all, researchers will examine ten sections of the Coeur d'Alene, Priest, North and South Forks of the Payette, South Fork Boise, Upper Salmon, Henry's Fork and Snake rivers for levels of current use to gain a data base for management and planning.

The Idaho Department of Parks and Recreation is responsible for coordinating overall planning of outdoor recreation in Idaho. In this study some of the river sections, which have primarily day use, are now managed by other agencies, such as the Bureau of Land Management or the

USDA Forest Service. Little information has been recorded about their use.

Wildland Recreation Management professors William McLaughlin, Edwin Krumpe, and James Fazio are coordinating a student survey team including Murray Feldman, Jamie Stoltz, Charles Wells, and Amy Braithwaite, who began surveying a sample of river users from late May through September 1983. Questions asked will help the research team determine percentages of river users who are from Idaho and from out of state, the portions of rivers used most, the number of first-time users, and management suggestions from users.

The Idaho Department of Parks and Recreation, which is funding the project, will use the information to maintain a variety of river experiences, including white water rafting, canoeing, motor boating, sport fishing, etc. on Idaho's Rivers.

Wildland Recreation Management

Team Tackles Environmental Awareness

Investigators:

James R. Fazio, Coordinator
William J. McLaughlin

Sam Ham
Lewis Nelson, Jr.
Cary Jones

Helping citizens deal with change in their community and preserve the environment is the intent of a project undertaken by members of the Department of Wildland Recreation Management. The program is sponsored by the Overthrust Industrial Association, 36 companies engaged in oil and gas development in a five-county area where southeastern Idaho, northeastern Utah, and western Wyoming meet. The Overthrust Area is a portion of a 50-mile-wide belt of rock running from Alaska to Mexico, covering the fifth largest deposit of natural gas in the world.

The companies of the association, aware of the rapid growth that accompanies development of gas and oil sites through new jobs and an enlarged tax base are sponsoring the project to help the communities plan for expected growth and reduce environmental impacts which will occur or are occurring. The grant to the University of Idaho researchers for development of an environmental awareness program is part of a larger one-million-dollar cooperative wildlife program to address impacts of increasing human activity on wildlife resources through wildlife research and mitigation efforts.

In the first phase of the project, University of Idaho team members held six community workshops to identify environmental problems that most concerned residents. Wildland Recreation Management professors James Fazio, coordinator, and William McLaughlin; Extension Professor Lewis Nelson, Jr.; Resource Management Institute graduate student Cary Jones, and media technician Malcolm Montgomery formed an interdisciplinary workshop team to tour the area and conduct the workshops. Local residents placed emphasis on five concerns:

- providing information about needs of native wildlife species to reduce impacts on their habitat, and to reduce poaching;
- encouraging respect for local laws and private property, so that newcomers could find out where boundaries existed and avoid trespassing, and learn such common rural courtesies as closing gates behind them and not harrasing livestock;
- restricting human activity, such as off-road vehicle use on the dry and shallow soils of the region, so fragile that wagon tracks from the Oregon Trail are still in evidence;
- preserving the rural life style and culture of the region; and
- providing information about recreation opportunities within the different counties, and their rules and regulations.



James Fazio leads a community workshop to identify environmental problems. *William McLaughlin photo*

Following the citizen involvement sessions, Wildland Recreation Management professor Sam Ham coordinated the production of a slide-tape titled "The Overthrust Area: a Double Treasure" with the assistance of media lab technicians Dan White, Richard Fedorchak, and Malcolm Montgomery. The show will be made available to school, church, youth and civic groups, sporting and recreation organizations and state wildlife federations. Aimed at high school students and adults, the program deals with the large picture of oil development in America, with attendant assets and liabilities, then turns to the specific five-county area, showing local wildlife and other resources, town buildings and citizens as they are known to the communities, and depicts various problems and ways to prevent them. Touching upon all five issues identified in the workshops, the program stresses avoidance of further damage to the environment, the current condition of wildlife, the problem of trespassing, and potential conflicts between newcomers and established residents.

A second major product is a series of full-color booklets written by James Fazio. Each will focus on one of the five counties in the project area (including Bear Lake County in Idaho), and will describe local recreation sources, land management agencies and sources of further information. In addition, there will be recommendations for what individuals can do to reduce their impacts while engaging in each major recreational activity.

The third product is a teacher's guide, which will include the booklet, a set of posters on off-road vehicles produced by the Bureau of Land Management, and a discussion guide to be used with the slide show. The guide will also encourage teachers to take advantage of two existing packages—Project Learning Tree, produced by the American Forest Institute, and Project Wild (see page 14).

Forest Resources



Harold Osborne, left, Manager of the University of Idaho Experimental Forest, leads a tour group through an area of the forest which was thinned in an experimental program to provide firewood. *George Savage photo*

Thinning Stand Increases Vigor, While Supplying Firewood

Investigators:

Donald Hanley
Harold Osborne

Just as carrots grow better when the plots are thinned out, so do trees grown for saw logs. But thinning timbered acres of small-sized trees may cost the timber owner \$60 to \$100 per acre. Because there is little demand for products from the small-sized trees, their market value is low. However, in recent years, the demand for firewood has been growing. Small-sized trees can help to meet that demand. Extension Forester Donald Hanley and Harold Osborne, Manager of the University of Idaho Experimental Forest, tried an experimental pilot project of thinning for firewood in 1982, and expanded it in 1983.

For the pilot project, a 1.3-acre stand of 80-year-old, even-aged mixed conifers was chosen. Selected woodcutters obtained permits to cut trees less than 9 inches in diameter, with the understanding that they would cut and move the wood within a month's time. For the acreage selected, available firewood was estimated to yield about nine cords per acre.

The Firewood Management Area established for 1983 contained 2.5 acres of timber in the Flat Creek Unit of the Experimental Forest. Permits were sold for half-acre sub-units, for rights to smaller, 65-year-old timber. Tree species included primarily western larch, Engelmann spruce, Douglas-fir, and grand fir, with minor amounts of lodgepole pine, western redcedar, subalpine fir and white pine.

According to Hanley, removal of the small, live trees is a clean operation which creates little slash in the stand. At the same time, the firewood cutter is working with small material, which is easy to handle, even though it is up to twice the weight of dry firewood. The green wood must be seasoned for a year before use in order to minimize creosote formation during burning.

From the tree-grower's standpoint, Hanley said, the owner needs to mark the trees which are to be left, usually looking for about 15-foot spacing between the trees. The stand after thinning will be in better condition, and may provide other resource opportunities, such as forest grazing. The trees removed are ones with small crowns and poor form which would not respond well to release if the larger trees of the same age were removed.

Osborne cautioned that owners must be specific about stating the time of year the wood is to be cut, the price, and restrictions in a formal contract. Wood lot owners must also comply with state regulations, and must select woodcutters carefully. Osborne recommended asking foresters for advice in setting up a firewood-thinning project.

The Flat Creek area used in the project will be used as a field demonstration area for forest tours. While some revenue from the firewood permit sales is gained by woodland owners, Hanley pointed out that the amount is small, and may be outweighed by the time the woodlot owner must spend marking leave trees and supervising the area. The major benefit is accomplishing a thinning program at low cost.

Laboratory Insects Must Remain Similar to Wild Populations

Investigators:

Molly Stock

Jacqueline Robertson

Quality of laboratory-reared insects is generally defined in terms of how well the insects fulfill their intended role in the field or the laboratory. For example, considerable attention has been given to quality control in mass-rearing insects for release as biological control agents. Mass-released insects must remain "normal" in order to compete effectively with their wild counterparts. Similarly, a colony intended to represent a species in controlled laboratory research must retain as many properties of the wild population as possible. However, colony insects may become, over time, very different from their wild counterparts. They adapt to the special requirements of the laboratory—diet, temperature, and light regime. They also may become inbred and genetically very different from wild populations.

A large colony of western spruce budworm, maintained continuously at the USDA Forest Service laboratory at Berkeley since 1964, is used extensively for pest management research whose results are then used in actual field work. For example, the number of lab insects which die when sprayed with a particular insecticide is used to predict results of field applications of that insecticide.

Forest Resources Professor Molly Stock, working with Jacqueline Robertson, Supervisory Research Entomologist at the USDA Forest Service Station in Berkeley in a cooperatively funded project, compared a diversity of genetic and biological characteristics of the laboratory insects with samples taken from field populations. Their results show that although the laboratory colony is less genetically diverse than natural populations, its response to chemicals is still basically the same. Results of this work support the validity of continued use of this colony for budworm research. However, Stock and Robertson have developed and implemented new procedures and regular monitoring to minimize future genetic divergence of the laboratory colony from its wild relatives.



