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Forest Resources

FIRE MANAGEMENT

Fire managers have been thrust into a new frontier marked by both tradition and change. Today, fire management blends traditional fire control with resource management activities based on principles of fire ecology and on land-use planning constraints.

Since fire affects all resource values, either directly or indirectly, the University of Idaho has developed an interdisciplinary fire program centered in Forest Resources. Directed by Leon F. Neuenschwander, professor of Forest Resources, it consists of a research working group involving Forestry, Range and Wildlife faculty. Current fire research by these members includes use of prescribed fire in forestry, range, and wildlife management; the effect of fire on plant and animal components of the ecosystem; the natural role of fire; interactions of fire with insects and disease; fire-grazing and fire-wildlife interactions.

The College of Forestry, Wildlife and Range Sciences offers four courses in the study of fire management. Undergraduate courses in wildland fire management, fire ecology, and prescribed burning are taught. A graduate course is offered in fire management and ecology. A readings course in fuels management may be offered periodically to interested students.

Leon F. Neuenschwander

GRAZING AFFECTS POTENTIAL FIRE INTENSITY, FREQUENCY

Leon F. Neuenschwander
G. Thomas Zimmerman

Many of northern Idaho's Douglas-fir forests serve as summer range for domestic livestock. Graduate researcher G. Thomas Zimmerman and Forest Resources Professor Leon F. Neuenschwander initiated a study to assess impacts resulting from prolonged livestock use of the forests.

A big game enclosure on the University of Idaho Experimental Forest, that has excluded grazing livestock since 1949, provided the study area. Paired plots located both inside and outside the enclosure were studied for overstory, understory, and fuel accumulation.

The researchers found that livestock grazing encouraged increases in numbers of trees, caused decreases in production, cover, and frequency of major palatable grasses, and altered dominance of shrub and forb species. Grazing was also responsible for increases in downed woody fuel in every size class, increases in forest floor duff depth, and decreases in live herbaceous fuels.

The resulting modifications in fuel distribution and composition are slightly less favorable to frequent surface fires, but are highly conducive to the vertical spread of fire. Potentials for major conflagrations appear to have increased in areas heavily grazed by livestock for long periods of time.

Information gained from this study shows that continued livestock grazing without fuel management not only will cause reductions in the frequency of low intensity fires, but will promote conditions that favor the occurrence of infrequent, high intensity fires.

This study was conducted in cooperation with the Intermountain Forest and Range Experiment Station of the USDA Forest Service.

Steve Baken monitors prescribed burning research at Worley, Idaho. *John Marshall photo*

Jamie Lewis lights prescribed fire with a drip torch as part of a field session for the wildland fire management course. The burning was part of a project for the Bureau of Indian Affairs, conducted on the Coeur d'Alene Indian Reservation at Worley. *Leon Neuenschwander photo.*

EXPERIMENTAL BURN DATA CORRELATE CONDITIONS, EFFECTS

Leon F. Neuenschwander
Stephen Baken

Economically disposing of logging residue following timber harvest poses a major concern for land managers in many temperate commercial forests. This problem becomes acute in thinning and selection-cut harvesting, where additional fuel increases the potential for economic damage from wildfire. Slash and debris gathered mechanically or by hand are pile burned. These activities, already costly, may have adverse effects on the soil, especially on steep slopes and erodable soils.

Because mature ponderosa pine resists damage from fire, prescribed burning may offer an alternative to present slash disposal practices. However, fire behavior and the ecological effects of burning are hard to measure and predict precisely. Though the physics of fire has been examined under both laboratory and field conditions, much of the existing fire research lacks the depth to describe the dynamic nature of fire.

Graduate researcher Stephen Baken and Forest Resources Professor Leon F. Neuenschwander, in cooperation with the Bureau of Indian Affairs (Coeur d'Alene Indian Tribe) and the Intermountain Forest and Range Experiment Station of the USDA Forest Service, are developing fire prescriptions as a management tool for commercial ponderosa pine stands in the Douglas-fir/ninebark habitat type. While looking primarily at fuel and duff reduction, they are also examining tree damage and natural regeneration.

For this study, researchers recorded conditions before and during burning on permanent plots in the Douglas-fir/western larch forests of Montana. They conducted fifty prescribed fires during the fall of 1978, using three burning techniques and a wide variety of intensities. Long term effects of the fires will be correlated with the original physical characteristics of each burn.

The study provides statistical correlations of fuel reduction with the size, moisture content and quantity of fuel. Models are being developed from the collected data. Fuel reduction and fire behavior will be analyzed as functions of several fuel and weather parameters: 1) air temperature, 2) relative humidity, 3) wind speed, 4) fuel size, 5) fuel quantity, and 6) fuel moisture content. Tree mortality will be related to crown scorch, cambial damage, and the physiological condition of the trees. Ponderosa pine tree regeneration will be related to duff depth and soil moisture.

Information gained from this study will help forest managers develop sound management plans for forest stands used as summer range for livestock.

GENETIC STUDIES DEFINE SPRUCE BUDWORM POPULATIONS

Molly W. Stock
Paul J. Castrovillo

The western spruce budworm, a native North American insect, defoliates vast expanses of Douglas-fir and true fir forests in the western United States and Canada. Idaho, in the middle of this insect's range, suffers budworm infestations on several million acres of public and private land annually. This pest species is not comprised of billions of identical organisms, but rather of many individuals, each with slight differences in physiology, morphology, and behavior. Individual variation, coupled with natural selection, gives rise to populations of insects which respond to the environment in different ways. Awareness of these differences is very important to effective understanding, monitoring, and management of western spruce budworm outbreaks.

Gel electrophoresis is a laboratory technique that has recently been applied at the University of Idaho to the study of population variation in forest insects. Genetic variation within a group of organisms is responsible for many of the physical differences among individuals. Electrophoretic separation and identification of insect proteins, which correspond closely to the insects' genes, provide information that can be quantified easily and used to delineate naturally isolated budworm populations. Estimating the degree of similarity of insects on the basis of a discrete set of genes with this tool removes much of the subjectivity which plagues comparison of less clear-cut traits such as behavior and morphology. Laboratory screening with electrophoresis is quick, convenient, and relatively straightforward once a routine is tailored to the species of interest.

The United States and Canadian governments are providing funding for the jointly sponsored CANUSA Spruce Budworms Program. Spruce budworm samples are obtained from cooperators located over most of western North America. Forest Resources Professor Molly Stock and graduate researcher Paul J. Castrovillo have begun to delineate "similarity units" of budworms–so far, three groups in the Idaho/Montana area and two in southern British Columbia. On the basis of genetic composition, these populations appear to be significantly isolated from each other, even though their ranges appear continuous.

It has been demonstrated with other species that genetic composition can reflect, and may be used to predict, insect response to environmental variables such as tolerance to insecticides. The presence or absence of diagnostic genes may also be helpful in understanding population movement. These important facets in dealing with the spruce budworm problem are being addressed by these studies with electrophoresis. Attempts are being made to correlate budworm similarity units with several parameters of interest, such as predisposition to outbreak, host tree preference, fecundity, or dispersal capabilities.

With the identification of morphologically similar but genetically distinct western spruce budworm populations, the questions arise: How stable over time and space are budworm similarity units? and To what key physical traits can these groups be related? Current research is aimed at finding an answer. Continuing studies will make available a system of looking at spruce budworm infestations from the genetic aspect, exceedingly important to pest managers, and will refine electrophoresis as a tool. Pest management decisions will be greatly enhanced when taking into account budworm population genetics.

PRESCRIBED BURNING COMPARED ON GRAZED, UNGRAZED STANDS

Leon F. Neuenschwander
G. Thomas Zimmerman

In a cooperative study, researchers have determined that prolonged livestock grazing in forest stands limits the effectiveness of prescribed burning. University of Idaho graduate researcher G. Thomas Zimmerman and Forest Resources Professor Leon F. Neuenschwander, in cooperation with the Intermountain Forest and Range Experiment Station of the USDA Forest Service, have studied prescribed understory burning in both grazed and ungrazed Douglas-fir stands on the University of Idaho Experimental Forest.

Prescribed burning, an increasingly useful technique in ponderosa pine and Douglas-fir forests of northern Idaho, reduces fire hazards, prepares mineral soil seedbeds, controls insects and disease, thins dense sapling stands, and improves forage yield, quality, and big game habitat.

Livestock grazing removes herbaceous fine fuels that normally support the spread of low intensity fires used in prescribed understory burning. Grazing is also responsible for greater accumulations of downed woody fuels of large sizes. Together, these grazing-induced fuel situations restrict the fire rate-of-spread, yielding slow moving fires that burn in a patchy pattern and smolder in larger fuels.

In contrast, forest stands excluded from grazing support rapidly moving fires that consume nearly all the fine fuels, top-kill the majority of the shrubs, and reduce downed woody fuel accumulations.

The researchers are seeking the specific burning prescription (weather and fuel moisture conditions) which will achieve prescribed burning results in grazed Douglas-fir stands equal to those achieved through burning ungrazed Douglas-fir stands.

DISTURBANCE FACTORS ENCOURAGE RARE PLANTS

Frederic D. Johnson
Rex C. Crawford

Prescribed burning is most often associated with timber stands or forests. But here in the Northwest, growers of bluegrass seed have routinely burned their fields following harvest to remove field debris and improve seed production, another example of planned burning. Results of a recent study of endangered and threatened plants indicate that planned burning and other forms of disturbance may also improve the habitat for some species which require full sun.

Graduate researcher Rex C. Crawford, working with Forest Ecology Professor Frederic D. Johnson, has found that five of six rare plant species proposed for threatened or endangered status in the Clearwater Basin are doing well enough to be removed from the list. A sixth plant, *Phlox idahonis*, still needs protection. At the start of the project, this plant was known to exist in only one meadow. Crawford found two more populations on wet meadows. All are on Potlatch Corporation land in the Pierce area.

Phlox idahonis is susceptible to grazing and its numbers are reduced by grazing pressure. Flowering is also reduced in shade. Researchers have concluded that fire must have been the disturbance factor involved in maintaining a healthy population. To follow up on this observation, they burned an ungrazed meadow which supported both a healthy community of phlox and healthy shrubs which were shading out the phlox. The results showed more stems and flowers of phlox in the meadow than had grown there previously. The shrubs were set back, or killed, but the phlox bloomed the following year.

Dasynotus daubenmirei has a very limited distribution. Nonetheless, it is clearly benefited by logging, with or without fire following. *Synthyris platycarpa* was found to be more widely established than expected. It too is a plant whose flowering is reduced in the shade of older forests and gains in numbers of plants and numbers of flowers following fire or logging.

Cardamine constancei and *Waldsteinia idahoensis* both benefit from moderate disturbance. A light fire or a partial cut seem to greatly improve these species. *Corydalis caseana hastata* grows in or on the edge of small streams. Fire or logging activities increase the sediment load in

Corydalis caseana hastata (foreground) blooms along the edge of Tepee Creek near an old railroad trestle. This community is located on a clearcut in the Headquarters area. *Rex Crawford photo*

these streams, which in turn provides a fine seedbed for *Corydalis* seedlings. The removal of trees over these streams stimulates flower and seed production.

Thus, all six species of endangered and threatened plants studied benefited from disturbance. Under natural conditions, fire was the disturbance factor involved. Now, we can add timber-harvesting as an additional beneficial factor. Of the six species studied, five were found to have extensive populations which were healthy and reproducing. Thus, they were recommended for removal from the proposed federal lists. Only *Phlox idahonis* is so rare and so restricted in habitat that it is still a candidate for endangered status.

LOGGING EQUIPMENT PROVIDES EXPERIENCE, REVENUE

Harold Osborne

Forestry students gain "hands-on" work experience on the University of Idaho Experimental Forest. The 7100-acre college forest contains an estimated stand inventory of 120 million board feet. Forest Manager Harold Osborne expects to harvest about 1.2 million feet annually, beginning this year.

Harvest activities on the forest began 7 years ago, under the guidance of Emeritus Professor Frank Pitkin. Revenues generated by sawlog and other product sales have funded research on the forest, equipment purchase, and forest operating costs. The forest serves as a teaching laboratory for logging methods from overstory removal to clearcutting. Students also have the opportunity to study the relation of logging to regeneration. Departments of Wildlife and Range in the college study animal behavior and grazing productivity on the forest.

Through an agreement with Lewiston Equipment Company, first struck in 1976, the college has been provided the use of a Clark 667 rubber-tired skidder, valued at $63,000, for a 2-year period. The college pays transportation and maintenance costs, but no rental fees.

Equipment operated on the forest and owned by the college includes an International TD-24 obtained as surplus from Alaskan pipeline construction, a smaller John Deere dozer, a fuel transport truck and mobile shop, pickups and a carryall. A road grader has also been obtained through an agreement with the Clearwater-Potlatch Timber Protective Association. Testing of a Case-Davis small-log skidder is featured on page 22. The donation of a mobile yarder has been promised by a Eugene, OR, equipment firm. Without such equipment loans and donations, the college could not have begun to use the forest so extensively as a research and training tool, according to Osborne.

Students gain valuable logging experience while working on the University of Idaho Experimental Forest. The sale of harvested timber supports forest research, equipment purchase and operating costs. Lewiston Equipment Company has loaned this Clark skidder to the college for a 2-year period. *Bill Loftus photo*

GUIDELINES DEVELOPED FOR RELEASING ADVANCE GRAND FIR

David L. Adams
Dennis E. Ferguson

To ensure the most efficient production of timber, the forest manager must make decisions with consequences lying far in the future. Among those decisions is whether or not to retain advance natural regeneration–small, young trees growing in the shadows of merchantable mature timber.

