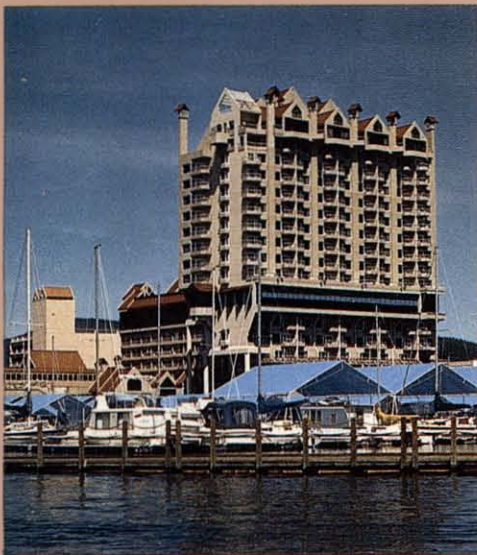


FOCUS

on Renewable Natural Resources



Forest, Wildlife and Range Experiment Station
College of Forestry, Wildlife and Range Sciences
Moscow, Idaho 83843

Volume 12



RESEARCH STRENGTHENS IDAHO ECONOMY

Focus is the annual report for the Idaho Forest, Wildlife and Range Experiment Station — the research arm of the College of Forestry, Wildlife, and Range Sciences. The college has five diverse departments under one roof — Fish and Wildlife Resources, Forest Products, Forest Resources, Range Resources and the Department of Wildland Recreation Management. Each year, *Focus* features a different department for its lead article. This edition features the Department of Wildland Recreation Management and its new emphasis on the expanding tourism industry in Idaho.

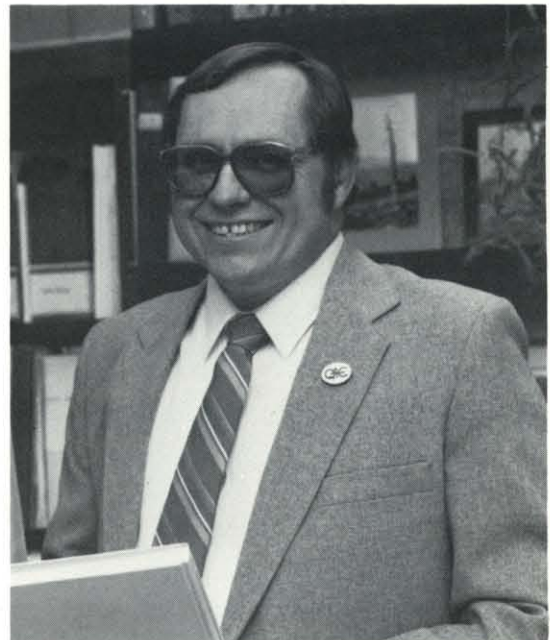
Idaho's economy is based on its natural resources. The University of Idaho is the land grant institution charged with conducting research in natural resources to help strengthen the state's economy. This research helps increase productivity, efficiency, and predicts the consequences of management actions and planning to enhance Idaho's resources to benefit all Idahoans.

The college will play a major role in Idaho's natural resource future. Research already completed, in progress, or planned will provide the scientific information needed for resource decisions to help make the Idaho economy competitive in the global marketplace.

To make the most of Idaho's natural resources, they must be allocated to provide a balance between amenity values, such as clean air, clean water and scenic beauty for tourism, and their use in the basic natural resource industries that are Idaho's mainstay. As places of great natural beauty dwindle in much of America, pollution-free environments with healthy fish and wildlife populations, wilderness areas, and places where one can go for solitude will grow in importance as commodities in Idaho's future economy. Conflicts between user groups are inevitable, but so is Idaho's pioneer spirit of cooperation to solve these differences.

A major research study on the economic importance of natural resource tourism by the Department of Wildland Recreation Management indicates that 44 percent of the travelers on Idaho's highways last summer were headed toward some outdoor recreational opportunity. As this major study is completed, the information will be provided to this rapidly-growing industry. Last year, the college initiated the first-ever Idaho Tourism Training Institute (see story on page 6) providing small businesses with a place to learn the new skills required by the computer age, advance existing skills, and begin working toward a future when tourism is predicted to be even more important to Idaho.