Sweetgum, a residential tree suitable for towns in southern Idaho's high plains, is one of 50 species described in a proposed planting guide. *Don Stinton photo*

Tree Planting Guide Written For Southern Idaho Towns

Investigators:

Arthur D. Partridge

Don Stinton

Donald Hanley

William Snyder

Trees, properly selected and used, can do much to improve the quality of city life. The Forest, Wildlife and Range Experiment Station is becoming more involved with the trees that comprise our urban forests. Don Stinton, a graduate student in Forest Resources, is developing a tree guide for the communities of the high plains of southern Idaho. Direction on the project is provided by Professors Arthur D. Partridge of Forest Resources, Donald Hanley of Forestry Extension, and William Snyder of Landscape Architecture.

The manual will list the tree species recommended for growth in south Idaho towns, emphasize those which perform most successfully, and detail the conditions for each species which offer the highest degree of success. The guide will deal primarily with the 50 species found to be most suitable for high plains towns. Each tree will be described individually. An appraisal will be made of its useful landscape features and relative success in enduring

urban site conditions. Insect pests, common diseases, advantages and shortcomings, as well as maintenance needs will be noted and discussed. Each tree species has a particular set of characteristics. These, matched with the needs of the property owner, dictate the best selection for a particular planting situation. Stinton planned to prepare the guide in book form during the summer. The Experiment Station hopes to receive matching funds for the project from the Idaho Department of Lands.

Basic Forest Insect Research Has Practical Applications

Investigators:

Molly Stock
Paul Castrovillo

Barbara Bentz
Pam Higby
Gene Amman

In the late 1800s and early 1900s, studies of forest insects were primarily descriptive. Insects were described and categorized without seriously considering their relationships with the forest. Since then, forest entomology has changed in many important ways. One shift is in its practicality. As forestry became a practical science, more intensive management of forest lands necessitated greater attention to insect problems. As a result, the study of relationships among forest insect groups has become more a means to an end than an end in itself. However, forest managers still need to know what insect they are working with.

While the majority of North American forest insect species have been described and are recognizable, there are still groups which look much alike, or are closely related, but are separate species; still others show considerable variation in appearance or behavior within a species. Forest Resources Professor Molly Stock's work at the University of Idaho focuses on the study of genetic relationships among forest insects, mainly spruce budworms (*Choristoneura* spp.) and bark beetles (*Dendroctonus* spp.), groups of considerable economic importance in North American forests. Anatomical similarities or differences among these insects often obscure species distinctions. Researchers can now employ a biochemical procedure called electrophoresis to obtain information on relationships among these groups of forest pests.

Under sponsorship of the Canada/United States Spruce Budworm Program (CANUSA), Stock and former graduate student Paul Castrovillo have worked with *Choristoneura* species. Their studies demonstrate that these species are all closely related. The division between spruce/fir feeders and pine feeders is not paralleled by genetic differentiation, and there are probably fewer actual species than have been described in the literature.

Black Hills Beetles

In a cooperative study, Stock and former Forest Resources graduate student Pam Higby worked with Gene Amman, Principal Entomologist for the USDA Forest Service Intermountain Forest and Range Experiment Station, to

compare mountain pine beetles from 15 sites in 7 western states. The main aim of the research was to discover how different the isolated beetles in the Black Hills of South Dakota are from the main body of the species.

Historically the Black Hills Beetles have been considered different, and even for one period a separate species, from beetles in most of the rest of the range, including Idaho. The high level of genetic similarity observed among all mountain pine beetle collections in this study, including the Black Hills sample, supported the current single-species interpretation of the mountain pine beetle.

Stock and Forest Resources graduate student Barbara Bentz are currently evaluating genetic relationships among and within all *Dendroctonus* species. They hope to use results of this research to identify for forest entomologists which criteria or groups of criteria, such as anatomical, behavioral, or chromosomal characters, are best for estimating species relationships.

Getting the Most Timber In Spite of Mistletoe

Investigators:

Arthur D. Partridge
Richard Halsey

Dwarf mistletoe, a major tree disease in the west, causes an estimated annual loss of 3.2 million board feet of timber. This wood loss can occur both as mortality, and as growth loss in height and diameter.

Previous surveys have shown the incidence of mistletoe in Douglas-fir to be nearly 80 percent for both the Boise and Payette National Forests. Because little information has been available for the effects of mistletoe on Douglas-fir, cutting practices have been developed which ignore or attempt to eradicate the mistletoe problem. No attempt has been made to relate timber volume production to the timing and spread of mistletoe.

Richard Halsey, a graduate student in Forest Resources, is working on the Boise National Forest to collect data on the amounts of mistletoe, its density and distribution on Douglas-fir. Halsey is working primarily with *Arceuthobium douglasii*, which affects Douglas-fir, and is of particular importance in southern Idaho. He is also collecting data on vigor of unaffected trees. Information relating the distribution and intensity of a mistletoe infection to the volume production of a tree may provide insight for scheduling tree harvest to coincide with the peak of timber productivity. Halsey is working with plant pathologist Arthur Partridge of Forest Resources at the University of Idaho, and forest pathologist Jim Hoffman of the USDA Forest Service.

When related to the size of an individual tree, Halsey's data will be used to predict future volume production. With this information, growth loss models can be formed, and present harvest scheduling guides may be improved. Prediction models which take the effects of mistletoe into account on lodgepole pine and ponderosa pine already exist for the central Rockies.

Forest Products

Ali A. Moslemi (second from right), Head of the Department of Forest Products, and George H. Belt (right), Director of International Programs and Associate Dean, conduct officials from the People's Republic of China through the Forest, Wildlife and Range Experiment Station at the University of Idaho. Minister of Forestry Yang Zhang (left), listens to the presentation translated by Dai Peters (second from left), a University of Idaho student, as members of the delegation look on. The wall in the background is panelled with Idaho's commercial wood species. Susan Roberts photo



Wood Technology, Marketing Expertise Strengthen International Research Bonds

Use of wood in the world market and as a renewable resource in individual countries has encouraged a broad-based approach to wood technology in the Department of Forest Products at the University of Idaho. Progress in understanding chemical reactions of wood in bonding can be applied not only to timber grown in the Pacific Northwest, but also to tree species grown in other parts of the world. Students and scientists from Honduras, Brazil, Morocco, Korea, Taiwan and more recently from the People's Republic of China have come to the University of Idaho to study how chemical processes used here can be adapted to woods native to their own countries. In addition, properties of southern hardwoods and Honduran pines have been the subject of studies conducted through the Department of Forest Products. Cooperation and exchange agreements with other countries have strengthened international relationships and identified the University of Idaho as a participant in international research programs. The Minister of Forestry from the People's Republic of China toured the Forest, Wildlife and Range Experiment Station with a delegation in July 1983. Minister Yang Zhang looked at research projects and received a copy of Chinese wood standards both in Chinese and in English translation, presented by Dean John H. Ehrenreich. A number of Chinese officials have toured the

campus and experiment station during the last four years.

Marketing of wood products and the running of efficient, cost-effective logging and biomass retrieval systems are important considerations for the Department of Forest Products. Early in August 1983, the department sponsored the first in a series of Inland Empire Forest Products Marketing Conferences to be held annually. The first conference focused on the export of forest products to Japan and China, to make Inland Empire forest products firms aware of the potential benefits and risks associated with entering those markets. The Western Wood Products Association, the U.S. Small Business Administration, the Service Corps of Retired Executives, the U.S. Department of Commerce International Trade Administration and University Continuing Education at the University of Idaho joined the Department of Forest Products in sponsoring the conference, a project of professor Robert L. Govett. Other marketing projects within the department have projected potential markets for forest products from developing countries, and for use of fuel recovered as biomass following logging operations. In addition to the marketing conferences the department is sponsoring annual workshops on lumber drying and on logging engineering. The latter will feature use of microcomputer technology in logging mountainous terrain.

Continuing Education/Extension

Project Wild

Lewis Nelson, Jr.

Fitting another course into the school curriculum would be a major project for most school districts. Yet Project Wild, which teaches awareness of the earth as habitat for people and wildlife, is approaching the teachers with topics for writing assignments, supplementary games that reinforce basic learning skills, and resource problem situations for students to solve within existing school subjects. The activities have been tested and evaluated in classroom situations.

Lewis Nelson, Jr., Wildlife Resources professor and member of the steering committee, is excited about the project, which has been developed over a three-year period. "Because this program is presenting neutral material—no special interest content—support is coming in from 18 state fish and game agencies, the Canadian Wildlife Federation, the American Humane Association, and the Defenders of Wildlife. It is rewarding to see these organizations support the same educational program." Other potential sponsors have also inquired about Project Wild.



The interdisciplinary curriculum activities have been set up through the Western Association of Fish and Game agencies and the Western Regional Environmental Education Council (WREEC). A seven-member steering committee includes educators who are agency personnel, WREEC members, and members-at-large. Activity-writing workshops in Alaska, Idaho, Arizona, Colorado and California produced the materials, which will be coordinated into booklets for kindergarten through grade 6, and grades 7 through 12 by late fall.