Overstory removal releases these young trees, opening their environment to increased sunlight, moisture, and nutrients. If they can adjust to the changed environment and grow well, they economically stock the site for the next rotation, shorten rotation time, and reduce the need for site preparation and planting. If the advance regeneration fails to adjust or adjusts too slowly, it occupies space better used for other trees. The economic consequences of a decision to retain or to remove advance regeneration could, thus, be considerable.

In the grand-fir/cedar/hemlock ecosystem of northern Idaho, advance regeneration of grand fir, *Abies grandis*, is particularly widespread. Should these small trees be retained? Or should they be removed and replaced by a possibly faster maturing regeneration?

A recently published study by David L. Adams, professor and Department Head of Forest Resources, and Dennis E. Ferguson, forester, USDA Forest Service, Intermountain Forest and Range Experiment Station, provides data which will help forest managers answer those questions more knowledgeably.

Investigating specifics within three general variables–tree characteristics, site conditions, and the extent of physiological shock sustained by released trees–Adams and Ferguson identified particularities of tree age, tree condition, and site condition that affect adjustment to release.

They also provide a predictive mathematical model for studying and displaying the relationships involved in release. This model, when incorporated into the regeneration establishment phase of the Prognosis Model of Stand Development constructed by A.R. Stage, principal mensurationist, Intermountain Forest and Range Experiment Station, will enable forest managers to evaluate the response of an inventoried stand to release as contrasted to other silvicultural methods.

This cooperative project is funded by the Forest Utilization Research Program (FUR) through the University of Idaho Forest, Wildlife and Range Experiment Station and the USDA Forest Service Intermountain Forest and Range Experiment Station, Moscow.

The sample tree, beside the height pole, was very slow in responding to release. It has grown only about 0.1 foot per year over a 12-year period. *Dennis Ferguson photo*

USERS MANUAL DEVELOPED FROM ECONOMIC ANALYSIS

E. Lee Medema **Charles W. McKetta**
Charles R. Hatch **James A. Moore**

Research projects, once begun, tend to spread and grow into new areas, producing not only initial results, but also encouraging further study and bringing in more cooperating agencies along the way. Because Idaho's 14 million acres of commercial forest land play an important part in the state's economy, the Forest Productivity Study was undertaken to bring together the parties concerned with forest inventory and analysis to discuss timber supply projections and inventory systems and to develop timber supply projections for the state through the year 2045. Results were published in January 1976 by Charles R. Hatch, Gerald M. Allen, Geoffrey L. Houck, and Kenneth M. Sowles.

Financial support provided by the Pacific Northwest Regional Commission through the Idaho Department of Lands backed the second phase of the study, an economic analysis published in June 1978 by Kjell A. Christophersen, Charles W. McKetta, Charles R. Hatch, and E. Lee Medema. This portion of the study identified stand

Burning of sagebrush was conducted by the Bureau of Land Management on this site near Shoshone, Idaho, for cooperative fire research to determine effects of fire on plant communities. *Bureau of Land Management photo*

management practices and evaluated possible treatment frequency and intensity for the rotation period. It analyzed and evaluated forest management treatments using financial and biological forest maturity criteria.

This led to the adaptation of the economic analysis model for use by forest managers. To link the model to the stand prognosis model developed by Stage in 1973, E. Lee Medema and Charles R. Hatch of Forest Resources developed a users manual written in FORTRAN IV. Computerized Help for the Economic Analysis of Prognosis-model Outputs (CHEAPO) was published in May 1979, under a contract with the U.S. Department of Agriculture Forest Service Intermountain Forest and Range Experiment Station, Forest Sciences Laboratory, Missoula, MT. A Stand Prognosis Model Workshop was held on the Idaho campus in August.

The culmination of this research has led to a further study by Medema, Hatch, James A. Moore, and McKetta, professors of Forest Resources and Mark Wendick of the Idaho Department of Lands. They are using data and concepts developed in the earlier studies to assist personnel from the Idaho Department of Lands in analyzing and interpreting forest management investment opportunities in managed stands and measuring the difference in income potential on state forest lands resulting from use of financial rather than biological rotation age. The Idaho Department of Lands is supporting the project.

FIRE EFFECTS EVALUATED ON BIG SAGEBRUSH COMMUNITY

Leon F. Neuenschwander
Nancy Clifton

The effects of a fall prescribed burn on a Wyoming big sagebrush-bluebunch wheatgrass community are being investigated by Forest Resources Professor Leon F. Neuenschwander and graduate researcher Nancy Clifton, in cooperation with the Bureau of Land Management and the USDA Forest Service Intermountain Forest and Range Experiment Station, Northern Forest Fire Laboratory, Missoula, MT.

Preburn sagebrush densities were determined and bunchgrass plants were tagged for a survival study during the summer of 1978. In September, an area of about 5000 acres was burned in a mosaic of 0.25- to 20-acre patches. Survival and regrowth of sagebrush and bunchgrass species, changes in plant species composition, and effects on summer distribution of sage grouse will be examined during the summers of 1979 and 1980.

The ultimate goal is to provide a quantitative analysis of changes in the plant community and in summer distribution of sage grouse following burning. Effectiveness of the particular burning prescription will be evaluated for meeting resource management objectives.

INSECT STUDY REFINES HAZARD RATING MODEL

John A. Schenk
David L. Adams
James A. Moore
Ronald L. Mahoney
Steven B. Laursen
Shane D. Weber
Barbara Busse

Studies of the fir engraver beetle over a wide range of site and stand conditions in 1979 have led to further refinement and validation of a model rating stand hazard for grand fir based on the moistness of the site. It has been established that grand fir is more susceptible to attack and mortality on sites at the drier end of its ecological range.

Use of standard forest cruise data in models developed and validated by Forest Resources Professors John A. Schenk, David L. Adams, and James A. Moore, Research Associate Ronald L. Mahoney, and Research Technician Steven B. Laursen offers the land manager assistance in stand treatment decisions. The original model (the Stand Hazard Rating) relates stand composition and average competitive stress to occurrence and level of grand fir mortality by the fir engraver. The project, begun in 1972, includes analysis of beetle community structure and habitat suitability and the effect of intensity of harvest cutting on slash accumulation, understory vegetation, cone and seed production and loss, and stand regeneration. It is supported in part by McIntire-Stennis and forest industries. Graduate researchers on the project are Shane D. Weber and Barbara Busse.

Researchers studied the entire community of grand fir bark and ambrosia beetles to determine relative abundance and habitat suitability for the various species. Of 14 species found, the fir engraver and another bark beetle, *Pityokteines elegans* were the most abundant, successfully infesting extremely wide ranges of tree and microhabitat conditions. Some species' attacks were restricted to narrow ranges of microhabitat. Although significant differences in habitat occupied by the various species were determined even at endemic population levels, the wide ecological amplitudes of some species overshadowed niche specialization. Therefore, direct control of one species would probably lead to the insurgence of others.

Cone production and cone and seed insect damage levels were related to two levels of shelterwood harvest cutting, a practice which allows a new crop of trees to become established before all the harvest-sized, sheltering trees are removed. Although heavily cut stands had only about 50 percent of the cone production of the lightly cut and control stands, they produced a greater number of cones per tree and a higher percentage of standing cone-bearing trees. Heavily cut stands also had the highest percentage of insect infested cones. Ninety-nine percent of all cone and seed damage encountered in this study was attributed to four insect species. It appears that substantially reducing the number of cone-bearing trees in a stand increases the impact caused by cone and seed insects.

The different levels of harvest intensity were also related to stand regeneration and subsequent site conditions. Post-logging survival of grand fir regeneration established prior to harvest was significantly lower in heavily cut stands than in lightly cut and control stands. This was largely due to increased competition caused by the upsurge of herbaceous understory plant species in the heavily cut stands.

RARE PLANTS LOCATED IN HELLS CANYON CORRIDOR

Frederic D. Johnson

Looking for rare plant species in the Hells Canyon river corridor is only part of the difficulty in collecting data—the other part is getting there. Rocky slopes and precipitous terrain make access to plant species a major problem.

Last summer, with the aid of USDA Forest Service jet boats, researchers Dave Mattson and Sue Bischoff, under the direction of Forest Ecology Professor Frederic D. Johnson, conducted a field survey in the corridor area. Working from a federal list of plants proposed for threatened or endangered status, and from a similar list compiled by the state of Oregon, the field team located several species in sufficient abundance to recommend their removal from proposed threatened or endangered status.

Of the eight rare species shown on the federal list, the team found healthy populations of *Hackelia hispida, Lomatium serpentinum* and *Rubus bartonianus.* They have recommended removal of these species from threatened status. Occurrence of a fourth plant, *Lomatium rollinsii,* was limited. It has been noted for retention on the list.

The team was unable to locate four other rare species, i.e., *Mirabilis macfarlanei* and *Happlopappus radiatus,* proposed as endangered, or *Penstemon elegantulus* and *Allium tolmiei* var. *persimile,* proposed as threatened. They have recommended the retention of *Mirabilis macfarlanei* on the federal list, but withheld recommendations for the other three species due to insufficient data.

During the field season, they also found and recommended removal of five of the nine rare species shown on the Oregon list. The project is part of a continuing effort to gather information on rare species proposed for threatened or endangered status in Idaho and surrounding areas. This information is being assembled and evaluated by the Idaho Rare and Endangered Plants Technical Committee, which will issue a list of Idaho sensitive plants in the spring of 1980.

Wildlife Resources

Fritz Creek fire in the Upper Selway produced a mosaic of burned and unburned stands which were used more by mule deer and elk than by white-tailed deer. Forage production on burned areas was three times greater than on unburned areas over a 4-year period. *James Peek photo*

FIRE BENEFITS BIG GAME BY IMPROVING BROWSE, NUTRIENTS

James M. Peek
Jerry L. Lauer
Jeffrey A. Keay
Robert A. Riggs
Evelyn H. Merrill
Thomas Owens

Wildlife and fire—conflict or complement? Researchers are finding that lightning-caused fires which in the past burned acres of big game range have improved forage for many species rather than destroying their habitat. As forests grow to contain mature to overmature timber, grasses and shrubs which are grazed by big game animals are gradually shaded out by the thickening branches of trees. Browse once available at a convenient level has now grown above the heads of many animals, which must desert their accustomed range area or starve. Grasses which are decadent and unproductive may be rejuvenated by burning.

Wildlife Resources scientists have been investigating responses of big game and big game forage sources to fire since 1973. Mule deer, white-tailed deer, elk and bighorn sheep all benefit from burning of their habitats, but size of burn and vegetation burned influence their responses. Fires which benefit mule deer may not benefit white-tails, for example.

In recent research on vegetation response to fire in the Selway-Bitterroot Wilderness Area, graduate researcher Evelyn Merrill discovered a three-fold increase in grass and forb production on herbaceous unions during the first year after burning. The increase was sustained for 4 years

following the 1973 fire, with increases primarily in perennial forbs and annual grasses. Low shrubs increased production after the burn, returning to original heights within 2 years. Shrub nutrient levels, especially nitrogen, increased for all species.

Graduate researcher Jeffrey Keay found that in the White Cap Creek area of the Selway, white-tailed deer tended to shy away from burns, while mule deer and elk increased use of the area and vegetation. Implications of this study, according to Professor James Peek, are that where fires burn in ponderosa pine communities in the Selway, elk and mule deer will derive the most benefit.

On smaller burns in the northern part of the state, graduate researcher Thomas Owens discovered that white-tailed deer did benefit from increased browse following a fire. Owens found that the white-tails browsed small burns on areas farther north of the Selway. The burns were conducted in the Hatter Creek area under the supervision of Leon Neuenschwander. Although fire can be very useful as a management tool for big game, managers must know how to use fire to benefit each species using the range, Peek said.

White-tailed deer use small burns in northern Idaho for feeding. *Larry Irwin photo*

Bighorn sheep preferred to graze on these small burned sites in sagebrush-grassland on the East Fork Salmon River. *Jerry Lauer photo*

In a study of bighorn sheep in Salmon County on the East Fork of the Salmon River, six burns, totalling 3.75 acres, were conducted by the Bureau of Land Management. Research Associate Jerry L. Lauer and graduate researcher Robert A. Riggs worked on the bighorn project with Peek. Their findings showed that bighorn sheep preferred burned areas to unburned for a 4-year period immediately following the burn.

This study gives further strength to data from Glacier National Park, Montana, where a 30-year-old burn has increased the size of the winter range. There, Riggs and Peek found that bighorn sheep preferred post-burn successional communities to adjacent climax grasslands. Once 200 head of bighorn sheep ranged the East Fork of the Salmon. While only about 50 bighorn sheep can be found in the area now, that number is expected to increase as habitat management and population management take effect. Fire can be used as a habitat management tool for bighorn sheep winter range, Peek said, with both short- and long-term benefits, depending on the vegetation community burned.

WOOD DUCK BROODS TRANSPLANTED IN IDAHO

Elwood G. Bizeau
Joseph Miles
Gary Gadwa

Idaho's wood duck population is getting some attention from Wildlife Resources scientists at the University of Idaho. Wood duck restoration is the final phase of a study of the bird's ecology in northern Idaho.