Working with the public and gathering the information that will guide resource decisions is the challenge the university faces in the next decade. Without a doubt, Idaho's traditional industries will remain important even as tourism increases. And our research will be more important than ever in providing information to help Idaho compete in the world market and enable Idahoans to make the best use of all their resources.



**Leon Neuenschwander, Associate Director,
Idaho Forest, Wildlife and Range Experiment Station**

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Fiscal 1986 Annual Report



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FOREST, WILDLIFE AND RANGE EXPERIMENT STATION

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Leon F. Neuenschwander, Associate Director

Howard Loewenstein, Assistant Director

Jane Pritchett, Editor

Lorraine Ashland, Artist

Michal Miller, Typesetting

Cover: A photo montage illustrates some reasons why Idaho lures more than 4 million visitors to the state each year. Whether it's (clockwise from top left) the Sawtooth Mountains in south-central Idaho (*Idaho Travel Council*), a cool stream near Moscow in the lower "Panhandle" (*Gerry Snyder*), a fishing spot on the Clearwater River near Lewiston (*Gerry Snyder*), or a resort on Lake Coeur d'Alene (*Coeur d'Alene Resort*), Idaho's natural resource treasures have made tourism the state's third-largest industry.



UNIVERSITY OF IDAHO LIBRARY

IDAHO'S TOURISM AND BASIC NATURAL RESOURCE INDUSTRIES CAN COEXIST

John C. Hendee, Dean
College of Forestry, Wildlife and Range Sciences
Director
Idaho Forest, Wildlife and Range Experiment Station



Recreation, tourism and Idaho's traditional natural resource industries all figure prominently in Idaho's future. Through careful planning and sound management, they can all benefit the economic and social well-being of the state and its people. Where conflicts exist, they need to be resolved to the benefit of a strong economy for Idaho, coupled with the quality of life that is the envy of residents in other states. Our natural resources and outdoor environment are what makes Idaho appealing to Idahoans as well as to visitors, future industries and productive people who might move here.

Tourism is promoted by some as the answer to reduced employment in Idaho's other basic resource industries: logging, mining, ranching and farming. But even though tourism is now Idaho's fastest-growing industry, Idahoans will be short-changed if that growth comes at the needless expense of jobs, taxes and wealth created by our traditional resource industries. Idaho is a resource-dependent state in its economy and lifestyles. Our challenge is to incorporate the expanding travel and tourism industry into Idaho's economy, along with logging, mining, ranching and farming. But while doing that we must maintain the environmental quality, scenic beauty, fishing, hunting and outdoor opportunities that Idahoans enjoy and out-of-state visitors come to experience.

With an upsurge in domestic travel caused by terrorism abroad and cheaper oil prices at home, Idaho's challenge to

integrate recreation and tourism with resource development is more urgent. Balancing those needs will challenge Idaho's leaders and universities, and they must contribute more education, research and leadership toward future growth of Idaho's natural resource economy and environmental quality.

Travel and tourism is a billion dollar business in Idaho with strong growth potential. Travel and tourism directly account for 12 percent of the state's income. Some travel is for business, including conventions drawn to growing facilities at destination sites such as Coeur d'Alene, Sun Valley, Boise and McCall. But an important draw for business travel, like tourism, is often the chance to experience Idaho's scenic beauty and outdoor opportunities. National consumer studies reveal that Americans now view travel and leisure expenditures as "necessary and essential." These facts, along with aggressive promotion of Idaho as a vacation destination, can help our travel and tourism industry contribute even more to our state's economy.

Idaho is a public land, with 21 million acres of national forests and vast areas under Bureau of Land Management administration. Idaho has three national park units: a small portion of Yellowstone National Park, Craters of the Moon National Monument, and the Nez Perce National Historical Park. In addition, it has an international reputation for its wilderness resources, natural beauty, hunting, fishing and river floating. The Frank Church-River of No Return Wilderness, covering 2.3 million acres of wilderness, is the largest unit of the National Wilderness Preservation System outside of Alaska. It is also the core of a network of 3.8 million acres of wilderness, with other units of the wilderness system nearby: the Gospel Hump, Selway-Bitterroot, Sawtooths and Hells Canyon. These areas offer some of the highest-quality wilderness big-game hunting, fishing and river floating in the world, activities that support a vigorous outfitting and guiding industry.