Stu Murrell, Environmental Education Coordinator for the Idaho Department of Fish and Game, has been designated Coordinator for Project Wild in Idaho. He is planning 15-hour Project Wild orientation classes for Spring 1984. Public school teachers who have taken the Wildlife Ecology and Management Workshop offered throughout Idaho by Murrell and Nelson through University of Idaho Continuing Education will serve as Project Wild orientation instructors. When plans are completed, Project Wild orientations will be advertised among school teachers, scout and Campfire leaders, 4-H leaders and other youth groups. Teachers and leaders must attend one of the orientation classes to obtain the Project Wild curriculum materials.

Forest Products Offers Marketing Bulletin

Robert L. Govett

The Idaho Forest Products Marketing Bulletin made its first appearance in January of 1982. A project of Forest Products professor Robert L. Govett, the bi-monthly bulletin is designed to provide a communications link for the forest products industry, private forest landowners and the University of Idaho. Serving primarily Idaho firms and residents, the bulletin's purpose is to provide current and topical information on forest products marketing and business management. Portions of the publication will be devoted to other items of interest to the forest products industry.

A primary feature of the bulletin is the reporting of mill delivered log prices, broken down in a range of low, average and high prices paid by species in various geographic regions of the state. The bulletin also includes a "classified ads" section in which ads of up to 25 words in length are run free of charge to the individual or company placing them.

The bulletin is produced by the Department of Forest Products of the College of Forestry, Wildlife and Range Sciences, with assistance from the Cooperative Extension Service, University of Idaho. The bulletin is sent to companies or individuals engaged in forest products business in Idaho. Copies of the bulletin are also available for distribution from Cooperative Extension Service Foresters, all County Offices of the Cooperative Extension Service, IDL Woodland Foresters and Idaho agents and offices of the USDA Soil Conservation Service.

SHORTCOURSES, WORKSHOPS, AND SEMINARS

Throughout the year, research scientists in the Forest, Wildlife and Range Experiment Station conduct workshops, shortcourses and seminars on campus and throughout Idaho and the West. Continuing Education programs which were sponsored, co-sponsored, or produced in cooperation with the Experiment Station or departments of the College of Forestry, Wildlife and Range Sciences over the last year are shown below.

	1982		
		February 7-11	Eighth Annual Aerial Photo Interpretation and Aerial Photography Workshop—Moscow
May 24 - July 2	Land Use Planning in Natural Resource Management Workshop—Moscow	February 25-26	Growing, Harvesting and Marketing Woodland Products in Idaho. In cooperation with UI Coop. Ext. Serv.—Coeur d'Alene
July 11-14	Fishery Ecology and Management Workshop—McCall	March 12	Wolf Symposium—Boise
July 13-14	Idaho Rangeland Committee Sagebrush Workshop—Twin Falls	March 14 - April 1	Continuing Education in Fire Management (CEFEM) Part 2: Applied Sciences—Moscow
July 14-17	Advanced Wildlife Ecology and Management Workshop—McCall	March 22-23	Forest Pesticides in the Inland Empire—in cooperation with Coop. Ext. Serv. UI and WSU—Spokane
July 26-28	Timber Sale Evaluation Workshop—McCall	March 24 - April 23	Wildlife Ecology Workshops March 24-26 Lewiston April 7-9 Caldwell April 21-23 Salmon
August 16-18	Idaho Farm and Land Institute Workshop—Boise	April 8	Range Plant ID Short Course for the Panhandle National Forest—Coeur d'Alene
August 20, September 10	Westgard Ranch Planning Team Meeting—Shoshone, Challis	April 11-12	Public Relations Workshop—for U.S. Forest Service—Elk City
September 11	Elk Management Symposium (2)—Idaho Falls	April 12-13	Africa—Renewable Resource Management—The Role of U.S. Universities—Moscow
October 14-15	Horse Logging Workshop—Moscow	April 20-23	Natural Resources Week—Moscow
October 18-21	Inland Empire Dry Kiln Workshop—Moscow	May 23 - July 1	Land Use Planning in Natural Resource Management Workshop—Moscow
October 19 - November 10	Forest Owners' Taxation Workshops—in cooperation with UI Coop. Ext. Serv. and the Idaho State Tax Commission Oct. 19 Sandpoint Oct. 20 Coeur d'Alene Nov. 4 Lewiston Nov. 9 Idaho Falls Nov. 10 Boise	May 26	Woodland Tree Marking Workshop—Harrison—in cooperation with Soil Conserv. Serv. and the Kootenai-Benewah Soil Conserv. Dist.
October 25 - November 19	Continuing Education in Forest Ecology and Silviculture (CEFES)—Moscow	May 31 - June 1-2	Range Monitoring Workshop—Challis
November 12-13	Forest Access Alternatives Symposium—Coeur d'Alene	June 13-18	University of Idaho Natural Resources Workshop. In cooperation with UI Coop. Ext. Serv.—Ketchum (youth educational program)
December 1	Sixth Annual Wilderness Resource Distinguished Lectureship—Michael Frome—Moscow	June 27 - July 1	Forest Habitat Types of Northern Idaho—Sandpoint
	1983	July 11-16	Forest Habitat Types of Idaho—Ketchum
January 18-19	Range Monitoring Workshops—Salmon, Challis		
February 5, and April 9	Natural History of Northern Idaho: Geology and Vegetation—Clark Fork		

Economist Suggests Changes In Wild Horse Adoption Methods

Neil Rimbey

Kenneth Sanders

The Wild Horse and Burro Act (pl 92-195) was enacted into law in December 1971. This law provides for the protection, control, management and disposal of wild and free-roaming horses and burros on public lands. This law and subsequent amendments, court injunctions and other actions appear to have protected the wild horse and burro herds. In fact, between 1971 and 1981 the estimated wild horse herd population increased from about 17,000 head to nearly 45,000 head. This rapid growth of the horse herds has created problems for the rangeland resource base, for wildlife, and for livestock managers.

One response to the Wild Horse and Burro Act has been the creation of the Adopt a Horse Program by the Bureau of Land Management (BLM). The program was established nationwide in 1976, and has resulted in the removal of 35,000 animals from western rangelands. These animals have been adopted by interested individuals from around the nation. The fee for adopting a horse is currently \$200 per head; burros can be adopted for \$75. The \$200 fee for horses only partially covers the estimated cost of gathering and placing the animals. The BLM has estimated the cost to be about \$325 per head, which does not include

expenses for holding, feeding and transporting horses which are difficult or impossible to place.

As might be expected, the primary demand appears to be for younger horses, which can be handled and broken, or otherwise "converted" into animals for riding, packing, or other utilitarian purposes. For example, the Boise District BLM gathered between 150 and 200 horses in the summer of 1982. The younger horses and mares with foals were readily adopted. However, there was little interest in the older stud horses, primarily because of the \$200 fee. In fact, at the time of this writing, the BLM in Caldwell is still feeding and caring for about 35 at a feedlot there. This fact is causing concern from other areas scheduled to gather horses this year. Current year funding for wild horse management is being eroded through having to care for and feed horses remaining from last year's roundups. This puts a cloud over gathering horses in 1983 without additional appropriations.

Neil Rimbey, Extension Range Economist with the Cooperative Extension Service in Caldwell, and an associate member of the Department of Range Resources, working with Range Resources professor Kenneth Sanders, has



This small band of wild horses is one of a growing number which roam freely on public lands in Idaho and other western states. Changes in the wild horse adoption program are suggested which might ease management problems for wildlife, rangeland and livestock managers. *David Bryant photo*

developed some suggestions which could help the situation from the standpoint of a professional economist. He outlined several approaches to promote the availability of adoptable horses, and to develop a market which would serve those who wish to adopt horses.

He suggested advertising the availability, quantity and quality of horses to be offered for adoption, a practice which has been tried previously; lowering the price of horses which have not been adopted after a certain length of time; and considering variable fees based upon the quality or type of horse. According to Rimbey, past demand has indicated a willingness to pay more than \$200 for mares and younger horses. He believes that older stud horses may not be adopted without a lower fee, and that some experimentation with fee levels or market development is warranted.

Another approach would hinge on amendments to the current Wild Horse and Burro Act, which might include giving immediate title to the animals, rather than the current wait for one year of supervised possession; eradicating the

four-horse adoption limit per individual; and providing authority for agencies to sell horses which had not been adopted.

Building on the auction system, and after an in-depth study of the wild-horse situation, Rimbey suggested that the excess wild horses might be placed through "free" market activity, with the highest bid for individual horses becoming the adoption fee. The proposal would serve several purposes, according to Rimbey. All of the horses would be sold at a price determined by competitive bidding; unadoptable horses would not be left for the agencies to feed. The market would determine the type horse which would generate the most revenue. This demand should suggest management direction for the agencies. If demand is high for younger horses, then the agencies should manage the herds to produce that type of animal. Roundups could be timed to maximize the number of young and reduce damage to rangeland. Wild horses could, in fact, come to be considered a resource from a planning and management standpoint.