The wood duck in Idaho breeds almost exclusively in the five northernmost counties, which may be the core of its breeding area in the intermountain states. The area extends into Montana, Washington, and southern British Columbia. A favorite of waterfowl watchers because of its unique habits and bright plumage, the wood duck is important as a game bird on only one hunting area in the state. Recent Pacific Flyway waterfowl regulations are designed to manage only major duck species, such as the mallard and pintail, which may leave the wood duck open to exploitation. To fill this gap, researchers undertook a wood duck research program.

The first step in managing a species involves finding out more about it. This study began by determining wood duck habitat preferences on the Coeur d'Alene Wildlife Management Area, then classifying and inventorying specific habitats in the Panhandle.

The researchers have been following wood duck production on the state's Coeur d'Alene Wildlife Management Area for 5 years and have initiated a banding program there. In the process of conducting habitat inventories, the researchers found many suitable habitat areas which were unoccupied by wood ducks. Elwood G. Bizeau, assistant leader of the Cooperative Wildlife Research Unit, and graduate researchers Gary Gadwa and Joseph Miles have been working out techniques for introducing wood ducks into the unoccupied areas.

Researchers have transplanted day-old wood duck ducklings with their brood hens, all from the lower Coeur d'Alene drainage, to 15 different lake areas in northern Idaho. Since the transplant program began in 1976, an average of 140 ducklings has been placed in new habitat areas each year. About 10 percent of the transplanted female ducklings have returned to nest in the new areas the following year. Keeping track of returning wood ducks and evaluating the results of the project are important to the research program.

To refine transplanting techniques for use by relatively untrained personnel, the researchers are using automatic nest recorders to obtain data on average incubation period, nest attendance, reaction to nest disturbance, and prediction of exact hatch dates.

The project is part of the migratory bird research program, which receives support from the Idaho Department of Fish and Game and the U.S. Fish and Wildlife Service.

Range Resources

PUBLICATION LAYS GROUND FOR RANGELAND DEVELOPMENT

Lee A. Sharp
Kenneth D. Sanders

The Pacific Northwest Regional Commission, comprising the governors of Idaho, Washington, and Oregon, fosters projects aiding the economic development of the three member states. In 1976 the Idaho Rangeland Committee and the University of Idaho Department of Range Resources through contracts with the Commission, initiated a program of rangeland development, management, and research. An important aspect of that program was gathering and assembling information about Idaho's physical and biological features, its land ownership and use, and major problems of range use and management. Lee A. Sharp and Kenneth D. Sanders, Department Head and professor of Range Resources, respectively, undertook this project which, in September 1978, culminated in *Rangeland Resources in Idaho: A Basis for Development and Improvement.*

This study consists of three major divisions: Physical and Vegetation Features of Idaho, Idaho Land Ownership and Use, and Issues and Problems Associated with Range Use and Management.

The first division identifies and describes Idaho's topographical provinces and includes general information on geology, precipitation, principal uses, and common wildlife species. The second half of this division identifies and describes vegetation zones and includes discussions of the distribution and evolution of particular vegetation types.

The second section, Idaho Land Ownership and Use, details in text and tables land ownership and use by percentages and acreage. Here Sharp and Sanders not only discuss the effects of specific ownerships and use on the land, but extend their study to include effects on the economy and lifestyle of Idahoans. Further, considering that present ownerships and use have evolved from past political and social attitudes and considerations, the authors begin and intersperse their discussion with summaries of relevant historical background.

Backgrounded also by discussions of past land use legislation and attitudes is the third major division, Issues and Problems Associated with Range Use and Management. Sharp and Sanders consider many of the present range use problems as having arisen from national land policies based on ignorance of the West's ecological realities. For example, homestead size limitations appropriate to the more humid, forested eastern seaboard were imposed upon the settlers of the arid western plains. Grazing capacity of the western rangelands was grossly miscalculated. And grazing itself—the most important contemporary rangeland use—was downgraded in favor of an eastern perception of the relatively small family farm.

Such persistent misconceptions impeded the evolution of enlightened rangeland policies and helped give rise to contemporary problems. Sharp and Sanders identify these problems as a lack of defined goals; use decision assessments concentrating on resource integrity without fully exploring social and economic objectives and consequences; low financial investment in rangeland maintenance and development; a frequent lack of adequate training for those charged with rangeland management; and a lack of coordinated land use programs among the various ownerships.

The authors conclude by conceding that though the citizens of Idaho and the western states have limited control over the demand for public land resources, they should have a strong voice in how and to what extent those demands will be met. It is important, they write, that the western states "not be exploited by outside forces."

Rangeland Resources of Idaho is not only a substantial presentation of Idaho's rangeland use, potential, and problems, but also supplies an important resource for realizing that potential and alleviating those problems. Governor John Evans, introducing the work, wrote, "It is my firm belief that the way of life we cherish so much in Idaho is intrinsically related to the land. How we use that land as a resource is indeed the key to our future and that of our children. This study presents a valuable first step towards the maintenance of our land and the future of Idaho."

Rangeland Resources of Idaho: A Basis for Development and Improvement was published jointly by the Idaho Rangeland Committee and the College of Forestry, Wildlife and Range Sciences at the University of Idaho. Copies are available from the Department of Range Resources.

GRASS SEEDING TESTED ON DOUGLAS-FIR PLANTATIONS

John E. Mitchell
David M. Eissenstat

Natural mountain meadows and other forest openings once provided ample forage for cattle and sheep. But over the past 40-50 years, as forest fire prevention and control have become more efficient, such meadows and openings have filled in, depriving livestock of natural forage. In the meantime, however, lumbering activities have created other forest openings potentially valuable as livestock grazing areas.

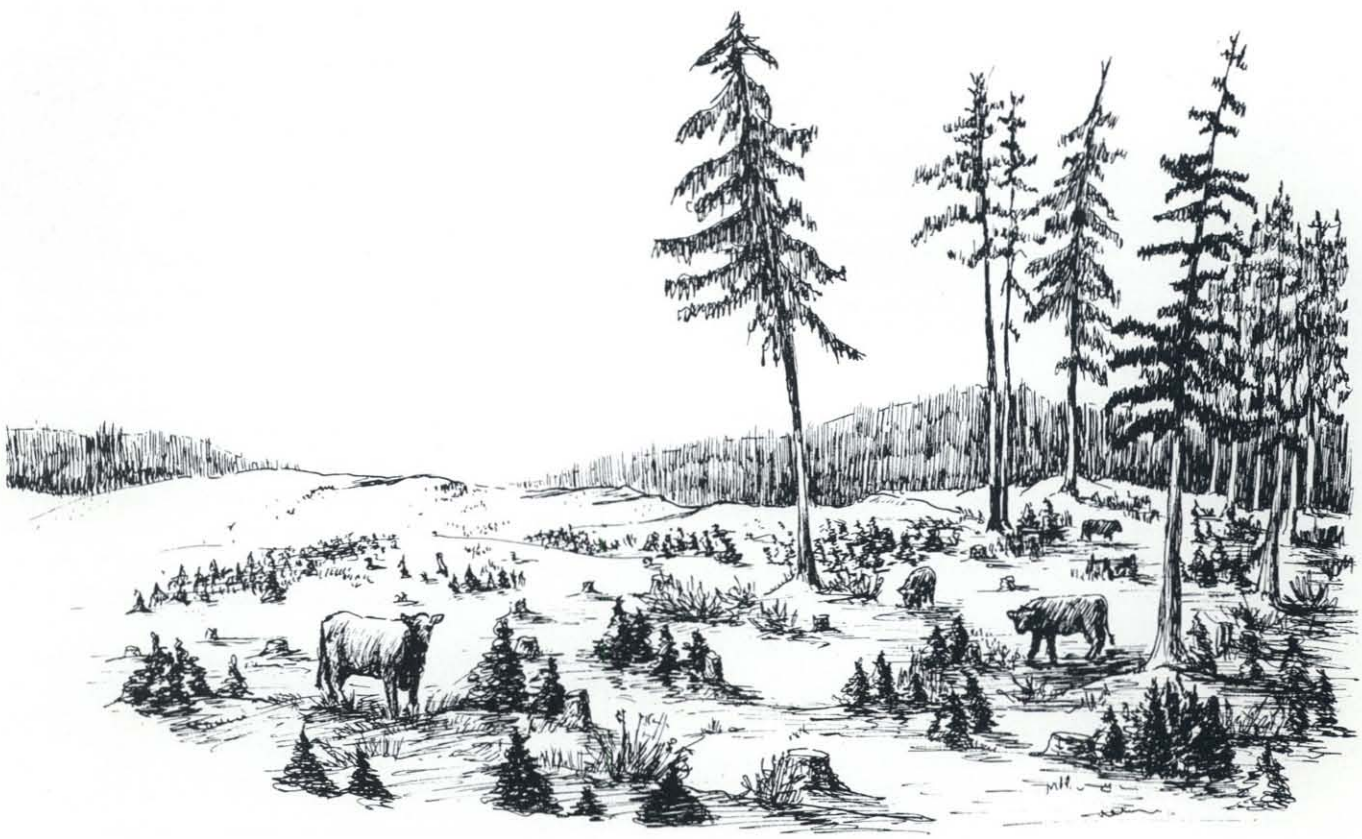
These cutover areas would seem to provide convenient replacements for the natural forest openings. And, indeed, livestock have grazed these areas with economic benefit to land managers and livestock operators alike. Unfortunately, mismanagement and a lack of objective information have sometimes caused costly setbacks in tree regeneration, leaving many forest managers reluctant to allow grazing on logged areas.

It has been hypothesized that the seeding of domestic grasses for livestock forage in the cool, moist redcedar zone should have no deleterious effect on tree regeneration. To test the hypothesis, John E. Mitchell, professor of range resources, and David M. Eissenstat, graduate assistant in range resources, have undertaken a study designed to gauge the feasibility of seeding Douglas-fir plantations with nonrhizomatous grasses.

The study area, located in the Clearwater River drainage approximately 12 miles north of Headquarters, ID, is a clearcut owned by Potlatch Corporation and located in a grazing allotment administered by the Clearwater-Potlatch Timber Protective Association.

In the winter of 1977, 145 acres of the clearcut underwent site preparation, and in April of 1978, canistered Douglas-fir seedlings were planted with eight-foot spacings. Within the study area, Mitchell and Eissenstat laid out three .75-acre macroplots of various aspects and slopes. Each macroplot was divided into three .25-acre treatments of equal size and shape. In June 1978, in each of the three macroplots, one division was sown with a mixture of orchard grass, timothy, and red clover; a second with Idaho fescue; and the third division was left unseeded as a control plot.

Modifying their methods as necessary to facilitate collecting accurate data, Mitchell and Eissenstat have monitored tree and grass growth and interactions, natural



seral species growth and competition, animal damage (particularly that caused by cattle), and tree seedling water tension.

Mitchell and Eissenstat are particularly interested in the latter. Should the seeding of grasses impair the productivity of Douglas-fir plantations, they hope to determine if the primary cause is moisture stress resulting from water competition between the tree seedlings and grass.

The project, which will continue through June 30, 1980, is funded through grants provided by the Clearwater-Potlatch Timber Protective Association, Potlatch Corporation, and the University of Idaho Research Council. Initial grant support was provided by the Short-Term Applied Research Program in 1977-78.

WATER QUALITY TESTED ON GRAZED WATERSHED

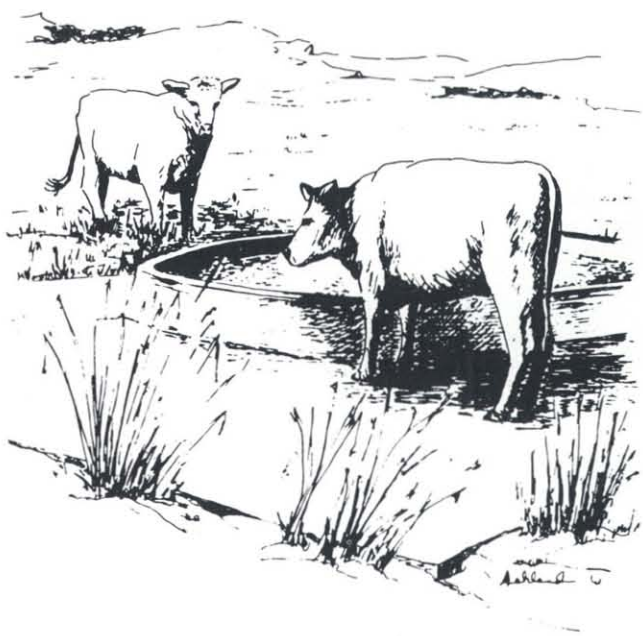
John E. Mitchell
Richard T. Rodgers

Protecting or improving the quality of water has become a major goal in many parts of the country, but especially in the West, where vast areas depend on clean water supplies for crop irrigation, fisheries, domestic use, and power generation. The Federal Water Pollution Control Act Amendments of 1972 have mandated that nonpoint pollution caused by runoff from agricultural land, including that used for livestock production, be identified and controlled by 1983.

Nonpoint pollution refers to problems which cannot be attributed to a specific site. A research team composed of Range Resources Professor John E. Mitchell, Agricultural Engineering Professor Myron P. Molnau, and graduate researcher Richard T. Rodgers from the University of Idaho, along with other scientists from Washington State University, are monitoring runoff from two watersheds to identify and measure pollutants originating from pastures in the northern Rocky Mountains. The Environmental Protection Agency (EPA) is sponsoring the 3-year cooperative project.