The growth of Idaho's travel and tourism industry needs to be planned and managed to realize its economic potential. It must be planned to prevent disruption of established ways of life with crowds, litter, crime, and to see that demands for services are balanced with potential for increased revenues. We must guard also against the impacts of tourism on soils, waters, and wildlife. We cannot risk unplanned development leading to aesthetic and resource degradation.

Unplanned tourism can take its toll in different ways. For example, years ago Gatlinburg, Tennessee, was a truly complementary gateway to the Great Smoky Mountains National Park with a few, well-designed hotels and motels,

all locally owned. Today, the natural marvels of the Smokies remain the principal attraction, but now the approach roads are lined with gaudy tourist attractions, chain motels and souvenir stores. Nearby Cherokee, the fascinating ancestral home of the tribe of that name, is similarly blighted by a clutter of gift shops selling artificial arrowheads and rubber tomahawks. This is not what we want for Idaho.

Idaho's environmental quality and public-land attractions need appropriate planning and protection for recreational use without overuse. The Sawtooth National Recreation Area is a world-class attraction only beginning to be discovered. A decade ago it was headed toward degradation from tourism and condominium development, but federal acquisition of scenic easements has reversed the trend. Now, whole portions of this beautiful valley remain in private ownership, it is a pastoral western scene with livestock grazing in lush vegetation in front of snowcapped mountains. "It's nice to see one place in the country that looks better now than it did 10 years ago" is a frequent comment of visitors returning after several years.

To keep the quality of life for those who live and work in Idaho, we need tourism *and* our basic resource industries. But we need to remember that both depend on our natural resources. As we seek to promote tourism, we need to recognize the role of the timber industry — not of the "cut-and-run" variety, but the "stable and long-run" variety. As we bring more acres of our national forests under management with additional roads, we must consider the effects on fish, wildlife, water quality, scenic beauty and tourism as well as the timber economy. But a revitalized wood products industry based on sound financial management, sustained-yield and environmental protection principles is wholly compatible with a healthy tourism and outdoor recreation industry that can also help resource-dependent communities with small business enterprises. Diversity is best, even fundamental, for community health and progress and Idaho's future.

The challenge facing the university is to provide education, research and leadership to help the balanced growth of natural resource industries. Foresters, fishery and

wildlife managers, range conservationists, and park rangers must gain a broader understanding of their influence on the tourism industry. Similarly, tourism entrepreneurs must be reminded of the importance of conservation, sustained-yield, and the contribution Idaho's basic resource industries make to our economy and lifestyle.

Beginnings toward this have been made with the college's Department of Wildland Recreation Management teaming up with the College of Business and Economics and the Cooperative Extension Service to offer the Idaho Tourism Training Institute. The institute provides small business owners with help in promoting, marketing and managing small tourist enterprises more effectively and efficiently (see article page 6). The college is also expanding its public education and research about natural resources, teaching the public that we need to wisely use, as well as appreciate and conserve, our resources in Idaho.

A major research effort was launched this year by the Department of Wildland Recreation Management to assess the economic values now and in the future of tourism and recreation in Idaho (see article page 4). Key questions are: What natural resource and outdoor recreation activities lure visitors to Idaho? What keeps them here? Where and for what do they spend their money on in our state? This information will help state leaders and the public plan Idaho's future as a resource-dependent state with a balanced future featuring the use and the appreciation of our natural resources. Cooperating in that effort are the university, the Idaho Travel Council, the Idaho Departments of Parks and Recreation, the Transportation Department, the U.S. Forest Service, the Bureau of Land Management, and Idaho Outfitters and Guides.

With the help of thoughtful natural resource education and research, Idaho *can* find ways to balance the use of our natural resources. The educators of the College of Forestry, Wildlife and Range Sciences look forward to developing vital new information and strong, knowledgeable leaders committed to using the state's splendid natural resources to build a strong, diversified economy where tourism and our basic resource industries can coexist and thrive.



Department of Wildland Recreation Management

RESEARCH STUDIES TOURIST BEHAVIOR AND SPENDING IN THE STATE

Investigators:

**Charles C. Harris
Sam H. Ham
Edwin E. Krumpe**

**William J. McLaughlin
Nick Sanyal**

Tourism is becoming known as Idaho's up-and-coming industry, perhaps the one bright spot on Idaho's economic horizon. Because of its importance, we need to know more about Idaho tourism. Who are the travelers coming to Idaho? Where are they from? Why do they come here? Are they drawn to Idaho by its abundant quality recreational opportunities, or for other reasons? Where do they go once they get here? And, of course, how do they affect the state's economy?