Range Resources

Southern Idaho Habitat Types Described

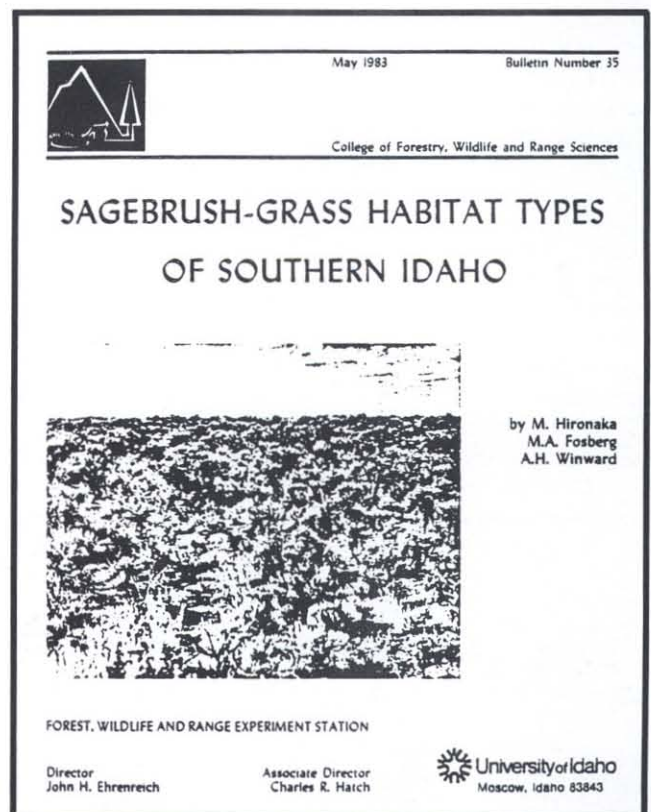
Investigators:

M. Hironaka
M.A. Fosberg
A.H. Winward

A system of land classification based on climax vegetation appeared this spring in a new publication, "Sagebrush-Grass Habitat Types of Southern Idaho." Authors Minoru Hironaka, Maynard Fosberg, and Alma Winward have described 32 different sagebrush-grass habitat types, with attention to variations, common understory plants, soil texture and classification, and management implications. Visual and descriptive keys are presented which can help personnel determine habitat types in the field. The authors also list scientific names of trees, shrubs, forbs, grasses and grass-like plants commonly found in sagebrush-grass regions.

The publication is the product of a cooperative agreement between the University of Idaho and the USDA-Forest Service Intermountain Forest and Range Experiment Station, Ogden, Utah, to develop habitat classifications for grasslands and shrublands in southern Idaho. The authors do not recommend use of the classification outside of southern Idaho, an area dominated by the basalt lava Snake River Plain. Other features of the area include the Owyhee Plateau and sedimentary mountain ranges laced with valleys suitable for grazing.

The 44-page booklet was published by the Forest,



Wildlife and Range Experiment Station of the University of Idaho as Bulletin Number 35. It was produced in cooperation with the College of Agriculture, the Experiment Station, and the Cooperative Extension Service of the University of Idaho. The authors and their cooperative disciplines are Hironaka, Professor of Range Resources in the College of Forestry, Wildlife and Range Sciences, University of Idaho; Fosberg, Professor of Soil Science in the College of Agriculture, University of Idaho; and Winward, Regional Ecologist for USDA-Forest Service Region 4, Ogden, Utah. Copies of the Bulletin may be purchased from the Forest, Wildlife and Range Experiment Station at the University of Idaho.

Computers Can Track Cows, Calves, Range, and Weather

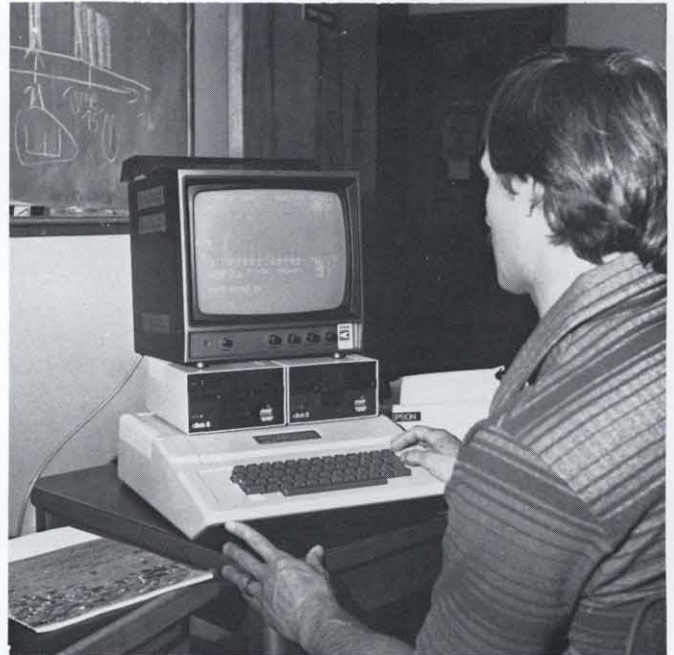
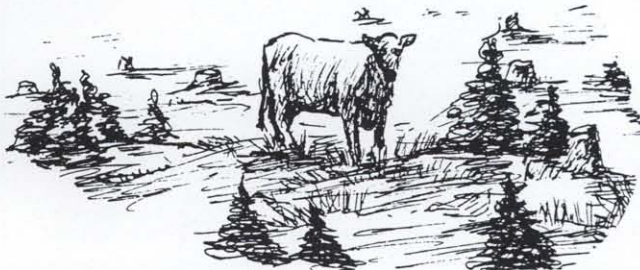
Investigators:
John Pardue

Lee Sharp
Ray Richmond

When pounds of beef per acre is the measure of productivity for a range resource, it makes sense to use all help at hand, including computers, to make the best use of the range. Agricultural Computing Professor John Pardue and Range Resources Professor Lee Sharp, along with Range graduate student Ray Richmond, know that ranchers are aware of conditions on various portions of their range. Ranchers also know where the weather has been mild or severe during a given season, and where the snow cover has been inadequate.

Pardue, Sharp and Richmond would like to see that knowledge put into a personal, micro-computer, as a form of record keeping, so that those responsible for range management can begin to compare patterns over one or several years and improve their use of the range. Ranchers involved in cow-calf operations raise and sell calves each year as their product. Using computers, they can easily graph the weight of calves produced by a certain cow over her productive lifetime, gauging when she should be replaced by another heifer. The whole herd can also be observed through a computer profile, with individual animals compared to herd averages.

The importance of range condition readily demonstrates itself through use of a computer program, where calf weight can be traced back to a particular range area, or series of areas over the rearing period. Pardue said the research team



John Pardue tracks the snow cover by month on a section of rangeland managed for cow-calf production. Data fed into a computer can be retrieved to show condition or weather on different sections of range or to graph the calves produced by a particular cow. *Susan Roberts photo*

would like to make ecologists of the ranchers, encouraging them to put the facts they observe daily into the computer for improved record keeping. Range condition is based on the plant species growing on a particular area, and the frequency of each species within a measured plot. With the aid of computers to retrieve data, the range manager can monitor changes in the palatable range plants and shift cattle accordingly.

The computer program developed for cow-calf management offers the rancher the chance to look at each range unit in terms of ownership, classification, condition, the time a number of cows have grazed a unit, the season that unit is available, and proposed actual use. Long-term management of a range can improve the resource, an important factor in Idaho, where much of the available rangeland is owned by federal agencies and used under a permit system by area ranchers. Information from some of the best range managers in the state has been used to set up programs for better management. Comparing the weight and health of cows and calves with the condition of the range or pasture unit and projecting the effect of weather from past observations of similar wet or dry years offers range managers a valuable predictive aid for getting the most from their resource.

The program has been developed as a cooperative project of the Colleges of Agriculture and Forestry, Wildlife and Range Sciences at the University of Idaho, with federal funding through the Renewable Resources Extension Act. Pardue, Sharp and Richmond are working to introduce computer education to resource managers and to prepare software programs through field testing.