According to Mitchell, of the six water pollutants defined by the EPA–sediments, inorganic nutrients, salts, organic debris, pesticides, and pathogens–only pathogens associated with fecal bacteria from grazing cattle might be expected to be significant if cattle have a significant effect on water quality coming from a watershed. Pathogen levels are evaluated by measuring fecal bacteria concentrations in the watershed runoff. Pastures are grazed from June through October, while the runoff, which begins in January, is over before the next grazing season. Fecal material from grazing cattle has thus had a chance to "cure" before the start of the runoff. The relationship between pathogen levels in runoff and curing time is a complex subject which is not well understood.

To protect the watershed, the researchers recommend a noncontinuous grazing system and the development of artificial water supplies for cattle away from main runoff channels. On the study site north of Moscow, livestock spend much of their time in a few "hangout" areas. Two of these are near water channels; others are in the woods, under shade, or elsewhere on the pasture. The area around the only developed watering area is heavily trampled.



By piping the watering area to a new location farther from the water channels, and by providing shade away from the channels, managers could encourage cattle to change their preferred haunts. The research team suggests introducing a simple two-pasture rotation system to avoid season-long trampling of favorite sites in a single-pasture system, and selling a few of the older cows less agreeable to change of grazing area.

The researchers felt that fecal bacteria levels and sedimentation on the study watershed could be reduced significantly by initiating the range improvements and management practices suggested to avoid high density use near the main water channels.

Wilderness Research Center

THE TAYLOR RANCH: A UNIQUE RESOURCE

The College of Forestry, Wildlife and Range Sciences extends far beyond the bounds of its campus classrooms and laboratories. Turning theory into practice are a 35-acre forest nursery, a school forest of over 7000 acres, a summer camp on Payette Lake at McCall, and perhaps the most unique of these "fresh air" classrooms, the Taylor Ranch Field Station.

Taylor Ranch, northeast of McCall, is 65 acres set in the heart of the Idaho Primitive Area. It sounds attractive, and it is, but don't pack up the auto and try to drive there. It can't be done. Taylor Ranch is accessible only by horse, on foot, or by aircraft.

"You drift down in to the canyon," says Ken Sowles, a department head who manages the ranch, "then, if no deer or bear is wandering across the strip, you set down between the woods and Big Creek."

The strip was constructed by Jess and Dorothy Taylor, using axes, saws, and horses. Jess Taylor and the University of Idaho met when, a dozen years ago, Maurice Hornocker, now professor of Wildlife Resources, asked to rent part of the ranch to headquarter a cougar study. Over Hornocker's extended study a friendship grew. Eventually, Taylor, looking toward retirement, confided to Hornocker his reluctant desire to sell the ranch.

A study of bighorn sheep behavior was completed at the Taylor Ranch in 1978. *James Bennett photo*

This news was communicated to Dr. Paul Dalke, now professor emeritus of Wildlife Resources, who, with some of his colleagues, proposed to the University the purchase of the ranch. In 1969, the University accepted and acquired a valuable facility for research in wilderness resources.

Notable among studies conducted out of Taylor Ranch are Hornocker's cougar study, completed in 1970, and a 2-year bighorn sheep study conducted by then-graduate researcher James W. Bennett and Associate Dean Ernest D. Ables and completed in 1978. This winter, Edward O. Garton, professor of Wildlife Resources, will begin a study on the area's raptor population.

The most frequent use of the unique environs of the Taylor Ranch, however, has been made by undergraduates pursuing studies funded through the Taylor Ranch Honorarium Program and conducted under the auspices of the University of Idaho Wilderness Research Center.

Since the inception of the program in 1974, students have researched bighorn sheep habitat, trout population and distribution, watershed conditions, and the territorial habits of the American kestrel. One current study is Wildlife Resources student Joel Bender's investigation of the rattlesnake subspecies inhabiting the Idaho Primitive Area.

To participate in the Taylor Ranch Honorarium Program, students must submit proposals to the Dean, College of Forestry, Wildlife and Range Sciences. The proposals are subsequently evaluated by a faculty committee on the bases of innovation, literature search, detail in methods used, potential for attainment of objectives, and educational value.

Students chosen to participate are awarded a $600 honorarium, provided transportation to the ranch, and given the equipment and supplies necessary to conduct their studies.

The Taylor Ranch Honorarium Program demands a serious commitment to research. Students must not only

A small plane takes off from the Taylor Ranch, downstream along the Middle Fork Salmon River. Researchers working out of the ranch, located in the Idaho Primitive Area, must pack or fly in all research equipment and supplies. *James Bennett photo*

devise their proposals and construct the methodology needed to fulfill them, but must conduct their projects professionally and thoroughly. When research is completed, students must submit formal reports on their findings. Often these reports, says Sowles, are of publishable quality. Also, Sowles adds, most of the students who complete the program go on to graduate schools.

Besides the objective knowledge gleaned from research, participants in the program gain subjective benefits. They are, for example, expected to mow the ranch's hayfield, to tend the ranch's garden, to repair fences, to work at general maintenance about the ranch headquarters–all done "by hand" and by horse. While conducting their research, they must learn to cope with the vagaries of topography and weather and with the ever-present potential hazards of the wilderness–not the least of which is isolation (Taylor Ranch has neither telephones nor electricity).

In consequence, says Sowles, they not only test their theories, but themselves. And they usually emerge from the ranch more self-disciplined, more self-confident, more self-reliant.

Sowles stresses that use of the Taylor Ranch is not limited to faculty and students of the College of Forestry, Wildlife and Range Sciences. Other university departments, universities, and agencies have used the Ranch. And Sowles invites enquiries from other interested organizations.

Taylor Ranch itself is a uniquely valuable resource. Perhaps Dr. Hartung described its uniqueness best: "You can go back in time in terms of primitive ecology. Once you get back to a primitive condition, you can work from there to determine what man has done to the wilderness. If we are going to put together meaningful ecological studies, this is such a place to do it."

Fisheries Resources

SALMON RESPOND TO ERYTHROMYCIN TREATMENT

George W. Klontz

A Fisheries Resources project in progress since 1974 at the Rapid River Hatchery near Riggins has resulted in an effective program to control prespawning deaths due to bacterial kidney disease of adult spring chinook salmon (*Oncorhynchus tshawytscha*).

The hatchery, operated by the Idaho Department of Fish and Game, is owned by the Idaho Power Company, which also funds the project. Principal investigator is George W. Klontz, department head of Fisheries Resources.

Though bacterial kidney disease is not of itself invariably fatal, it is believed that the disease weakens the fish, making them easier prey, more susceptible to other diseases, and often unfit for their long journeys. The disease is considered to be initially transmitted from the adult female to the offspring via the egg. However, once infected, the fish can transmit the bacterium by contact, forming a disease cycle intensified by relatively crowded hatchery conditions.

During the first 5 years of this study, adult spring chinook salmon were trapped and injected with erythromycin preparations. The response to the injections was positive; incidence of bacterial kidney disease lesions in treated fish declined from 50 percent to a current level of less than one percent.

Because an infected female can transmit the disease to her eggs, the research team used erythromycin phosphate to water-harden eggs from injected females with lesions at spawning and from noninjected females without lesions at spawning.

All treated eggs had a lower fungus infection incidence during incubation than untreated eggs, a result, Klontz believes, due more to having a healthier embryo than to a direct effect of the erythromycin on the fungus.

Klontz also found that fish hatched from water-hardened eggs were not only free of bacterial kidney disease when hatched, but remained free of the disease during the pre-smolt rearing period. During the past 3 years, Klontz reports, there have been no clinical indications of the disease in pre-smolts, nor have any been found to be carriers of the disease.

The injection and water-hardening program has apparently succeeded in controlling bacterial kidney disease in spring chinook salmon at the Rapid River Hatchery. And, by breaking the transmission cycle of female to offspring, the program creates a self-generating effect which, Klontz hopes, will bring a larger, healthier spring chinook salmon return in spring 1980.

KOKANEE INVESTIGATED IN NORTH IDAHO LAKES

David H. Bennett
Peter F. Hassemer

Kokanee fishing is the primary sport fishery in large, north Idaho lakes—the estimated harvest in Coeur d'Alene Lake alone may surpass the half million mark for the 1979 fishing season. However, harvest and catch rates of Pend Oreille and Priest Lake kokanee fisheries have declined drastically in the past years. The importance of the kokanee fishery in north Idaho and declines of the Pend Oreille and Priest Lake kokanee populations have been the subjects of intensive research efforts in previous years.

David H. Bennett, professor of Fisheries Resources, and graduate researcher Peter F. Hassemer are studying the early life history of the Coeur d'Alene and Pend Oreille lakes kokanee from egg deposition to fry. Investigations will be made into survival during various stages of life (prehatching to lake-residing fry) and postemergence fry growth as related to time of emergence and food availability during lake residence. Survival rates of wild and hatchery reared fry will be compared to assess the overall contribution of hatchery fish to the sport fishery.

Fry production is concentrated in two bays of Pend Oreille Lake and one bay of Coeur d'Alene Lake. Mid-water trawls made during the fry emergence period of 1979 showed that in Coeur d'Alene Lake, fry emergence was occurring prior to 30 May and was apparently completed by 25 June. Fry emergence in Pend Oreille Lake began prior to 7 June and was still occurring, although at a very low level, on 25 July. Analysis of fry caught in the trawls revealed that the mean length of fry at emergence is 25 mm and that fry were emerging and moving to open water before completely absorbing their yolk sacs.

This information will help to explain why kokanee stocks continue to decline in north Idaho lakes. Causes and timing of mortality will be identified and recommendations made to aid fisheries management agencies better regulate kokanee populations and provide more fish to the angler.

RESIDENT FISHERY SURVEYED ON LOWER SNAKE RESERVOIRS

David H. Bennett
Robert G. White
Paul Bratovich
Hal Hansel
William Knox
Douglas Palmer

Construction of hydroelectric dams on the Lower Snake River has created additional warmwater fish habitat by changing from river to reservoir conditions. Habitat alterations accompanied by successful introductions of warmwater fish species have caused a change in the fish communities. Increased angler acceptance of warmwater species and possible interactions with resident and anadromous salmonids have contributed to the need for basic biological data to manage this fishery effectively.

Little is known concerning the life history, population dynamics, species interactions, and angler use of resident fish species in the Lower Snake reservoirs (Ice Harbor, Lower Monumental, Little Goose, and Lower Granite). University of Idaho Fisheries Resources Professors David Bennett and Robert White, with graduate researchers Paul Bratovich, Hal Hansel, William Knox, and Douglas Palmer, are presently attempting to provide some of this information. Specifically, data are being collected on angler use, fishing success, and attitudes; and on population dynamics, species-habitat associations and preferences, life histories of resident fishes and resident species interactions with steelhead trout and chinook salmon.

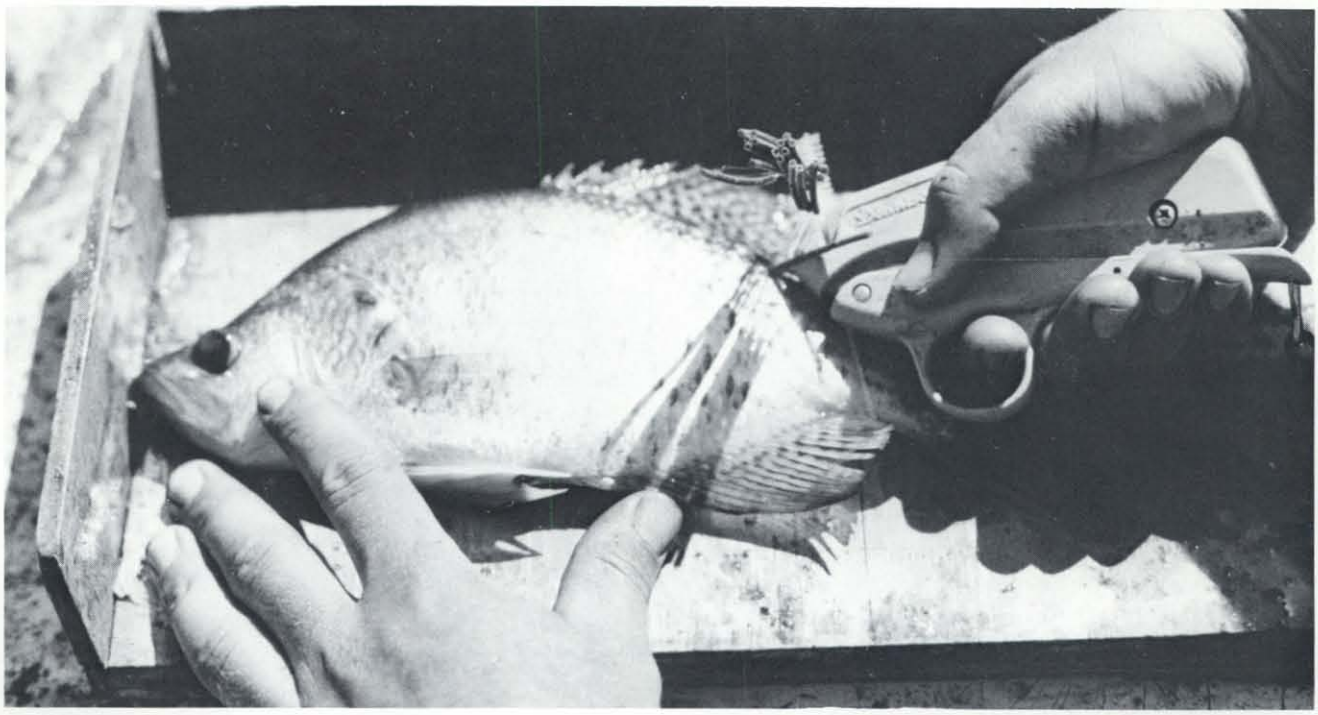
Aerial and ground surveys and questionnaires are employed to evaluate angler use, fishing success, and angler attitudes on Little Goose Reservoir. Survey clerks record numbers of fishing boats, boat anglers, shore anglers, and pleasure boats encountered on these surveys. Anglers are interviewed and given a questionnaire. These data will be used to estimate angler success in numbers and weight of fish per angler hour, numbers and weight of fish harvested, and economic value of the sport fishery. Results of these surveys through August show that angler use is heaviest during April, May, and early June. Aerial surveys indicate that Little Goose and Ice Harbor reservoirs are subjected to the most intense use during these months. Late June through August is a period of light angler use but heavy pleasure boat use on all reservoirs.