In these austere times, concerns about any industry in Idaho naturally lead to questions about its impact on the state's economic health. How much income does resource-based tourism bring to Idaho and how many jobs does it create?

In a new major study initiated by the Department of Wildland Recreation Management, researchers will seek answers to these and other questions. The project is a cooperative effort by principal investigator Charles C. Harris and all the professors in the department — Sam H. Ham, Edwin E. Krumpe, William J. McLaughlin and doctoral candidate Nick Sanyal. They developed the initial research design and the questionnaire that will be used to question nearly 10,000 Idaho visitors about their reasons for coming to the state.

Funds to support the research have been contributed by the Idaho Department of Parks and Recreation, the Idaho Travel Council, and the McIntire-Stennis Fund, which supports natural resource education and research. Other federal land management agencies may contribute to the research in the future.

A major goal of the research will be to assemble, for the first time, comprehensive baseline data on Idaho's tourists and outdoor recreationists, their activities, and their spending in the state. The information will be used to provide the state's regional tourism committees and government agencies with details about the characteristics of travelers and their trips in and through the state. Such information will be used to plan and manage Idaho's tourism and recreation resources and determine how to lure more travel to Idaho.

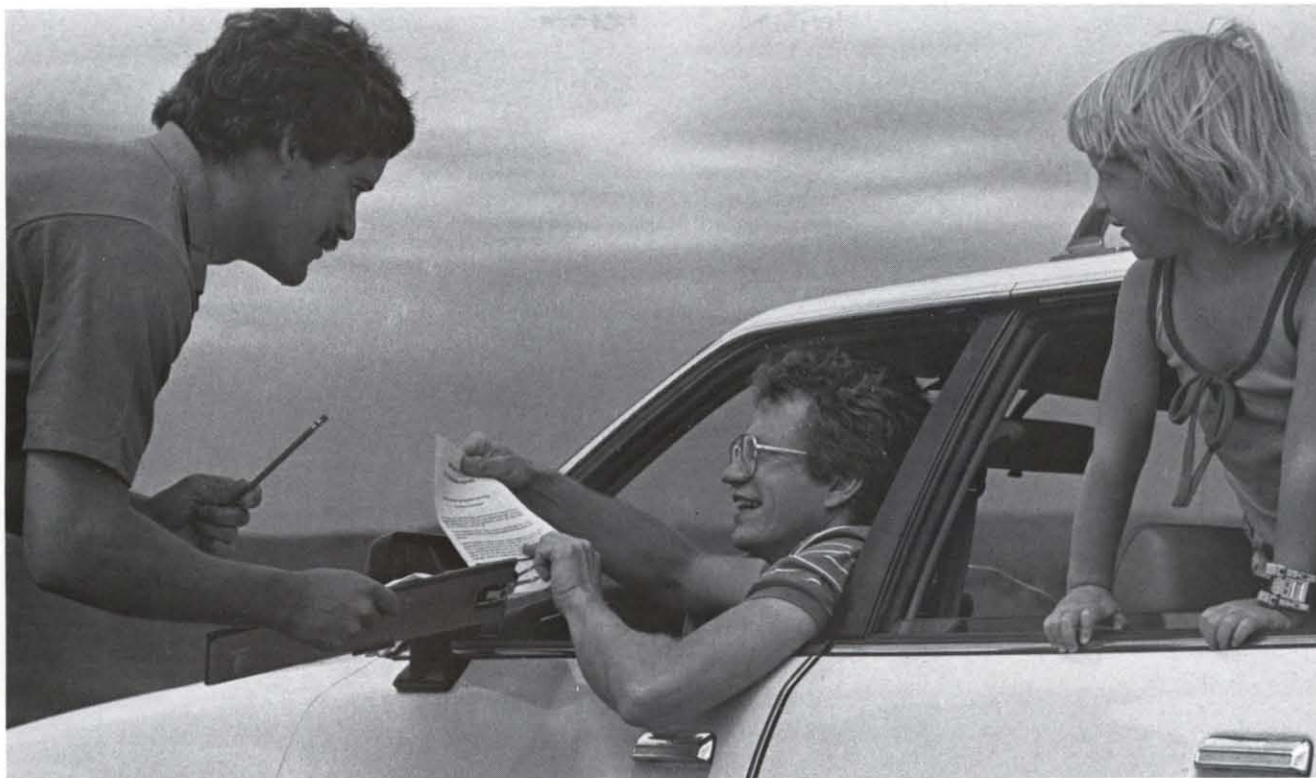
The research also will provide market data to help clarify the differences between the travelers who choose Idaho as a major destination on their trip and those who merely travel through the state. How the two differ in regard to income, in-state spending habits, media utilization, and the images held of Idaho will be determined and the information used to help promote the state in the future. In addition, theoretical questions dealing with how travelers make their travel plans and what factors influence their decision-making will be answered.