Appendix

EXPERIMENT STATION SCIENTISTS

Stoszek, Milena J.
Director of the FWR Nutritional Lab and Research
Associate Professor

Pym, Geneva
Research Technician

DEPARTMENT OF FISH AND WILDLIFE RESOURCES

Ables, Ernest D.
Department Head and Professor
Wildlife ecology, especially animal behavior and
radiotracking technique

Bennett, David H.
Associate Professor
Warmwater fishery management, fish ecology

Bizeau, Elwood G.
Assistant Leader, Cooperative Wildlife Research Unit and
Professor
Birds, principally waterfowl and marsh

Bjornn, Theodore C.
Leader, Cooperative Fishery Research Unit and Professor
Fish ecology and management

Bradley, Terrence
Fishery Research Associate

Burge, Howard
Fishery Research Associate

Chacko, A. Jim
Fishery Research Scientist
Parasites and parasitic diseases of fish, anatomy and
histology of fishes

Congleton, James
Assistant Leader, Cooperative Fishery Research Unit and
Assistant Professor
Marine ecology, environmental physiology

Corrarino, Charlie
Fishery Research Associate

Dalke, Paul D.
Professor Emeritus
Wildlife management

Drewien, Roderick C.
Research Wildlife Biologist
Wildlife, migratory birds, endangered species

Falter, C. Michael
Professor
Reservoir limnology, stream ecology

Garton, Edward O.
Associate Professor
Wildlife population biology, systems ecology

Hornocker, Maurice G.
Leader, Cooperative Wildlife Research Unit and Professor
Population ecology, predator-prey interactions

Hungerford, Kenneth E.
Professor Emeritus
Wildlife management

Irving, John
Fishery Research Associate

Kessler, Winifred B.
Associate Professor
Range management/wildlife relationships

Klontz, George W.
Professor
Diseases and rearing problems of aquatic animals

Kusel, John
Wildlife Research Associate

Lawless, Mary M.
Wildlife Research Associate

MacPhee, Craig
Professor Emeritus
Fish behavior, ecology, toxicology

Melquist, Wayne
Research Wildlife Biologist

Moffitt, Christine M.
Visiting Assistant Research Professor
Fish ecology and management, fish passage

Nelson, Lewis, Jr.
Extension Professor

Nelson, Louis
Wildlife Research Associate

Peek, James M.
Professor
Big game management, habitat relationships

Ringe, Rudy
Fishery Research Associate

Stauffer, Dean
Wildlife Research Instructor

Wright, R. Gerald, Jr.
Cooperative Park Studies Unit Project Leader—Biology, and
Associate Professor
Range systems ecology, simulation modeling

DEPARTMENT OF FOREST PRODUCTS

Campbell, Alton G.
Assistant Professor
Wood chemistry

Christophersen, Kjell A.
Associate Professor
Forest products marketing, production economics

Guevara, Ruben
Research Associate

Hofstrand, Arland D.
Professor
Anatomy and mechanical properties of wood

Howe, John P.
Professor Emeritus
Wood science and technology

Johnson, Leonard R.
Professor
Forest engineering, industrial engineering, mathematical
modeling

Lee, Harry W.
Assistant Professor
Forest engineering

Moslemi, Ali A.
Department Head and Professor
Panel products technology, wood residue utilization

Steinhagen, Peter H.
Associate Professor
Heat and mass transfer applied to wood

DEPARTMENT OF FOREST RESOURCES

Adams, David L.
Department Head and Professor
Silviculture, forest management (growth and yield)

Belt, George H.
Associate Dean for Research, FWR Experiment Station
Associate Director, Director of International Programs
and Professor
Hydrology, meteorology, planning, forest management

Brockhaus, John
Research Instructor

Brunsfeld, Steven
Research Associate

Burlison, Vernon H.
Extension Forester Emeritus and Extension Professor
Emeritus

Burnell, Donald G.
Research Scientist

Canfield, Elmer R.
Associate Professor Emeritus
Forest Pathology

Crookston, Nicholas L. II
Research Associate

Dennis, Brian
Assistant Professor
Statistical ecology

Deters, Merrill E.
Professor Emeritus
Forest silviculture

Fins, Lauren
Executive Director, Inland Empire Tree Improvement
Cooperative and Assistant Professor
Forest genetics

Force, Jo Ellen
Assistant Professor
Modeling, land use planning, biometry

Goudie, James W.
Research Associate

Hanley, Donald P.
Extension Forester and Associate Extension Professor

Hatch, Charles R.
Professor (on leave with USAID Joint Career Corps in India)
Mathematical stand modeling, mensuration

Heller, Robert C.
Research Professor Emeritus
Remote sensing, photo interpretation, forest entomology
surveys, and evaluation

Hosman, Kevin
Research Associate

Johnson, Frederic D.
Professor
Forest ecology, forest communities, forest botany

Kessler, Bruce
Research Associate

Knox, Diane
Research Technician

Laursen, Steven B.
Research Associate

Loewenstein, Howard
FWR Experiment Station Assistant Director and Professor
Forest soils and tree nutrition

Machlis, Gary E.
Cooperative Park Studies Unit Project Leader—Sociology,
and Assistant Professor
Interpretation, human ecology, environmental sociology

McKetta, Charles W.
Assistant Professor
Timber production economics, forest management, forest
taxation

Medema, E. Lee
Associate Professor
Forest resource economics, forest policy, stumpage market
analysis

Mika, Peter G.
Research Associate

Moore, James A.
Director, Intermountain Fertilization Cooperative, and
Associate Professor
Silviculture, quantitative methods, forest production

Neuenschwander, Leon F.
Associate Professor
Fire ecology, fire management, prescribed burning, general
ecology

Osborne, Harold L.
Manager, University of Idaho Experimental Forest and
Research Instructor
Silviculture, harvesting

Partridge, Arthur D.
Professor
Forest pathology

Pregitzer, Kurt S.
Assistant Professor
Forest ecology, forest soils, ecosystem classification,
nutrient cycling

Schenk, John A.
Professor
Forest entomology, insect ecology, silviculture, and
biological control of forest insect pests

Seale, Robert H.
Professor Emeritus
Forest economics

Sheehan-Akers, Katherine
Research Associate

Skille, Jack
Research Scientist

Srivastava, Nilema
Research Associate

Stark, Ronald W.
Professor
Population dynamics and integrated pest management of
forest insects

Stiff, Charles
Assistant Professor
Mensuration, mathematical tree and stand modeling

Stock, Molly W.
Associate Professor
Forest insect population genetics and biosystematics

Stoszek, Karel J.
Professor
Silviculture, forest protection, forest entomology

Tennyson, Larry C.
Associate Professor
Watershed

Ulliman, Joseph J.
Professor
Aerial photography, mapping, aerial photo interpretation,
remote sensing

Vander Ploeg, James
Research Associate

Wang, Chi-Wu
Professor Emeritus
Forest genetics

Wenny, David L.
Forest Nursery Superintendent and Assistant Professor
Silviculture, forest regeneration

Young, Bruce
Research Associate

DEPARTMENT OF RANGE RESOURCES

Bryant, David
Department Head and Professor
Range and livestock management

Bunting, Stephen C.
Associate Professor
Fire ecology, range ecology

Ehrenreich, John H.
Dean, College of Forestry, Wildlife and Range Sciences,
FWR Experiment Station Director and Professor

Hironaka, Minoru
Professor
Range ecology, synecology, autecology

Kingery, James L.
Assistant Professor
Range improvements, natural resource policy and
economics

Sanders, Kenneth D.
Associate Professor
Range management

Sharp, Lee A.
Professor
Grazing practices, rangeland policy considerations, range improvements

Tisdale, Edwin W.
Professor Emeritus
Range resource evaluation and management, native range vegetation types, ecology of range weeds, vegetation habitat relationships

DEPARTMENT OF WILDLAND RECREATION MANAGEMENT

Fazio, James R.
Associate Dean of Academics and Professor
Communication and principles of natural resource management, environmental interpretation, continuing education delivery systems, conservation history

Frome, Michael
Visiting Associate Professor
Communications

Ham, Sam H.
Assistant Professor
Interpretation, communication, environmental education

Krumpe, Edwin E.
Director of Wilderness Research Center and Assistant Professor
Social psychology, decision processes in recreation, communications and interpretation

McLaughlin, William J.
Department Head and Associate Professor
Regional and recreation planning methods, citizen participation, recreation behavior, perception and visual resource management

Fedorchak, Richard
Media Technician

UNIVERSITY OF IDAHO EXPERIMENTAL FOREST AND FOREST NURSERY

Osborne, Harold L.
Manager, University of Idaho Experimental Forest and Research Instructor

Bassler, Gregory
Forester

Strong, Allan E.
Logging Superintendent

Wenny, David L.
Forest Nursery Superintendent and Assistant Professor

Brenda Sterner
Nursery Technician

ADMINISTRATIVE SERVICES

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Managers, Taylor Ranch

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Coordinator of Continuing Education

Bottger, Richard F.
Director of Administrative Services

DeWald, Dan
Manager, Clark Fork Experiment Station

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Motor Pool Technician and Property Controller

Roberts, Susan B.
FWR Experiment Station Editor

Sargent, Marilyn
Assistant Director, International Programs

Savage, George H.
Director of Information Services, Managing Editor and Adjunct Associate Professor of Natural Resources Communications

RESEARCH PROJECTS AND INVESTIGATIONS

This listing of projects shows the range of work in progress through the experiment station; it is not a publication listing. To save space, abbreviated project titles are given. If additional information is needed, please write to the principal investigators or to the Associate Director, Forest, Wildlife and Range Experiment Station, University of Idaho.