The majority of the anglers interviewed were fishing for smallmouth bass and crappie. Other species sought by anglers included channel catfish, sturgeon, bullhead, and trout.

Electrofishing gear, horizontal and vertical experimental gill nets, trap nets, and beach seines are all being used in various habitat types in Little Goose Reservoir to assess species composition, indices of relative abundance, movements, and habitat preferences and associations. Fish are collected to determine seasonal distribution of resident fish as well as interactions which may occur between warmwater and anadromous species such as steelhead and chinook salmon.

These intensive field investigations are being conducted on Little Goose Reservoir at five sampling stations representing major habitat types. An additional three

White sturgeon wears the gill net used to remove it unharmed from Little Goose Reservoir. The fish will be marked for future identification and released. *E. Martin Cobb photo.*



Researcher tags a white crappie netted in Little Goose Reservoir. The tags will aid in the study of crappie population movements and density. *E. Martin Cobb photo.*

sampling stations located in other Lower Snake River reservoirs are used for comparison of the fishery resources. To date, over 10,000 fish comprising 25 species have been sampled. Game species have accounted for 44 percent of the total catch, with white crappie and smallmouth bass most abundant. Nongame species comprised 56 percent of the catch; largescale sucker accounted for over 30 percent of the catch. Surveys in the tailwater section of Little Goose indicate that white sturgeon are abundant.

Stomach contents of selected juvenile and adult warmwater fishes are being examined monthly to determine the relative importance of various food items. The availability of key food organisms greatly affects fish growth and can consequently affect the quality of the fishery. Monthly food habits will be compared to evaluate changes in food preferences and consumption with the availability and vulnerability of a food item. Also, information concerning food preferences will be used to determine important species interactions.

Preliminary analysis indicates that the major food item of smallmouth bass is crayfish; channel catfish eat primarily chironomid fly pupae and algae; zooplankton is a major dietary component of redside shiner and crappies; and, bullheads and suckers consume primarily algae. Sculpins were the major forage species of predatory fishes. Stomach samples from species considered potentially predatory on salmon and trout contained no salmonids at the end of the smolt migration.

The age structure and growth of selected warmwater fish populations is being determined from annual growth rings on bony parts (scales, otoliths, spines). Present and previous growth rates will be compared with those of the same species in other parts of the range to evaluate environmental suitability. This information will aid in evaluating critical stages in a species life cycle and identify those factors that affect survival and production.

Underwater surveys of spawning areas and determination of gonad size are being used to evaluate the timing and duration of spawning at sampling sites. At this writing, a total of 54 spawning nests were located, 22 of which were immediately identified as smallmouth bass by the presence of eggs, fry, and/or adults. Smallmouth bass nests were observed first in early June; active nests were observed until mid-July. Spawning activity for various sunfish species was initially observed in early July. Eight active pumpkinseed nests were identified. Gravid sunfish specimens appeared in the dissections through late August. The remainder of the nests located will be identified from physical data and egg samples.

In addition to the detailed fishery surveys, data on the existing physicochemical environment will be collected. These data will be correlated with population dynamics, habitat preferences and selected aspects of the life history and will be used with various species criteria to aid fishery biologists in managing the resident fishes in the Lower Snake reservoirs and satisfying angler demand.

THIRD TURBINE CONSIDERED FOR ANDERSON RANCH DAM

Robert G. White
Dan Wade

Anderson Ranch Dam was built on the South Fork of the Boise River near Mountain Home in the early 1940s by the United States Bureau of Reclamation. The project was designed for flood control, storage of irrigation water, and hydroelectric power production.

Since 1951, the powerhouse has been in operation with two 13.5-megawatt turbines, which generate 27 megawatts, or up to 34.5 megawatts at safe overload capacity. Due to an increased demand for energy production, the Bureau of Reclamation proposes to install a third turbine, anticipated in the original powerplant design, to use surplus water, now spilled during spring runoff. With the installation of a 30-megawatt generating unit and rewinding of the existing turbines, increasing their generating capacity from 13.5 to 20 megawatts each, the generating capacity of the Anderson Ranch Power Plant would be increased to 70 megawatts. While summer flows, which are determined by the amount of water needed for irrigation, would remain unchanged, winter maximum flows would be increased from the current 1600 cubic feet per second (cfs) to about 2400 cfs.

Fisheries Resources Professor and Assistant Unit Leader Robert G. White and graduate researcher Dan Wade have been studying the impact a third generating unit installed and operating in the Anderson Ranch Power Plant would have on the fishery. Because increased winter flow patterns could adversely affect fish populations on the South Fork of the Boise River, the study was designed to evaluate the present status of fish populations, and that of the macroinvertebrates on which they feed. Concentrating on the channel edges, where sudden reductions in flow could leave fish and their food organisms stranded or disrupt spawning activities, fisheries scientists looked at the problems of increased discharges through simulated peaking tests, watching for displacement of fish, fish eggs, or fish food organisms.

Beginning with a base flow of 200 cfs of water through the dam, the volume was increased 140 cfs for each 10-minute period until a maximum discharge of 2400 cfs was reached. During the period of rapid rise, fisheries researchers evaluated the response of radio-tagged rainbow trout and mountain whitefish. Fish behavior was monitored before and during full peaking, and while flow decreased. Radio-tagged fish moved out of the high velocity areas, generally in a shoreward direction, where boulders provided more protected water.

Because the fishery depends largely on the availability of food organisms for fish, the researchers placed the greatest emphasis on response of aquatic insects. Samples of stream bottom were taken to gather data on the number of insects per unit area before, during, and after peaking tests. The tests were repeated for several different discharge levels. White found no net decrease in bottom dwelling organisms although a change had been expected.

Sampling tests of drifting insects were taken before, during, and after peaking to determine the impact on invertebrates. Large, unnatural amounts of insect drift were found at the time of peaking. These organisms, in larval or nymph stages, move most often just before daylight and right after dark. In normal operation of the power plant, discharge is gradually increased during early morning hours at 35 cfs per 10-minute intervals in order to peak at high energy use hours, from 7 to 8 a.m. At 35-cfs increase levels of discharge would have started around 2 a.m. Increasing the flow at 140 cfs would mean starting up at 5 a.m., much closer to the time invertebrates begin their natural movement.

Researchers found that in the area closest to the dam, drifting insects were largely swept away regardless of the magnitude, rate of rise or timing of release during simulated tests. The intensity of the drift increase depended on the upper discharge level and rate of rise. Magnitude of the drift decreased over time.

Distribution and relative abundance of macroinvertebrates differed significantly from one sampling site to another. Although the benthic invertebrates decreased in number as they moved downstream, the number of varieties increased.

Parts of the study were subcontracted to the Idaho Department of Fish and Game, primarily the evaluation of fish populations below the dam, and assessment of spawning and rearing habitat for rainbow trout and mountain whitefish below the dam. The Idaho Department of Fish and Game manages the fishery, which has been operated since 1976 as a trophy rainbow trout fishery with special creel and size regulations. The Department is collecting recapture data from tagged fish caught by project personnel, fish and game biologists and anglers.

Data collected in this study will be used by the Bureau of Reclamation in its feasibility study for installing the third generating unit, in an environmental impact study, and in recommending the timing, rate of release and magnitude of discharge from the dam. Study results will also be used by the U.S. Fish and Wildlife Service in completing the required Coordination Act Report.

Forest Products

A small-wheeled skidder has been developed from a Case-Davis 30-horsepower backhoe. The machine's backhoe has been modified for grappling logs. *Leonard Johnson photo*

NEW SKIDDER MAY REDUCE COSTS AND WASTE

Leonard R. Johnson
Walter L. Moden, Jr.
Michael W. Leverick

A small-wheeled skidder has been developed and is being tested by the Forest Products and Agricultural Engineering Departments. The purpose of the study is to determine the cost and practicality of moving small diameter trees from the woods to some central point. In the past, these trees have been cut as part of precommercial thinning operations, but there has been no attempt to utilize the material. Left in the woods, the downed trees create a fire hazard and an invitation to insects.

The skidder was developed by modifying a 30-horsepower backhoe manufactured by Case-Davis. The basic machine has 4-wheel hydrostatic drive and is fully articulated. These features make it similar to conventional wheeled skidders used in commercial logging operations. The backhoe on the machine was modified to a grapple. Other modifications included adding protective plating and an operator canopy.

Leonard R. Johnson, professor of Forest Products, Michael Leverick, Forest Products graduate researcher, and Walter L. Moden, professor of Agricultural Engineering are testing the skidder in three stands on the University of Idaho Experimental Forest. Data collected on the time and cost required to move the small diameter trees will be used to develop equations for predicting the productive capacity of the machine on similar stands. Costs will be calculated and compared with current costs of treating precommercial thinning slash along with the potential value of the material.

The study is funded by the University of Idaho Experimental Forest, the U.S. Department of Agriculture Forest Service Equipment Development Center, San Dimas, CA, the U.S. Department of Agriculture Forest Service Intermountain Forest and Range Experiment Station, Missoula, MT, and the manufacturer, Case-Davis.

TEAM EVALUATES IMPACT OF DEFORESTATION ON FUELWOOD

Kjell A. Christophersen

The rapidly dwindling forests in many parts of the world have triggered considerable worldwide concern. The U.S. Agency for International Development (USAID) is particularly concerned with the impact of deforestation on the forest resource base and the shrinking supply of fuelwood. To this effect AID has initiated a study, carried out by the U.S. Department of Agriculture Forest Products Laboratory in Madison, WI, to evaluate the severity of the problems and what can be done about them. The College of Forestry, Wildlife and Range Sciences is involved in this project through a subcontract with the Forest Products Laboratory.

The aim of the project, in part, is to identify donor agencies throughout the world, such as USAID, that sponsor forestry projects in less developed countries (LDCs). Forest Products Professor Kjell A. Christophersen is a member of the evaluation team which has visited and interviewed donor agencies and visited several project sites in LDCs. Multilateral donor agencies, such as the World Bank, Food and Agriculture Organization of the United Nations (FAO), and bilateral donor agencies throughout Europe and elsewhere in the western world have been interviewed. Several countries and projects have been selected for in-depth study to determine the factors that make a project a success or failure. The final report will offer recommendations to USAID for the best use of aid money earmarked for forestry support in the future.

NEW STRUCTURAL PANEL OFFERS WORLDWIDE BENEFITS

John P. Howe
H.B. McKean
Manoel Sobral

The work of Forest Products Professor Emeritus John Howe and graduate researcher Manoel Sobral shows that pulp chip strands can be mixed with strands from round wood in oriented strand panels and still have panels whose properties exceed voluntary standards in breaking strength and stiffness. The idea for this research originated with H.B. McKean, affiliate faculty member in Forest Products. McKean, recently retired Vice President of the Potlatch Corporation, worked closely with Sobral on this project.

This innovative discovery gives four immediate benefits: 1) a wider range of wood raw material can be used to produce structural panels, 2) savings in initial capital costs, 3) energy savings, and 4) reduced manufacturing costs since mill residue pulp chips cost less than pulp logs or roundwood chips.

The technology of reducing low quality wood into strands or flakes which are then formed into resin bonded panels of high strength received some attention in the late 1940s. Significant research activity in this area of technology began in the 1960s with results being reported extensively by the 1970s. In early 1976 at Lewiston, Potlatch Corporation began operating the world's first commercial plant using oriented wood strands. A second plant, belonging to Georgia Pacific, will soon be in production in North Carolina. Both of these facilities manufacture an oriented strand panel or structural flakeboard to be used as the core for composite plywood, i.e., a plywood with veneer face and back and an oriented strand panel core. The core panel is made with strands aligned across the panel to simulate the grain direction of veneers used as plywood core. The production and use record of the composite plywood from Lewiston since early 1976 has established the composite plywood as completely interchangeable with all-veneer plywood.

The oriented strand panel or structural flakeboard can also be manufactured in an all-strand panel (i.e., no veneer) with properties approximating those of all-veneer plywood.

Sobral's study was made with grand fir, *Abies grandis*, a true fir commonly found in northern Idaho.[1] This new structural panel offers worldwide benefits in a time of increasing demand for wood panels and a rising need for more efficient use of world forest resources.

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[1] This species is mixed with other true firs in lumber and plywood markets and sold as white fir or when mixed with hemlock sold as hem-fir.