The first phase of the research, which began in June, 1986, is to conduct roadside interviews with 10,000 people actually traveling on Idaho's major highways or using Idaho airports. The interviews will continue this fall and through the winter and spring of 1987. A carefully-designed, multi-stage cluster sampling process will be used to insure that the data represent all Idaho travelers for all four seasons.

At the time of the roadside interview, each group of travelers is given two mail-back trip diaries. The first asks travelers to report their expenditures while traveling through Idaho. The other seeks information on the characteristics of the key attractions that they visited in Idaho.

"Information from the trip expenditure diary will be used to calculate how much tourists and travelers are spending on specific products and services within the state," Harris said. "Later, we will use those figures to estimate how much tourist spending added to the state's economy and calculate how much employment that spending should stimulate." The projections should also provide an indication of how many dollars and jobs are lost when people travel through Idaho to major destinations in other states.

As an important first step of the study, an advisory committee was created to review key research questions and develop objectives for the study to insure its usefulness for private businesses and recreation managers. Representatives of the state's travel industry and federal and state resource management agencies served on the committee. They include the travel division of the state's Department of Commerce, the Idaho Travel Council, the Boise Convention and Visitors'



Travelers on Idaho's major highways were given trip expenditure diaries to help researchers determine their impact on the state's economy. The results will help natural resource managers create better plans for handling increased tourist travel. *Gerry Snyder*

Bureau, the Idaho Department of Fish and Game, the Idaho Parks and Recreation Department, the U.S. Forest Service and the Bureau of Land Management.

Planning for the research started in January, 1986, and the study will continue for three years. It will employ three graduate students and four graduates of the Department of

Wildland Recreation Management working as roadside interviewers and data managers. The researchers plan to conduct other, more detailed, surveys of specific segments of Idaho's current and potential tourism markets based on the information gathered in this research. The information gathered should help planning and managing the emerging tourist industry to the benefit of the state's economy.

IDAHO TOURISM TRAINING INSTITUTE HELPS SMALL BUSINESS OPERATORS

**Institute Director:
Sam Ham**

"The greatest need in the travel industry in Idaho is for better educated suppliers. This program fills a total void that exists."

*Bobbie Patterson, Executive Director
Boise Convention and Visitors Bureau
Participant in Tourism Training Institute*

Tourism is Idaho's third-largest and fastest-growing industry, but small business operators need to upgrade their skills to remain competitive in the planning, promotion and marketing of tourism. To help fill those needs, the Department of Wildland Recreation Management this year sponsored the first Idaho Tourism Training Institute.

Thirty-eight trainees from small businesses, including motels, outfitters and guide services and private campgrounds, came to Moscow February 1-14, 1986, for intensive training at the University of Idaho.

The 3½-day institute covered such topics as financing and accounting for small businesses, writing effectively for marketing, time management, marketing to groups through conventions and tours and using microcomputers for reservations, promotional letters and accounting for small businesses.

"We knew even before the institute of the need for this kind of outreach, but the amount of support that has surfaced since February convinces us this cannot be a one-shot affair," said Institute Director Sam Ham, professor of Wildland Recreation Management.

The idea for the first institute was developed at a 1984 Governor's Conference on Outdoor Recreation and Tourism, sponsored by the department and other state agencies. Participants noted an urgent need for improved tourist marketing and business management skills.