DEPARTMENT OF FISH AND WILDLIFE RESOURCES

- Effects of wolf predation on Vancouver Island deer. E. D. Ables, I. Hatter
- Effect of habitat manipulations on wildlife. E. D. Ables, L. Mettler
- Recruitment of largemouth bass (*Micropterus salmoides*) in the Coeur d'Alene Lake system. D. H. Bennett
- Fishes of the Savannah River National Environmental Research Park. D. H. Bennett
- Walleye investigations in Idaho. D. H. Bennett
- Examination of the spawning ecology and early life history of kokanee salmon in Coeur d'Alene Lake. D. H. Bennett
- Evaluation of the feasibility of cross-fostering bald eagle eggs to osprey nests. E. G. Bizeau
- Reestablishment of the whooping crane in the western United States. E. G. Bizeau, R. C. Drewien
- Habitat use and reproductive success of an introduced population of Rio Grande wild turkeys. E. G. Bizeau, C. Ogden
- Coeur d'Alene River fisheries investigations. T. C. Bjornn
- Evaluation of methods for controlling bacterial kidney disease in Snake River chinook salmon. T. C. Bjornn
- Evaluation of various hatchery rearing conditions on seaward migration of steelhead trout. T. C. Bjornn
- Sedimentation and productivity of salmonid streams. T. C. Bjornn
- Wild versus hatchery trout. T. C. Bjornn
- Adult fall chinook trapping for Snake River egg bank program. T. C. Bjornn
- Adult cui-ui at Marble Bluff Dam. T. C. Bjornn
- Habitat selection and species interaction of juvenile trout in Flathead River tributaries. T. C. Bjornn
- Development and validation of habitat-standing crop functions for stream fish and their foods. T. C. Bjornn
- Evaluation of wild stock status. T. C. Bjornn
- Mineral additions to water at Dworshak National Fish Hatchery. T. C. Bjornn
- Effects of cottonwoods on salmonid habitat. T. C. Bjornn, M. A. Brusven
- Evaluation of pilot rearing programs for steelhead at Dworshak and Hagerman National Fish Hatcheries. T. C. Bjornn, R. Ringe
- Role of short distance migration on the homing of salmon. T. C. Bjornn, R. Ringe
- Fish time and size for release. T. C. Bjornn, C. M. Moffitt, D. Lam
- Effects of collection and transportation on chinook salmon smolts. J. L. Congleton, T. C. Bjornn
- Collection and transport of spring chinook smolts from Lower Granite Dam and possible chinook-steelhead interactions. J. L. Congleton, T. C. Bjornn, C. Robertson
- Effects of stress on the viability of chinook salmon smolts transported from the Snake River to the Columbia River estuary. J. L. Congleton, T. C. Bjornn, B. Watson, B. Burton
- Payette Lake limnology. C. M. Falter
- Fate, distribution and limnological effects of volcanic tephra in St. Joe and Coeur d'Alene River deltas. C. M. Falter, J. M. Skille
- Benthos of streams on the southern Cascade Mountains, Washington. C. M. Falter
- Volcanic ash effects in the Palouse River. C. M. Falter, M. A. Brusven, J. Milligan
- Avian predation on western spruce budworm. E. O. Garton
- Baseline survey of Bannock Creek Research Natural Area. E. O. Garton, K. S. Pregitzer, F. Rabe
- A survey of grizzly bear habitat in the Selkirk Mountains. M. G. Hornocker, J. Almack
- Ecology of the bobcat in the River of No Return Wilderness. M. G. Hornocker, G. Koehler
- Population dynamics of reintroduced fisher in northcentral Idaho. M. G. Hornocker, M. Luque
- A survey of trade in spotted cats and river otter in Central and South America. M. G. Hornocker, W. Melquist
- Population dynamics of the jaguar in Brazil. M. G. Hornocker, H. Quigley
- Black bear ecology in northern Idaho. M. G. Hornocker, J. Rohlman
- Ecology of the ocelot in southern Texas. M. G. Hornocker, M. Tewes
- Factors influencing success of salmonid spawning in tributaries of Priest Lake, Idaho. J. Irving, T. C. Bjornn
- Sage grouse response to wildfire. W. B. Kessler
- Pheasant and quail populations of the Umatilla Indian Reservation. W. B. Kessler
- A study to abolish the carrier states of bacterial kidney disease and furunculosis in anadromous salmonids. G. W. Klontz
- Computerized production forecasting in salmon hatcheries. G. W. Klontz

- Vertical transmission of infectious pancreatic necrosis virus in rainbow trout. G. W. Klontz
- Evaluation of commercial ornamental fish diets. G. W. Klontz
- Environmental gill disease in rainbow trout. G. W. Klontz, A. J. Chacko
- Epidemiology of proliferative kidney disease in rainbow trout. G. W. Klontz, A. J. Chacko
- Aquaculture computerized production. G. W. Klontz, W. Fairgrieve Jr., T. McArthur, R. Focht, C. Herr
- Evaluation of wild stock status. C. M. Moffitt, T. C. Bjornn
- Fish production in drainages where anadromous fish have been excluded by construction of dams. C. M. Moffitt, T. C. Bjornn
- Statistical methods for fish and wildlife biologists: a video course. L. J. Nelson
- Survey of economic value of wildlife in Idaho. L. J. Nelson, M. G. Hornocker, E. G. Bizeau
- Relation of rank-order of bull moose to winter habitat use. J. M. Peek
- Mule deer investigations in the vicinity of Rufus Woods Lake. J. M. Peek
- Bighorn sheep response to post fire communities on Ship Island Burn, Middle Fork Salmon River, Idaho. J. M. Peek
- Aerial census for elk populations. M. Samuel, E. O. Garton
- Effects of increased fine sediment on incubation and emergence of chinook salmon and steelhead trout. R. White
- Mountain goat activity and behavior in relationship to Highway 2 reconstruction and visitor use in Glacier National Park. R. G. Wright
- Population dynamics and habitat use of mule deer at Craters of the Moon National Monument. R. G. Wright
- Mule deer population dynamics and distribution at Craters of the Moon National Monument. R. G. Wright
- A synthesis of the scientific data base at Glacier National Park. R. G. Wright
- Investigation of riparian ecosystems, Flathead Basin, Montana. R. G. Wright

DEPARTMENT OF FOREST PRODUCTS

- Idaho forest products marketing. R. L. Govett
- Idaho directory of primary processors. R. L. Govett
- Forest products marketing to China. R. L. Govett
- Influence of a number of techniques on the dimensional stability of birch wafers. R. Guevara, A. A. Moslemi
- Chemical stabilization of fiberboards. R. Guevara, A. A. Moslemi
- Effects of various logging methods on soil compaction, infiltration, capacity and moisture content. H. W. Lee
- Rainfall-snowmelt relationship for a clear-cut and a partial cut. H. W. Lee

- Infiltration into forest soils using a ring infiltrometer and a rainfall simulator. H. W. Lee
- Developing and testing wood residue delivery systems. L. R. Johnson
- Simulation of logging systems by computer. L. R. Johnson
- Development of small skidder for small wood recovery. L. R. Johnson
- Testing of existing production models of soil compaction under northern Idaho logging conditions. L. R. Johnson
- Evaluating double-entry logging for forest residue recovery in the Intermountain region. L. R. Johnson
- Cement-wood particleboard with northern Rocky Mountain species. A. A. Moslemi
- The influence of chemical accelerators for inorganic binders for particleboard. A. A. Moslemi
- An analysis of larch extractives and their impact on setting of portland cement. A. A. Moslemi
- Wood-cement bond development with Korean lignocellulosics. A. A. Moslemi, W. Y. Ahn
- The potential of selected Amazonian hardwoods for inorganic-bonded particleboard. A. A. Moslemi, M. Sobral Filho
- The compatibility of Honduran species with inorganic binders. A. A. Moslemi, R. Guevara
- The impact of 30 chemicals on larch-cement hydration. A. A. Moslemi, L. Zhentian
- The relationship between hydration parameters with strength and dimensional properties of cement-bonded particleboard. A. A. Moslemi, D. Ritter, A. D. Hofstrand
- Development of head conditioning schedules for frozen and unfrozen veneer logs. P. H. Steinhagen
- Flash-drying improvements by better mixing action. P. H. Steinhagen
- Preventing blue stain in Honduran sawnwood for export. P. H. Steinhagen

DEPARTMENT OF FOREST RESOURCES

- Shade effects on western redcedar seedlings. D. L. Adams
- Survival and growth of Douglas-fir planted in north Idaho brushfields. D. L. Adams, S. Christianson
- Seed wafer development: physiology of seed germination, rodent repellents, soil-site relations. D. L. Adams, C. Dirks
- Development of models of spruce budworm defoliation-induced changes. D. G. Burnell
- Field identification of Idaho willows. S. J. Brunsfeld, F. D. Johnson
- Annotated plant list of the University of Idaho Experimental Forest. S. J. Brunsfeld, H. L. Osborne
- Ecology and management of Pacific yew. R. Crawford, F. Johnson
- Use of species abundance distributions for monitoring trends in water pollution impacts. B. Dennis