John Howe, left, and Manoel Sobral examine board samples made from a combination of round wood and pulp chip strands. *Dave Hoffman photo*

Continuing Education/Extension

EDUCATORS PROVIDE DATA FOR RARE II DECISIONS

As a resource becomes scarce, its management becomes a concern to more people. Land use allocation has become a subject of major interest in the 1970s. This is evidenced in the number of persons attending zoning hearings–whether the land in question involves an individual's or corporation's privately owned land, or those portions of federal or state managed land and water often referred to as the commons.

The U.S. Department of Agriculture (USDA) Forest Service instituted its Roadless Area Review and Evaluation (RARE II) process in 1977 to catalog all remaining undesignated acreage with wilderness character in the national forests. The draft environmental statement, published in June 1978, detailed 8 million acres as potential wilderness in Idaho, in addition to 3 million acres which had already been proposed or designated.

Scientists in the University of Idaho's College of Forestry, Wildlife and Range Sciences were concerned that data assembled were difficult for residents to interpret. Concerned with making useable information available to encourage more knowledgeable public input on wilderness decisions, they collected detailed information on an area by area basis which they published as an aid to Idaho citizens. The publication, *The RARE II Process in Idaho: A Procedure for Evaluating Resource Tradeoffs,* was authored by Charles W. McKetta, Charles R. Hatch, E. Lee Medema, and Kjell A. Christophersen. In addition to listing resource use by area, the authors outlined a step by step procedure for assessing impact on an area by area basis if those lands were put into wilderness, giving emphasis to local impacts rather than an overall state perspective.

A second paper, by Christophersen and McKetta, *The RARE II Process in Idaho: A Case Study of Changing Roadless Area Boundaries,* showed the arbitrary nature of boundaries in wilderness areas, and suggested subdivision by like resource character to reduce conflict. This approach was reflected in the USDA Forest Service final environmental impact statement in 1979.

Two additional reports reviewed employment impacts which would result from different proposed classifications. They distributed these to government officials, the forest industry, USDA Forest Service, and conservation associations, trying to provide as much factual information to interested groups as possible.

TREE COOPERATIVE WORKS FOR THE FUTURE

Between now and the twenty-first century, the world's population is expected to increase substantially, and the demand for forest products is expected to increase along with it. Unfortunately, commercial forest area may not increase; indeed, it may diminish. To keep pace with demand, commercial forests will have to produce more–and not simply more trees, but faster growing, better quality trees. One organization working toward that end is the Inland Empire Tree Improvement Cooperative (IETIC).

Founded in 1967, IETIC consists of 22 public and private timber producers in Idaho, Washington, and Montana. The University of Idaho belongs to IETIC, as do the University of Montana and Washington State University. Completing the membership roll are three state agencies, four U.S. government agencies, four tribal councils, and eight private industries.

Instrumental in its founding were Chi-Wu Wang, professor emeritus, University of Idaho, and Russell H. Hudson, manager of forestry for the St. Regis Paper Company and current chairman of IETIC.

The cooperative's original goal was the genetic improvement of commercial ponderosa pine. That goal has recently been expanded to include Douglas-fir, western white pine, grand fir, lodgepole pine, and western larch. Six committees, one for each tree species, work to develop genetically improved seeds. Once grown in cooperators' seed orchards, the seeds are distributed among IETIC members.

Besides sharing seed, members of the cooperative enjoy other benefits. They share a broader genetic sampling base than that normally available to individual research. They share facilities and labor, reducing program development costs. And, most significant, they share ideas and abilities.

Lauren Fins, executive secretary of IETIC and professor of Forest Resources, is optimistic. Genetics,

she says, used like silviculture or fertilization as a management tool in an ecologically sound, integrated forest management program, will help produce those hardier, faster growing, higher yielding, better quality twenty-first century trees.

WILDLIFE PROGRAMS AVAILABLE FOR IDAHOANS

Extension and Continuing Education services are noted for carrying university education to the people of Idaho. This year, in addition to current programs, the College of Forestry, Wildlife and Range Sciences has added a continuing education program in wildlife. Lewis Nelson, Jr. has taken on the new position in the Department of Wildlife.

A major part of Nelson's time is spent in giving presentations and setting up workshops throughout Idaho for interested groups, such as wildlife biologists, conservation officers, the Idaho Wildlife Federation, and school teachers. The length of the programs can vary from a 30-minute talk to 2 weeks, depending on the nature and depth of the material to be covered. Nelson is now in the process of becoming familiar with the many organizations and people interested in natural resources convervation in Idaho.

Some of the programs presently being planned include a number of short talks on various wildlife topics and workshops on communications, raptor identification, statistical analysis of biological data, census methods for nongame wildlife, Hungarian partridge management, wildlife ecology for school teachers, and new methods in wildlife management. Groups wishing to schedule talks and workshops are encouraged to contact him.

While he usually works only with adults and youth leaders, Nelson took part in the wildlife section of the state 4-H conference held in July on the University of Idaho campus. Also in July, at McCall, he taught principles of conservation in a training program for volunteer hunter education instructors who will be working with young people throughout Idaho.

SHORTCOURSES, WORKSHOPS AND SEMINARS

Throughout the year, research scientists in the College of Forestry, Wildlife and Range Sciences conduct workshops, shortcourses and seminars on campus and throughout Idaho and the West. Continuing Education programs which were sponsored by the college, or for which college departments served as co-sponsor or cooperator over the last year are shown below. Many of the shortcourses and workshops are offered on an annual basis. Further information may be obtained from the Office of Continuing Education, University of Idaho, Moscow, ID 83843.

1978

June 5 - 9	Forest Habitat Types of Idaho - Riggins
July 10 - 14	Nonforest Habitat Types Workshop - Idaho Falls, Salmon, Ketchum
August 1 - 2	Intensive Timber Culture Conference - Coeur d'Alene
September 17 - 24	Natural Resources Workshop - Alpine, WY
September 25 - 26	Public Lands Environmental Impact Statement Workshop - Denver
October 23 - November 17	Continuing Education in Forestry, Ecology and Silviculture

1979

January 10 - 12	Workshop on Range Analysis Methods - Challis
January 11 - 13	Capital Investment Alternatives - Coeur d'Alene
February 4 - 9	Western Park and Recreation Maintenance Management School - Port Townsend, WA
February 5 - 9	Aerial Photo Interpretation/Aerial Photography Workshop
February 15	Tree Care - Lewiston
March 19 - 23	Communication Shortcourse for Natural Resources Personnel
March 21 - 23	Shortcourse on Kiln Drying of Inland Species - Spokane Community College
March 27 - 28	Continuing Education in Forestry, Ecology and Silviculture Update - Missoula, MT
April 21 - 28	Natural Resources Week
April 23 - 24	Shade Tree Clinic - Boise
April 24	Preliminary Workshop: Computerized Help for the Economic Analysis of Prognosis-Model Outputs (CHEAPO): A Users Manual
April 26 - 27	Shade Tree Clinic - Coeur d'Alene
May 20 - 25	Public Involvement Workshop
May 23	Workshop for State Land Board Personnel - Malta
June 4 - 8	Forest Habitat Types of Idaho - A Shortcourse for Land Managers - Coeur d'Alene
June 7 - 13	Large Mammals in the Yellowstone Ecosystem - Yellowstone National Park
June 12 - 15	Shortcourse on Kiln Drying of Inland Species - Spokane
June 14 - 20	Educational and Recreational Uses of Public Lands - Yellowstone National Park
June 15 - 16, 22 - 23	North Idaho Environmental Education Workshop - Coeur d'Alene
August 23 - 24	Stand Prognosis Model Workshop
September 10 - 14	Remote Sensing for Natural Resources
September 10 - 21	Advanced Limnology - McCall
September 24 - 28	Vegetation/Terrain Analysis Remote Sensing Workshop - Coeur d'Alene
October 5 - 7	Wildlife Ecology Workshop - Boise
October 29 - November 2	Fish Management Shortcourse - Columbia, MO

Wildland Recreation Management

VISITOR DATA COLLECTED AT SKI AREAS, PARKS

Joseph E. Hoffman
Fred Tomlins
Don Stamn
M. M. Harris
Margaret Bailey
Marjorie Slotten

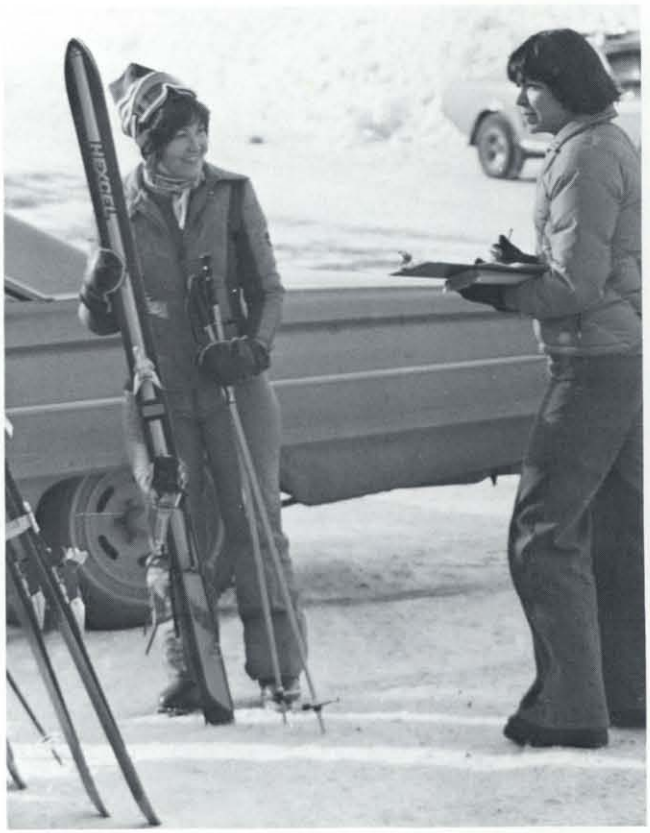
Secretary of the Interior Cecil D. Andrus talked about the importance of outdoor recreation in a speech last April at the University of Idaho.

> "...the people of Idaho also had a growing concern for the health and beauty of our state as well as its economy. They required jobs, but after work they wanted mountains and valleys where they could hike and camp, rivers and streams where they could fish, areas where they could enjoy nature."[1]

Not only Idahoans, but citizens from many parts of the country come to Idaho to enjoy skiing, hiking, and fishing. Wildland Recreation Management researchers have completed two complementary studies on visitor expenditures at 21 ski areas and in 9 state parks to assess the impact of tourism dollars on the state's economy.

According to Professor Joseph E. Hoffman, the primary purpose of the ski study was to ask skiers how much they spent per trip on a variety of items, which included food, lodging, clothing, entertainment, lift tickets, and air or ground transportation to their destination. Researchers also collected demographic data—the number of persons in a party, where they came from, and how long the skiing trip lasted. Skiiers were asked to list ability levels for members of the group.

Graduate researcher Fred Tomlins and research associates M.M. Harris, Margaret Bailey and Marjorie Slotten visited each of the ski areas to hand out questionnaires to skiers as they arrived in the parking lot. All 21 ski areas in Idaho which maintained lifts in addition to rope tows were surveyed during the 1977-1978 winter ski season. Data were collected from skiers at Bald Mountain, Bear Gulch, Bogus Basin, Brundage, Caribou, Cottonwood, Grand Targhee, Kelly Canyon, Lookout Pass, Lost Trail,



Researchers met arriving skiers in the parking lots and distributed questionnaires for a study of ski trip expenditures in Idaho. *Margaret Bailey photo*

Magic Mountain, North-South Bowl, Pomerelle, Schweitzer, Silverhorn, Skyline, Snowhaven, Soldier Mountain, Sun Valley, Tamarack and Taylor Mountain.

In a companion study of park visitor expenditures, graduate researcher Don Stamn worked with Hoffman, Harris, Bailey and Slotten to collect data in nine state parks during the summer of 1978. Research associates again passed out questionnaires to park visitors in parking lots or at park entrances.

Similar data were requested from park visitors to Farragut, Hellsgate, Henry's Lake, Heyburn, Massacre Rocks, Ponderosa, Priest Lake, Three Island and Winchester state parks. In addition, visitors were asked to list the main purpose of their trip, and indicate the importance of the park visit to that trip—whether they stopped primarily to see the park, or to spend the night en route to another location. Both studies were sponsored by the Pacific Northwest Regional Commission.

[1] Andrus, C.D. 1979. Reorganization and the Department of Natural Resources: implications for wilderness. Wilderness Research Center Distinguished Lectureship No. 3. University of Idaho, Moscow. April 27. Forest, Wildl. and Range Exp. Sta., Univ. of Idaho. 16 pp.