Support for the institute was provided by more than 30 cooperators who joined in the effort to launch the institute. Time and expertise were contributed by the faculty of the Department of Wildland Recreation Management, marketing and accounting experts from the College of Business and Economics, owners of small businesses, the U.S. Forest Service, and the Idaho Travel Council. The Cooperative Extension Service provided the institute with a \$5,000 grant.

"We were extremely pleased with the degree of cooperation shown throughout Idaho's tourist industry," Ham

said. "We had faculty come from as far away as Alaska at their own expense. The support and encouragement from Ralph McMullen of the Idaho Travel Council was especially appreciated."

Dean John C. Hendee of the College of Forestry, Wildlife and Range Sciences told the trainees he hoped the institute would serve as the research and development arm of Idaho's small tourism enterprises. "Tourism should supplement, not replace, Idaho's other natural resource industries such as



State Travel Director Ralph McMullen tells entrepreneurs about the Idaho Travel Council's promotional programs. *Jane Pritchett*

timber, mining and agriculture," Hendee said. "Our industries need to coexist and complement each other to build a strong economy." Hendee urged those involved in the tourist industry to cooperate and communicate when conflicts might arise between competing needs. "We need the strengths of all our natural resource industries," Hendee said.

One effort to strengthen Idaho's tourism industry was described by State Travel Director Ralph McMullen who said



A panel of owners of tourist enterprises gave views on management challenges and answered questions from ITTI participants. From left, Frogg Stewart of Holiday River Expeditions, George Hill of Hill's Resort, Eleanor Harmon of Harmon's Travel Agency and Dave Hand of the Idaho Innkeepers Association tell about their businesses. *Jane Pritchett*

the Idaho Travel Council was created to market the state as a vacation destination, increase conventions and inform Idaho citizens about the benefits of tourism on the economy. "Some 25,000 Idahoans are employed by the travel industry and we hope to increase that number by bringing more visitors into the state," McMullen said.

The more travelers that are brought into the state, the more challenges Idaho's small tourist businesses may face. As river outfitter Peter Grubb of River Odysseys West said,

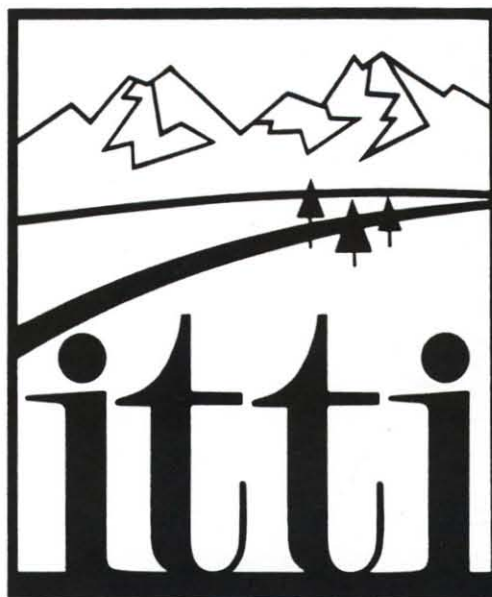
"The natural resources and beauty of Idaho have created the setting. It is now the challenge of those in the travel business to provide the services necessary to enjoy the gift of nature."

One problem about providing those services and bringing those visitors to Idaho will be the increased competitiveness among tourist enterprises. "It takes more than scenic beauty to make business work," Ham said. "We're competing with Oregon, Washington, Wyoming, and Utah for the tourist dollar and we need to give Idaho a competitive edge."

Giving Idaho entrepreneurs the competitive edge by increasing their marketing and business management skills is what the Idaho Tourist Training Institute was all about. "It is a very high departmental priority to do everything possible to help Idaho's tourist industry continue to grow and prosper," Ham said.



Gaining "hands on" computer skills was a new experience for many participants in the Idaho Tourism Training Institute. *Rick Stier*





Taylor Ranch Field Station deep in the Frank Church River of No Return Wilderness has facilities for scientists and researchers. The university tries to keep the wilderness environment even if it means using mules or hand tools. *Jane Pritchett*

WILDERNESS RESEARCH CENTER EXPANDS ITS CAPABILITIES

Ed Krumpe, Director

The university's Wilderness Research Center expanded the research capabilities of the Taylor Ranch Field Station, a unique facility located in the Frank Church-River of No Return Wilderness. The oldest log cabin was renovated into a fully equipped field laboratory; a small mammal collection was begun, and the herbarium collection was expanded.