- Ecophysiological genetics of larch casebearer-western larch pathosystems. L. Fins
- Early detection of graft incompatibility for Inland Douglas-fir and the selection of compatible rootstocks. L. Fins
- Shoot growth in relation to adaptation and productivity in western larch (*Larix occidentalis*). L. Fins
- Genetic consequences of seed-tree cutting. L. Fins
- Public participation in forest land use planning. J. E. Force
- Characteristics and behaviors of firewood collectors. J. E. Force
- Development and application of the tree and stand simulator for Douglas-fir. J. W. Goudie
- Stand-based economic analysis of plantation spacing in simulated stands of lodgepole pine. J. W. Goudie
- Method to compare two diameter distributions using the variance-covariance matrix of the Weibull parameters. J. W. Goudie, B. Dennis
- Spruce budworm population model. C. R. Hatch
- Population behavior and natural enemy studies of the western spruce budworm. C. R. Hatch, R. W. Campbell
- Growth and yield model for eucalyptus in Morocco. C. R. Hatch, H. Mazzoudi
- Development and validation of a metamodel for yield estimation. C. R. Hatch, C. T. Nguyen
- Ecology and distribution of Idaho woody plants. F. D. Johnson
- Natural regeneration of *Thuja plicata*. F. D. Johnson, T. Parker
- Predicting the occurrence of buried seed in forest soils. F. D. Johnson, N. Kramer
- Classification for site quality and productivity in the upland pine forests of interior Honduras. F. D. Johnson, C. T. Stiff
- Riparian vegetation used by grizzly bear in Yellowstone National Park area. F. D. Johnson, D. Mattson
- Modeling the effects of nitrogen fertilization on stem form development of forest trees. S. B. Laursen
- Development of shrub height and cover models for Idaho forest ecosystems. S. B. Laursen, J. A. Moore
- Tree growth and response to soil and foliar nutrient levels and environmental factors. H. Loewenstein
- Impact of timber harvesting on microbial nutrient cycling. H. Loewenstein, J. Entry
- Classification of financial costs for timber sale road components in the northern region. C. W. McKetta
- The Jones Act and Alaskan forest products. C. W. McKetta
- Fuel treatment specifications and economic cost procedures. C. W. McKetta, L. F. Neuenschwander
- An empirical evaluation of methods used to assess economic effects in the northern region. E. L. Medema
- Western spruce budworm impact assessment: hazard model validation and vulnerability model development. P. G. Mika



- Intermountain Forest Tree Nutrition Cooperative. J. A. Moore
- Reforestation guidelines for northern Idaho. J. A. Moore, D. L. Adams, S. Fitzgerald
- Modeling early shrub succession after clearcut and burn treatments in grand fir-cedar-hemlock forests. L. F. Neuenschwander
- Effects of slash pile burning on soils. L. F. Neuenschwander
- Ecology of bitterbrush. L. F. Neuenschwander, S. C. Bunting
- Effect of fire on antelope bitterbrush. L. F. Neuenschwander, S. C. Bunting
- Trees for high desert towns. A. D. Partridge, D. P. Hanley, D. A. Stinton
- Harvest schedules for mistletoe-infected Douglas-fir. A. D. Partridge, J. Hoffman, R. L. Halsey
- Carbohydrate utilization and carbon storage by coexisting fungi causing conifer root disease. A. D. Partridge, D. J. LeTourneau, C. L. Bertagnole
- Regeneration of root disease openings in Idaho forests. A. D. Partridge, E. Militante, J. Y. Woo
- Amelioration of problems in coniferous seeds and seedlings. A. D. Partridge, J. Y. Woo, B. A. Advincula
- Predicting response to fertilization using one-year changes in needle weight. K. S. Pregitzer
- Developing forest fertilization screening trials in the Intermountain Region. K. S. Pregitzer
- Cone production and losses to insects in a Douglas-fir seed production area as influenced by nitrate nitrogen fertilization. J. A. Schenk
- Post harvest evaluation of channel sediments and aquatic ecosystems in Horse Creek. J. Skille
- Expansion and evaluation of the MFPS (Multipurpose Forest Projection System) for Boise Cascade Corporation. C. T. Stiff
- Relationships among *Ips pini* from California, Idaho, and New York. M. W. Stock
- Genetic variation among mountain pine beetle subpopulations along an endemic to epidemic gradient across the north slope of the Uinta Mountains in Utah. M. W. Stock, G. D. Amman
- Genetic variation among mountain pine beetles from seven western states. M. W. Stock, G. D. Amman
- A general model of insecticide efficacy for forest defoliators. M. W. Stock, J. L. Robertson
- Relationships of foliage biomass to six descriptive environmental gradients within the *Thuja-pachistima* and *Tsuga-pachistima* series of northern Idaho. K. J. Stoszek, E. Hernandez-Vasques
- Silvicultural options for understocked ponderosa pine stands in the Chihuahua region of Mexico: even-aged or uneven-aged. K. J. Stoszek, M. Mendoza-Briseno
- Applying uneven-aged silvicultural systems to ponderosa pine-Douglas-fir and grand fir-subalpine fir stands in northern Idaho. K. J. Stoszek, R. Muentner
- Effects of clearcutting and prescribed burning on nitrogen mineralization rates in surface soils. K. J. Stoszek, G. J. Niehoff
- Evaluation of reforestation practices in African savannah types. K. J. Stoszek, N. Samba
- Relationships between western pine shoot borer infestations and nutritional status of ponderosa pine. K. J. Stoszek, G. E. Verzino
- Biodegradation of lignocellulose. M. Stoszek
- Forest management effects on stream channels. L. C. Tennyson
- Application and evaluation of the Gospel Hump "SNOWSED" model on a small forested watershed. L. C. Tennyson
- Characterization and movement of Mount St. Helens tephra on a high mountain lake watershed in Idaho. L. C. Tennyson
- Characterization of the sedimentation cycle with Cesium-137 dating technique. L. C. Tennyson
- Training site delineation for TMS/Forestry study. J. J. Ulliman, J. Brockhaus
- Development of methods using high altitude photography. J. J. Ulliman
- Validation of spruce budworm aerial photo/risk model. J. J. Ulliman, B. L. Kessler
- Quick tests for seedling physiological status. D. L. Wenny
- Containerized production of hardwoods for conservation planting. D. L. Wenny
- Irrigation of hybrid poplar with effluent from the processing of potatoes. D. L. Wenny, K. Kilpatrick
- Testing a tree vigor model to determine lodgepole pine resistance to mountain pine beetle. S. J. Zimmer

DEPARTMENT OF RANGE RESOURCES

- Implementation/evaluation guidelines for prescribed burning in sagebrush/grasslands. S. C. Bunting
- Evaluation of the frequency plot method as an improved technique for the measurement of success. S. C. Bunting, M. Hironaka
- Successional status of a tall forb community in the Centennial Mountains. S. C. Bunting, R. B. Murray
- Reproductive ecology of curlleaf mountain mahogany. S. C. Bunting, L. F. Neuenschwander
- Prescribed burning in *Pinus pinaster* in northern Portugal. S. C. Bunting, F. Rego
- Vegetation change analysis by the frequency plot method: development and procedures. M. Hironaka, S. C. Bunting
- Habitat type classification for the grasslands and shrublands of southern Idaho. M. Hironaka, M. Fosberg
- Sage grouse response to wildfire. W. B. Kessler
- The interrelationship of wildlife and livestock use in tree establishment, survival and growth in three different habitat types in northern Idaho. J. L. Kingery

Ecology of bitterbrush. L. F. Neuenschwander, S. C. Bunting
 Control of Utah juniper with tebuthiuron. K. D. Sanders
 Economics of public grazing and multiple use. K. D. Sanders
 Short duration of crested wheatgrass. K. D. Sanders
 Evaluation of range seeding. L. A. Sharp
 Evaluation of salt-desert shrub rangeland through time. L. A. Sharp
 Ecology of the grasslands of the Snake and Salmon river systems in Idaho. E. W. Tisdale
 A synthesis of the scientific data base at Glacier National Park. R. G. Wright
 Vegetative succession on the lava field at Craters of the Moon National Monument. R. G. Wright

DEPARTMENT OF WILDLAND RECREATION MANAGEMENT

Media package for Colorado Outdoor Education Center. S. Bone, J. Fazio, S. Ham
 Evaluation of a campground recycling program at a Washington state park. S. Ham
 Slide/tape presentation for Moscow Tourism and Convention Committee. S. Ham, R. Fedorchak
 Slide/tape presentation for Idaho Travel Committee. S. Ham, R. Fedorchak
 A validity assessment of the "familiarity" construct as used in recreation behavioral research. S. Ham, E. E. Krumpke

Co-editorship of the *Journal of Interpretation*. S. Ham, G. Machlis
 Public relations case study and plan for new energy-related industries. C. Jones, J. Fazio
 A method to assess and evaluate the information base and science activities at Glacier National Park. E. E. Krumpke, J. M. Peek, P. Hayward
 Archeological survey of prehistoric sites of the Big Creek Drainage of the River of No Return Wilderness. F. Leonhardy
 Cycles of social and economic change in tourist systems. G. Machlis
 A critique of the concept of social forestry. G. Machlis, L. Medema
 An evaluation of threats to the natural resources of world national parks. G. Machlis, D. Tichnell
 Monitoring employee attitudes in the National Park Service. G. Machlis, M. VanEvery
 Interpretive mapping and visitor distribution analysis at Grand teton and Yellowstone National Parks. G. Machlis, S. Ham, M. VanEvery
 A methodology to interpret and monitor the ecological health of national parks. G. Machlis, G. Wright, J. Kusel
 Montana fish, game and parks recreation survey of Flathead River users. W. J. McLaughlin, E. E. Krumpke
 Cognitive images, visitor profiles and the choice process in dispersed forest recreation. W. J. McLaughlin, E. E. Krumpke
 Profiles of Flathead River recreation use at Glacier National Park. W. J. McLaughlin, E. E. Krumpke
 The relation of gender to preferred psychological outcomes of outdoor recreationists. W. J. McLaughlin, W. C. Salvi

FISCAL 1983 PUBLICATIONS AND REPORTS

Copies of Forest, Wildlife and Range Experiment Station publications and reprints of some journal articles are available from the authors. Reports issued in fulfillment of contracts are not available for distribution.