Appendix

EXPERIMENT STATION SCIENTISTS

FOREST RESOURCES

Adams, David L.	Professor and Department Head Silviculture, forest management (growth and yield)
Anderson, Hal N.	Research Technician
Belt, George H.	Professor Hydrology, meteorology, planning, forest management
Brown, Steve	Research Technician II
Burlison, Vernon H.	Extension Professor and Extension Forester Emeritus
Canfield, Elmer R.	Associate Professor Forest pathology
Crookston, Nicholas L., II	Research Associate
Deibell, Roger	Research Technician
Deters, Merrill E.	Emeritus Professor Forest silviculture
Eckroth, Wallace	Assistant Forest Nursery Supervisor
Erickson, David A.	Research Technician
Fins, Lauren	Executive Secretary, Inland Empire Tree Improvement Cooperative and Assistant Professor Forest genetics
Force, Jo Ellen	Visiting Assistant Professor Modeling, land use planning, biometry
Gall, William R.	Assistant Professor Statistical design and analysis of forest genetics research, forest tree physiology
Gilbert, John	Laboratory Technician I
Goudie, James W.	Research Associate
Hanley, Donald P.	Silviculture Extension Forester and Assistant Extension Professor
Hatch, Charles R.	FWR Experiment Station Associate Director and Professor Mathematical stand modeling
Heller, Robert C.	Research Professor Remote sensing, photo interpretation, forest entomology surveys, and evaluation
Johnson, Frederic D.	Professor Forest synecology, autecology, phytogeography

King, John G.	Associate Professor Watershed management, water quality
Loewenstein, Howard	FWR Experiment Station Assistant Director and Professor Forest soils and tree nutrition
Mahoney, Ronald L.	Research Associate
McKetta, Charles W.	FWR Experiment Station Economist and Assistant Professor Timber production economics
McMurtray, Maggie	Research Associate
Medema, E. Lee	Assistant Professor Forest resource economics, forest policy, stumpage market analysis
Mika, Peter G.	Research Associate
Mitchell, Kenneth J.	Associate Professor Modeling growth and yield of coniferous stands
Moore, James A.	Assistant Research Professor Silviculture, quantitative methods, forest production
Neuenschwander, Leon F.	Assistant Professor Fire ecology, prescribed burning, general ecology
Osborne, Harold L.	Research Instructor, Experimental Forest Manager
Partridge, Arthur D.	Professor Forest pathology
Pitkin, Franklin H.	Experimental Forest Manager and Forest Nursery Superintendent and Professor Emeritus
Pitkin, George	Assistant Forest Supervisor
Reggear, Robert C.	Experimental Forest Assistant Manager/Supervisor
Scanlin, David C.	Research Assistant Professor Soil fertility and soil-site relationships with tree growth
Schenk, John A.	Professor Forest entomology
Seale, Robert H.	Emeritus Professor Forest economics
Skille, Jack	Research Associate
Stark, Ronald W.	Coordinator of Special Programs and Professor Entomology
Stock, Mary W.	Assistant Professor Insect physiology, ecology, population genetics
Stoszek, Karel J.	Professor Silviculture, forest protection and forest entomology
Ulliman, Joseph J.	Professor Aerial photography, mapping, aerial photo interpretation and remote sensing
Wang, Chi-Wu	Emeritus Professor Forest genetics
Wenny, David L.	Forest Nursery Manager and Assistant Professor Regeneration
Zwolinski, Malcolm J.	Visiting Professor Watershed management

WILDLIFE RESOURCES

Ables, Ernest D.	Associate Dean and Professor Wildlife ecology, especially animal behavior and radio-tracking techniques
Asherin, Duane A.	Research Wildlife Biologist
Bailey, Theodore N.	Research Wildlife Biologist
Bizeau, Elwood G.	Assistant Leader, Cooperative Wildlife Research Unit and Professor Birds, principally waterfowl and marsh
Dalke, Paul D.	Emeritus Professor Wildlife management
Drewien, Roderick C.	Research Wildlife Biologist Wildlife, migratory birds, endangered species
Garton, Edward O.	Assistant Professor Wildlife population biology, systems ecology
Hornocker, Maurice G.	Leader, Cooperative Wildlife Research Unit and Professor Population ecology and predator-prey interactions
Hungerford, Kenneth E.	Emeritus Professor Wildlife management
Kessler, Winifred B.	Assistant Professor Range management/wildlife relationships
Nelson, Lewis, Jr.	Associate Professor Continuing education
Peek, James M.	Professor Big game management and habitat relationships
Peterson, Steven R.	Associate Professor and Department Head Waterfowl ecology and nongame wildlife management
Riggs, Robert A.	Research Associate
Stauffer, Dean	Research Technician
Stoszek, Milena J.	Research Scientist Animal nutrition

RANGE RESOURCES

Booth, Terrance D.	Range Research Scientist
Brunsfeld, Steven	Research Associate
Bunting, Steven C.	Assistant Professor Fire ecology, range ecology
Ehrenreich, John H.	Dean, Experiment Station Director and Professor
Hironaka, Minoru	Professor Range ecology, synecology and autecology
Kingery, James L.	Instructor Range improvements and natural resource policy and economics
Mitchell, John E.	Assistant Professor Range ecology
Sanders, Kenneth D.	Associate Professor Range management

Sharp, Lee A.	Professor and Department Head Grazing practices, rangeland policy considerations, range improvements
Smith, Mia	Research Technician
Tisdale, Edwin W.	Emeritus Professor Range resource evaluation and management, native range vegetation types, ecology of range weeds, and vegetation habitat relationships
Voth, Annette S.	Research Technician

FISHERIES RESOURCES

Beleau, Marshall	Research Scientist
Bennett, David H.	Associate Professor Warmwater fishery management, fish ecology ɜy
Bjornn, Theodore C.	Leader, Cooperative Fishery Research Unit and Professor Fish ecology and management
Chacko, A. Jim	Visiting Assistant Professor
Falter, C. Michael	Professor Reservoir limnology, stream ecology
Klontz, George W.	Professor and Department Head Diseases and rearing problems of aquatic animals
Lai, Khiet V.	Visiting Assistant Professor
Leonard, James M.	Research Associate
MacPhee, Craig	Professor Fish behavior, ecology, toxicology
Ringe, Rudy R.	Research Associate
Rose, Steven	Research Associate
White, Robert C.	Assistant Leader, Cooperative Fishery Research Unit and Associate Professor Fish ecology and management

FOREST PRODUCTS

Christophersen, Kjell A.	Assistant Professor Natural resource economics
Hofstrand, Arland D.	Associate Professor Anatomy and mechanical properties of wood
Howe, John P.	Emeritus Professor Wood science and technology (full forest utilization, wood processing and products)
Johnson, Leonard R.	Associate Professor Forest engineering, industrial engineering, mathematical modeling
Moslemi, Ali A.	Coordinator of Graduate Programs and Professor Panel products technology, wood residue utilization, energy
Sowles, Kenneth M.	Coordinator of International Programs, Professor and Department Head Forest products utilization and marketing

WILDLAND RECREATION MANAGEMENT

Fazio, James R.	Associate Professor and Department Head Communication and principles of natural resource management, environmental interpretation, continuing education delivery systems and conservation history
Ham, Sam H.	Instructor Interpretation, communication, environmental education
Hoffman, Joseph E., Jr.	Associate Professor Recreation management, economics of recreation, and recreation preferences
Krumpe, Edwin E.	Assistant Professor Social psychology, decision processes in recreation, communications and interpretation
Machlis, Gary E.	Cooperative Parks Unit Leader and Assistant Professor Interpretation, human ecology, environmental sociology
McLaughlin, William J.	Assistant Professor Regional and recreation planning methods, citizen participation, recreation behavior, and perception and visual resource management

ADMINISTRATIVE SERVICES

Bottger, Richard F.	Director of Administrative Services
George, Willard L.	Research Electronics Technician
Hieb, Susan R.	FWR Experiment Station Editor
Kaufman, Betty M.	Special Projects Coordinator
Kibbee, Darline L.	Mountain Pine Beetle Symposium Editor
Lewis, Arlow	Caretaker, Taylor Ranch, Wilderness Research Center
Savage, George H.	FWR Experiment Station Associate Editor

RESEARCH PROJECTS AND INVESTIGATORS

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 Office of the Associate Director of the Forest, Wildlife and Range Experiment Station, University of Idaho.

FOREST RESOURCES

The use of seed wafers in reforestation. D.L. Adams

Evaluation of plantation growth in the grand fir, cedar, hemlock ecosystem. D.L. Adams

The influence of grand fir stand characters and management practices on bark beetle population and damage levels, stand regeneration and growth. D.L. Adams

Prediction of seedling physiological status through waveform analysis. D.L. Adams

Response of advance grand fir regeneration to release from overstory competition in northern Idaho. D.L. Adams

Fugitive dust emission from surface mining. G.H. Belt

Evapotranspiration models, G.H. Belt

Equivalent clearcut area model. G.H. Belt

Analysis of landslide hazards and slope stabilization measures near Seoul, Korea. G.H. Belt

Estimating subsurface flow using finite-element methods. G.H. Belt

Wood-inhabiting fungi. E.R. Canfield

Model integration for Gospel-Hump multi-purpose resource development plan. J.E. Force

Least-squares analysis of a twelve-parent diallel, including reciprocal crosses, with unequal subclass numbers. W.R. Gall

Least-squares analysis of a two-level diallel experiment, with unequal subclass numbers, for crossability among provenances. W.R. Gall

Economic analysis of intensive forest management. C.R. Hatch

Economic investment model. C.R. Hatch

Development of a retrieval system mapping routine. C.R. Hatch

Utilization of forest biomass. C.R. Hatch

Conversion of prognosis model to south Idaho stands. C.R. Hatch

Use of photo interpretation and remote sensing techniques to establish hazard rating criteria for spruce budworm susceptible stands. R.C. Heller, J.J. Ulliman

Color photos help evaluate effectiveness of Douglas-fir beetle pheromones. R.C. Heller

Color infrared photos define irrigation types and management practices in eastern Idaho. R.C. Heller

Development of remote sensing techniques to improve irrigation inventories. R.C. Heller

Assessment of wildlife habitat by use of large scale color aerial photographs. R.C. Heller

Ecology and distribution of Idaho woody plants. F.D. Johnson

Sensitive plants of Hells Canyon. F.D. Johnson

Sensitive plants of Clearwater and Nezperce National Forests. F.D. Johnson

Regeneration of western redcedar. F.D. Johnson

Streambottom vegetation of Sawtooth Valley. F.D. Johnson

Classification of north Idaho bogs. F.D. Johnson

Natural sedimentation rates from a forested watershed. J.G. King

Snow ablation process. J.G. King

Evaluation of effects of road construction on hydrology and sedimentation. J.G. King

Evaluation of effects of road construction on aquatic fauna and flora. J.G. King

Bark beetle species complex in grand fir stands before and after shelterwood cuttings. S. Laursen

Tree growth and response to fertilization as indicated by soil and foliar nutrient levels and envrionmental factors. H. Loewenstein

Bioassay of selected Idaho forest soils. H. Loewenstein

Legume-conifer interrelationships. H. Loewenstein

Deficiency symptoms and critical levels of nutrients in Douglas-fir. H. Loewenstein

Validation of the use of understory plants as indicators of grand fir mortality by the fir engraver. R.L. Mahoney

Idaho Department of Lands - Resources Planning Act assessment. C.W. McKetta

A model for economic evaluation of forest management practices. C.W. McKetta

Investment analysis of forest management alternatives on northern Idaho Department of Lands commercial forest acreage. C.W. McKetta

The stability rationale: economic implications of an even flow constraint in forest management. C.W. McKetta

A comparison of stumpage price behavior on state lands and national forests in Idaho. C.W. McKetta

Lumber production in the western states: historical perspective and implications of production, employment, and trade. E.L. Medema

Timber sale impact: Nezperce National Forest case study. E.L. Medema

Investment analysis of state owned forest lands in Idaho. E.L. Medema

Economic evaluation model. E.L. Medema

Resources Planning Act assessment - Idaho. E.L. Medema

Changes in labor intensities in the lumber producing industries. E.L. Medema

Assess the impact of spatial distribution of Douglas-fir at the time of establishment on growth and yield. K.J. Mitchell

Simulation of the response of Douglas-fir to fertilization. K.J. Mitchell

Utility of "Fraser's" polygons as a measure of density and a predictor of growth. K.J. Mitchell

Construction of log population tables. K.J. Mitchell

Construction of lodgepole pine yield tables. K.J. Mitchell

Effect of Douglas-fir tussock moth defoliation on juvenile coniferous tree growth and development and stand dynamics. J.A. Moore

Relationships of western spruce budworm outbreaks to site/stand attributes, development, and management history. J.A. Moore

Timber stand growth projections in support of silvicultural prescriptions. J.A. Moore

Influence of grand fir stand characters and management practices on bark beetle population and damage levels, stand regeneration and growth. J.A. Moore

Response of herbaceous vegetation following prescribed burning. L.F. Neuenschwander

Fire ecology of north Idaho. L.F. Neuenschwander

Response of vegetation and sage grouse to prescribed burning in a big sagebrush/Idaho fescue habitat type. L.F. Neuenschwander

Fire as a silvicultural tool in ponderosa pine. L.F. Neuenschwander

Decays and cavity-nesting birds. A.D. Partridge, E.L. Bull

Survey methods for root-disease centers. A.D. Partridge, E.R. Canfield

Disease-insect descriptions and keys. A.D. Partridge, E.R. Canfield

Disease-insect interactions in forest trees. A.D. Partridge, E.R. Canfield

Idaho tree diseases and defects. A.D. Partridge, E.R. Canfield

Techniques to identify, quantify and predict decays and diseases of timber in the inland northwest. A.D. Partridge, E.R. Canfield

Forest fertilization. F.H. Pitkin

Containerized western redcedar seedling establishment and growth. F.H. Pitkin

Tree growth and response to fertilization as indicated by soil and foliar nutrient levels and environmental factors. D.C. Scanlin

Influence of grand fir slash condition on success of attack and brood development of the fir engraver. J.A. Schenk, J.A. Moore

Hazard rating lodgepole pine stands for mortality by mountain pine beetle. J.A. Schenk, R.L. Mahoney, J.A. Moore, D.L. Adams

Genetic characteristics of western spruce budworm associated with geographic distribution and density levels. M.W. Stock