In addition, two summer wilderness interns were hired to work half-time on research projects and half-time on doing the ranch work. Ed Krumpe, the center's director, explained that the two students would learn valuable wilderness work skills such as trail construction, working with the mule team to put up hay, horse-packing, cabin maintenance, and crosscut sawing, for which they were paid. They also received valuable experience helping several ongoing research projects, as half-time volunteers.

The center's Technical Advisory Board played an active role in initiating these and other projects. Board members include college faculty members Ernest D. Ables, James R. Fazio, C. Michael Falter, E.O. Garton, Maurice Hornocker and Karl Stoszek. Also members are Frank C. Leonhardy, University of Idaho anthropologist; Clem Pope, USDA Forest Service; and Mike Schlegel, Idaho Department of Fish and Game. *Ex officio* members include William J. McLaughlin, head of the Department of Wildland Recreation Management, and Holly and Jim Akenson, on-site managers of the Taylor Ranch Field Station.

With the support of Dean Hendee, the center plans to host a "blue ribbon" panel of wilderness experts and scientists to assess the highest research potential of the Taylor Ranch Field Station. "We want to be certain that we identify the full potential of the site for research in wildlife, air and water quality, habitat and species diversity, natural ecosystem dynamics, and anthropological and social dimensions of wilderness," Hendee said. "Our unique location and remote facilities, along with the university's unparalleled staff of natural resource scientists, provide us with the potential to conduct a world-class program of field research in natural and wilderness ecosystems."

The Taylor Ranch Field Station was the featured subject in the Winter 1986 edition of *Idaho: The University*. Included in that issue were an article on the ranch's history by George Savage, college editor; an article by college associate editor Jane Pritchett on a project directed by Frank Leonhardy, professor of anthropology; an article by Wilderness Research Center Director Edwin E. Krumpe on other ranch-based research projects; and illustrations by Lorraine Ashland, college graphics artist.

Krumpe said that the center is in the process of developing a long-range plan of research and is identifying funding sources to enable the center to carry out those goals. "Scientific inquiry into wilderness and natural ecosystems is one of 10 college-wide quests for excellence and the Wilderness Research Center will play a key role in fulfilling this quest," he said.

WILDLAND RECREATION MANAGEMENT FACULTY PLAYS BIG ROLE IN PRESIDENT REAGAN'S COMMISSION ON AMERICANS OUTDOORS

Investigators:

**Edwin E. Krumpe
Robert C. Lucas
Sam H. Ham**

**William J. McLaughlin
Charles C. Harris
And others**

Faculty members in the Department of Wildland Recreation Management provided a major contribution to President Ronald Reagan's Commission on Americans Outdoors this spring. The commission, consisting of senators, congressmen, government officials, businessmen, scientists and private citizens, is charged with conducting a comprehensive nationwide study of the outdoor recreation needs of America.

In one important step, scientists in the recreation profession were selected to review and synthesize the scientific literature in recreation and natural resource disciplines. Edwin E. Krumpe was asked to co-chair the review process for recreation research natural resource management with Robert C. Lucas, leader of the Wilderness Research Work Unit of the USDA Forest Service Intermountain Forest and Range Experiment Station in Missoula, Montana.

Four scientists in the Department of Wildland Recreation Management were authors of synthesis papers. Sam H. Ham co-authored a paper on "Use of Information and Education in Recreation Management" with Professor Joseph Roggenbuck of Virginia Polytechnic Institute and State University. William J. McLaughlin and Charles C. Harris co-authored a paper on "Regional Resource Recreation

Planning." Krumpe co-authored two papers for the literature synthesis with Lucas: "Research on Recreation Trails and Trail Users" and "Wilderness Management."

The purpose of all of these papers was to pull together the key studies and findings of all the research that has been conducted since the seminal work in 1963 of the presidential Outdoor Recreation Resources Review Commission. The papers summarize what has been learned, point out gaps in existing knowledge, and make key recommendations for the future.

These, along with six other synthesis papers, will appear in the section coordinated by Lucas and Krumpe. The President's Commission on Americans Outdoors will publish all of the literature review papers in a special 1,000-page volume of the Commission Report early in 1987.

In words of congratulations, Dean John Hendee said, "Being chosen to play a lead role in such an important and prestigious task is indicative of the level of excellence and high esteem to which our faculty has risen in the research community."