DEPARTMENT OF FISH AND WILDLIFE RESOURCES

Beamesderfer, R. C., and J. L. Congleton. 1982. Spawning behavior, early life history and habitat selection of northern squawfish with references to Colorado squawfish. Final rep. to Colorado River Fishery Project, U.S. Fish and Wildl. Serv.
 Bennett, D. H., and E. C. Bowles. 1982. Recruitment of largemouth bass (*Micropterus salmoides*) in the Coeur d'Alene Lake systems. Progr. rep. to Washington Water Power.
 Bennett, D. H., P. M. Bratovich, W. Knox, D. Palmer, and H. Hansel. 1983. Status of the warmwater fishery and the potential of improving warmwater fish habitat in lower Snake reservoirs. Completion rep. to U.S. Army Corps of Eng. Walla Walla, Wash. 451 pp.

———. 1983. Status of the warmwater fishery and the potential of improving warmwater fish habitat in lower Snake reservoirs. Executive summary. U.S. Army Corps of Eng. Walla Walla, Wash. 33 pp.
 Biederman, B. M., C. C. Lin, E. Kuyt, and R. C. Drewien. 1982. Genome of the whooping crane. *J. Hered.* 73:145-146.
 Bull, E. L., A. D. Partridge, and W. G. Williams. 1981. Creating snags with explosives. USDA Forest Serv. Res. Note PNW-393.
 Congleton, J. L. 1982. Distribution, abundance and cut migration timing of chum and chinook salmon fry in the Skagit salt marsh. *In* Salmon and Trout Migratory Symposium, E. L. Brannon and E. A. Salo, eds. June 1981. College of Fisheries, University of Washington.

- Drewien, R. C., S. R. Derrickson, and E. G. Bizeau. 1981. Experimental release of captive-reared greater sandhill cranes at Grays Lake Refuge, Idaho. Pages 99-111 in J. C. Lewis, ed. Proceedings 1981 Crane Workshop, Nat. Audubon Soc. Tavernier, Florida.
- Falter, C. M. 1983. Nutrient loading to Payette Lake, Valley County, Idaho. Final rep. to Payette Lakes Sewer Dist., McCall.
- Garton, E. O., K. Pregitzer, and F. W. Rabe. 1983. Baseline inventory of terrestrial and aquatic resources of the Bannock Creek Research Natural Area. Final rep. to USDA-Forest Serv. Intermtn. Forest and Range Exp. Sta., Ogden, Utah. 150 pp.
- Griffith, B. 1983. Ecological characteristics of mule deer: Craters of the Moon National Monument, Idaho. CPSU rep. B-83-2. 95 pp. plus appendices.
- Groman, D. B. 1982. Histology of the striped bass. Amer. Fish. Soc. Monogr. No. 3. Bethesda, Maryland. 116 pp.
- Hendee, J. C., C. Schoenfeld, and J. M. Peek. 1982. Wilderness wildlife research opportunities and limitations in designated wilderness areas of the United States. Trans. 43rd. Internatl. MAB-IUFRO Workshop on Ecosystems Research. Kyoto, Japan.
- Irving, J. S., and T. C. Bjornn. 1983. Effects of spawning gravel size composition on salmonid embryo survival. Final rep. to USDA Forest Serv. Idaho Coop. Fish Res. Unit, Univ. of Idaho. 17 pp.
- Irving, J. S., B. Shepard, T. C. Bjornn, N. Horner, and R. R. Ringe. 1983. Fish resources in the Gospel-Hump area of central Idaho and potential impacts of forest management activities. Final rep. to USDA Forest Serv. Idaho Coop. Fish Res. Unit, Univ. of Idaho. 129 pp.
- Kessler, W. B. 1982. Wildlife and second-growth forests of southeast Alaska: problems and potential for management. USDA Forest Serv. Alaska Reg. Admin. Doc. No. 110. Wildlife and Fisheries Habitat Notes 4. USDA Forest Serv. Reg. 10, Juneau, Alaska, in coop. Forest, Wildl., Range Exp. Sta. Univ. of Idaho, Moscow. 36 pp.
- Klontz, G. W. 1983. Trout farming in Idaho. Aquaculture Digest 8(5):1-3.
- Leary, R. F., H. E. Booke, and C. M. Moffitt. 1983. Electrophoretic variation in American shad, *Alosa sapidissima*. Isozyme Bull. January.
- Lewynsky, V. A., and T. C. Bjornn. 1983. Coeur d'Alene River fisheries investigations. DJ Job Completion rep. to Idaho Dept. Fish and Game. 33 pp.
- McAuliffe, J. R., and D. H. Bennett. 1982. Observations on the spawning habits of the yellowfin shiner, *Notropis lutipinnis* (Jordan and Brayton). J. Elisha Mitchell Sci. Soc. 97(3)
- Melquist, W. E., and M. G. Hornocker. 1983. Ecology of river otters in west central Idaho. Wildl. Monogr. No. 83. Supplement to J. Wildl. Manage. 47(2). The Wildl. Soc., Inc. 60 pp.
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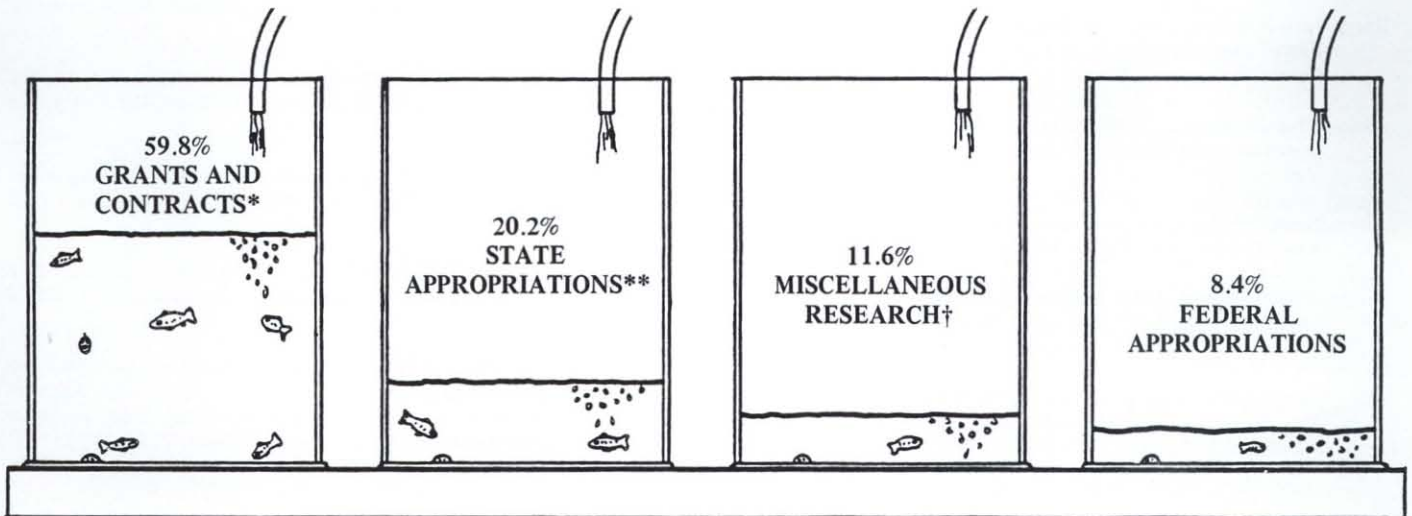
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Fiscal Year 1983 Financial Picture



Research expenditures, shown by funding source, totaled \$5,320,000 for the Fiscal Year 1982-83.

* Includes "in-kind" funds

** Includes FWR Experiment Station, Wildlife, Fisheries, Wilderness and Forest Utilization Research

† Includes Forest Nursery, Experimental Forest, Idaho Research Foundation, Taylor Ranch, WICHE, and Alumni Account

MASTER'S THESES

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Agency and Funding Support

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U.S.D.I. Bureau of Reclamation
U.S.D.I. Fish and Wildlife Service
U.S.D.I. National Park Service
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