Genetic features of *Choristoneura occidentalis* and *C. viridis* populations exhibiting differential response to selected insecticides. M.W. Stock

Electrophoretic features of western spruce budworm larvae and their toxicological correlations. M.W. Stock

Inter- and intraspecific variation among bark beetle (*Dendroctonus*) species. M.W. Stock

Genetic features of endemic and epidemic mountain pine beetle populations attacking lodgepole pine in the Intermountain Region. M.W. Stock

Comparative studies on the physiological environment indices of grand fir stands expressing a gradient of hazard conditions to the western spruce budworm in the Intermountain Region. K.J. Stoszek

The relationship of western spruce budworm outbreaks to site/stand attributes, development, and management history. K.J. Stoszek

Intensive forest management project: protection. K.J. Stoszek

Silviculture prescription guidelines. J.J. Ulliman

Use of large scale aerial photographs for wildlife habitat inventories in coniferous forest habitats, central Idaho. J.J. Ulliman, E.O. Garton

WILDLIFE RESOURCES

Behavior, dispersal and altitudinal migration of bobcats in Idaho. E.D. Ables

Re-establishment of the whooping crane in western U.S. E.G. Bizeau

Ecology of the wood duck in north Idaho. E.G. Bizeau

The Rocky Mountain population of the western Canada goose. E.G. Bizeau

Inventory of redhead duck habitat in Idaho and Washington. E.G. Bizeau

Whooping crane reintroduction program. R. Drewien

Wildlife resource inventory of Bureau of Land Management lands in north Idaho. E.O. Garton

Dietary selection of granivorous birds. E.O. Garton

Computer programs for estimating population abundance and mortality and natality rates. E.O. Garton

Simulation models for use in wildlife population analysis management. E.O. Garton

Development of estimation techniques applicable to fixed station transect censuses for songbirds. E.O. Garton

Ecology of the wolverine in northwest Montana. M.D. Hornocker

Ecology of badgers on the Snake River Birds of Prey Natural Area, Idaho. M.G. Hornocker

Population characteristics and dynamics of river otters in west-central Idaho. M.G. Hornocker

Reproduction, food habits and movements of great blue herons in southern Idaho. M.G. Hornocker

Analysis of predator-prey interactions on the Salmon tract, Twin Falls, Idaho. M.G. Hornocker

Land management practices and sharp-tailed grouse in south-eastern Idaho. W.B. Kessler

Effects of logging on bird populations in coastal forests of south-east Alaska. W.B. Kessler

Responses of big game to a rest-rotation grazing system. J.M. Peek

Relationship of productivity and biomass of forest communities and associated ungulates to forest fire. J.M. Peek

Movement patterns and determinants of habitat use of big game in northern Idaho. J.M. Peek

Habitat selection patterns of grizzly bears in Glacier National Park. J.M. Peek

Evaluation of bighorn sheep use of fall burns, East Fork, Salmon River. J.M. Peek

Evaluation of overstory removal on bitterbrush winter range on ungulate use and vegetation response. J.M. Peek

Effects of silvicultural regeneration systems on birds and small mammals. S.R. Peterson

Feeding activity and behavior of prairie falcons and red-tailed hawks in the Snake River Birds of Prey Natural Area. S.R. Peterson

The value of snags on the University of Idaho Experimental Forest. S.R. Peterson

The ecology of Hungarian partridge on the Palouse Prairie, Idaho. S.R. Peterson

Ruffed–blue grouse habitat relationships in southeastern Idaho. S.R. Peterson

Resource partitioning among woodpeckers. S.R. Peterson

Crippling losses of waterfowl in firing line hunting. S.R. Peterson

Nutritional requirements of mountain beaver. M.J. Stoszek

Trace mineral metabolism of pronghorn antelope. M.J. Stoszek, W.B. Kessler

RANGE RESOURCES

Effects of fire on desert mountain shrub vegetation in Trans-Pecos, Texas, S.C. Bunting

The vegetation of the Guadalupe Mountains. S.C. Bunting

Seasonal variation in the flammability of redberry juniper. S.C. Bunting

Habitat type classification for grassland and shrublands in southern Idaho. M. Hironaka

Competition between seeded grass and tree seedlings on forest plantations. J.E. Mitchell

Effect of animal grazing on water quality of nonpoint runoff. J.E. Mitchell

Successional patterns on grazed and ungrazed communities in the Boise National Forest. K.D. Sanders

Interrelationships of cattle, deer and elk grazing in central Idaho. K.D. Sanders

Livestock grazing management studies, Point Springs Experimental Pastures. K.D. Sanders

Idaho rangeland development and improvement. K.D. Sanders

Evaluation of range improvement practices. L.A. Sharp

Ecology of salt-desert shrub rangelands. L.A. Sharp

Multiple-use capabilities of forest-associated rangelands in the central Idaho batholith. L.A. Sharp, M. Hironaka

Grazing practices to manipulate vegetation. L.A. Sharp

Ecology of grasslands of the Snake and Salmon River systems in Idaho. E.W. Tisdale

Review of literature on sagebrush vegetation of North America. E.W. Tisdale

FISHERIES RESOURCES

Probable walleye (*Stizostedion vitreum*) habitation in the Snake River and tributaries of Idaho. D.H. Bennett

Response of selected salmonids to reduced stream flow. D.H. Bennett

Juvenile emigration of lahontan cutthroat trout in the Truckee River-Pyramid Lake system. D.H. Bennett

Status of the warmwater fishery and the potential of improving warmwater fish habitat in the Lower Snake reservoirs. D.H. Bennett

Adult steelhead trout losses in the McNary pool of the Columbia and Snake rivers. T.C. Bjornn

Sedimentation and productivity of salmonid streams. T.C. Bjornn

Effects of chronic turbidity on social contest in steelhead trout and coho salmon. T.C. Bjornn

Food habits and distribution of rainbow and cutthroat trout in Lake Koocanusa. T.C. Bjornn

Density of juvenile steelhead trout as related to spawning escapements and fry stocking. T.C. Bjornn

Analysis of scales from Clearwater steelhead trout to determine size and age at seaward migration. T.C. Bjornn

Maintenance of fish resources with enlargement of the power house at Minidoka Dam. T.C. Bjornn

Status of upper Columbia River salmon stocks with regard to the Endangered Species Act. T.C. Bjornn

Evaluation of fish resources in the Gospel Peak Buffalo Hump area. T.C. Bjornn

Response of cutthroat trout populations to special angling regulation–St. Joe River and Kelly Creek. T.C. Bjornn

Dynamics of a rainbow trout population in a fertile stream. T.C. Bjornn

Evaluation of the aquatic resources in Silver Creek at the Nature Conservancy site. T.C. Bjornn

Pilot rearing of steelhead and salmon at national fish hatcheries for Lower Snake Fish and Wildlife Compensation Plan. T.C. Bjornn

Angler opinions of hatchery fish in steelhead fisheries of Vancouver Island, B.C. T.C. Bjornn

Importance of habitat components to carrying capacity of forest streams for salmon and trout. T.C. Bjornn

Limnological evaluation of Lake Koocanusa. C.M. Falter

Impacts of selective water withdrawal on zooplankton communities of Lake Koocanusa. C.M. Falter

Causal mechanisms of phytoplankton blooms in the River Murray, South Australia. C.M. Falter

A study to abolish the carrier states of bacterial kidney disease and furunculosis in anadromous salmonids. G.W. Klontz

The economic feasibility of raising finfish in geothermal waters. G.W. Klontz

A survey of food fish production in Idaho. G.W. Klontz

Control of bacterial kidney disease in spring chinook salmon. G.W. Klontz

Development of a refined method to predict weight gain in hatchery raised fish. G.W. Klontz

Evaluation of biofilter operating factors. G.W. Klontz

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Selective chemicals for the control of stickleback. C. MacPhee

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Investigation of the short-term effects of starvation on pre-smolting salmonids. C. MacPhee

Effects of power peaking on fall chinook egg incubation and hatching. R.G. White

Effects of increased fine sediment on incubation and emergence of chinook salmon and steelhead trout embryo and fry. R.G. White

Status of the warmwater fishery and the potential of improving warmwater fish habitat in Lower Snake River reservoirs. R.G. White

Effects of altered flow regimes, temperature and river impoundment on adult steelhead trout and chinook salmon. R.G. White

Potential impact of peaking flow on fish and aquatic macroinvertebrates in South Fork Boise River. R.G. White

Development and application of a methodology for recommended salmonid egg incubation flows. R.G. White

Effects of reduced stream discharge on fish and aquatic macroinvertebrate populations. R.G. White

FOREST PRODUCTS

Investment analysis of forest management alternatives and estimates of differences in income potential resulting from financially, rather than biologically, derived rotation ages on northern Idaho Department of Lands commercial forest acreage. K.A. Christophersen

Technical and economic practicability of new lumber products made from dead white pine, K.A. Christophersen and J.P. Howe

Humidity effects on strength of overlaid all strandcore. A.D. Hofstrand

Straight line linear expansion of plystran exposed to different levels of moisture. A.D. Hofstrand

Technical and economic practicability of dowel-laminating crossties before drying. J.P. Howe

Concrete crossties–a challenge to the forest products industry. J.P. Howe

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Implementation of a logging simulation model (SAPLOS). L.R. Johnson

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WILDLAND RECREATION MANAGEMENT

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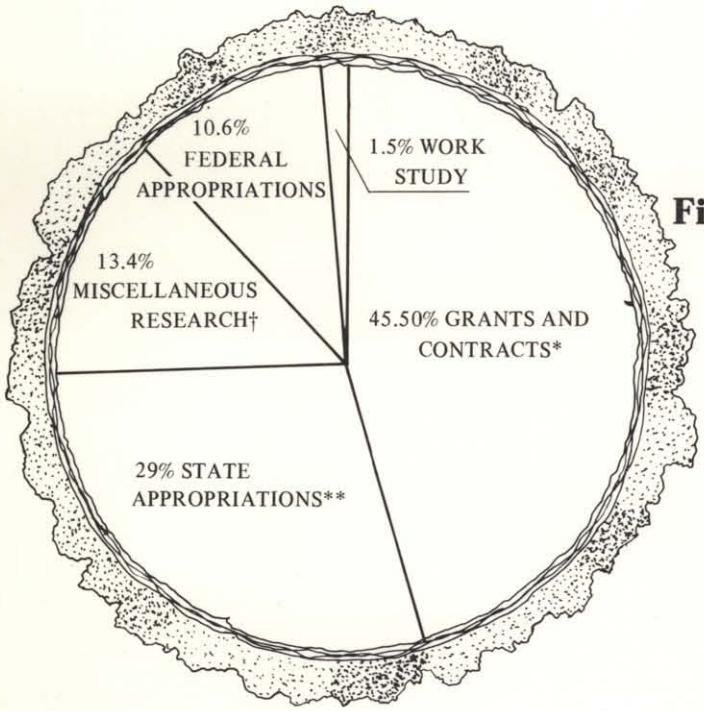
Agency and Funding Support



Fiscal Year 1979 Financial Picture

Research expenditures, shown by funding source, totaled $3,550,000 for the Fiscal Year 1978-1979.

* 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

Abbott Laboratories
Alaska Fish and Game Department
American Fishing Tackle Manufacturing Association
American Forest Institute
Anaconda Forest Products
Bennett Lumber Company
Boise Cascade Corporation
Boise National Forest
Boone and Crockett Club
British Columbia Forest Service
Bunker Hill Company
Clearwater National Forest
Crown Zellerbach
Curtis Berklund
Diamond International Corporation
Dow Corning
Greater Shoshone County, Inc.
Idaho Citizens Grazing Association
Idaho Department of Fish and Game
Idaho Department of Health and Welfare
Idaho Department of Parks and Recreation
Idaho Department of Public Lands
Idaho Fish Food Industry
Idaho Forest Industries
Idaho Nuclear Energy Commission
Idaho Power Company
Idaho Research Foundation, Inc.
Idaho Water Resources Board
Idaho Water Resources/Research Institute
Inland Empire Paper Company
Institute of Paper Chemistry
Lucky Peak Nursery
Morrison-Knudsen Company
National Oceanic and Atmospheric Administration
National Science Foundation
National Wildlife Federation
Nature Conservancy
New York Zoological Society
Northern Pacific Railway
North Idaho Forestry Association
Pacific Northwest Power Company
Pacific Northwest Regional Commission
Pack River Lumber Company
Payette National Forest
Potlatch Corporation
South Idaho Forestry Association
Stillinger Trust
St. Regis Paper Company
The Wildlife Society
U.S. Army Corps of Engineers
U.S.D.A. Agricultural Research Service
U.S.D.A. Cooperative Research
U.S.D.A. Forest Service, Intermountain Forest and Range Experiment Station
U.S.D.A. Forest Service, Northeastern Forest Experiment Station
U.S.D.A. Forest Service, Pacific Northwest Forest and Range Experiment Station
U.S.D.A. Soil Conservation Service
U.S. Department of Commerce
U.S. Department of Energy
U.S.D.I. Bureau of Indian Affairs
U.S.D.I. Bureau of Land Management
U.S.D.I. Bureau of Reclamation
U.S.D.I. Fish and Wildlife Service
U.S. Department of Navy/Naval Undersea Center
University of British Columbia
University of Idaho Experimental Forest
University of Idaho Forest Nursery
University of Maine
Washington State University
Weyerhaeuser Company
Wildlife Management Institute

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