For more information about the commission's work, write to Krumpe or,

Victor H. Ashe, Executive Director
President's Commission on Americans Outdoors
P.O. Box 18547
Washington, D.C. 20036-8547



Cross-country skiers may be interested in recreation planning detailed in a special report from President Reagan's Commission on Americans Outdoors.

Department of Fish and Wildlife Resources

UI STUDY TRIES TO PREDICT DREDGING EFFECTS ON SALMON, STEELHEAD HABITAT AND SURVIVAL

Investigators:

David H. Bennett
Frank C. Shrier

If sediment continues to pour into the Snake River at current rates, the U.S. Army Corps of Engineers predicts the Lewiston Levee will be unable to protect Lewiston, Idaho, from spring flooding unless dredging operations or some other alternatives are begun. But if dredging is used to eliminate the sediment, what will its effect be on game fish such as salmon, steelhead, bass and trout in the Clearwater and Snake Rivers?

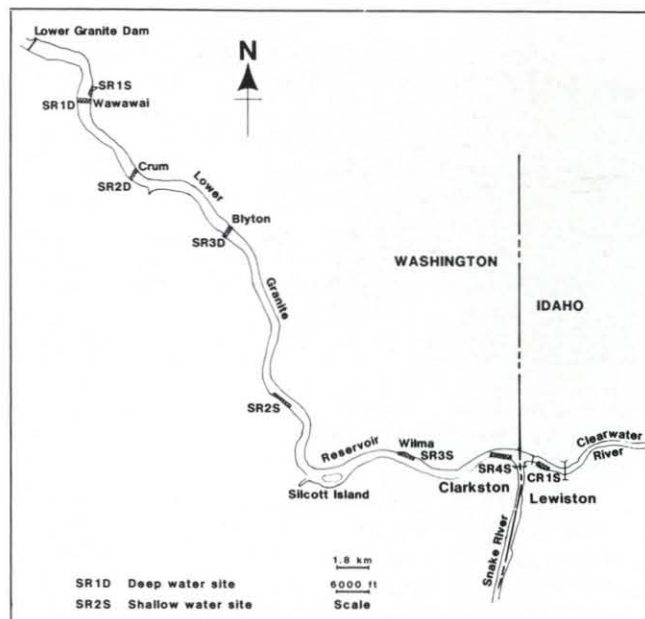
A major study by the University of Idaho's Department of Fish and Wildlife Resources attempted to find out. And the results of the study may surprise more than a few fishermen.

Under contract with the Walla Walla District of the Army Corps of Engineers, Professor David H. Bennett and Frank C. Shrier, research associate, captured nearly 32,000 fish from the Lower Granite reservoir downriver from Lewiston to assess the effects of dredging on fish production. Of major concern were the effects of dredging and disposal of the dredged material on the steelhead and salmon (anadromous salmonids) using the Clearwater and Snake Rivers for migrations.

To help resource managers make decisions on dredging and disposal operations, the scientists were asked to assess the effects of the dredging and its proposed in-water disposal on fishing. They were also asked to determine the composition and abundance of adult, juvenile and larval fishes at the sites proposed for the disposal sites and to attempt to determine the importance of the sites to the fish.

In addition, the two-year study attempted to assess the effects of different methods of dredging on the fish and determine appropriate time periods for the dredging to occur. Another concern was water quality since dredged sediments might reduce the oxygen level, which the fish need for survival.

The study area selected for this project included eight study stations — five shallow and three deep-water sites — on Lower Granite Reservoir extending from the confluence of the Clearwater and Snake Rivers at Lewiston and downriver to the Lower Granite Dam at river mile 107.5 in southeastern Washington. This area is important for electrical



A map of the eight study stations used in a Department of Fish and Wildlife Resources study on how dredging sediment from the Snake River near Lewiston could affect the habitat of salmon, steelhead and other game fish. Lorraine Ashland map

power generation, flood control, cargo transportation to the Port of Lewiston, recreation and fishing.

The only study station on the Clearwater River was a shallow-water station located directly across from the Port of Lewiston, which was originally designed as a turn-around area for barges when the levee was constructed.

The uppermost shallow-water station on the Snake River was located at the Port of Clarkston. Other sites include the Port of Whitman at Wilma, a canyon site, a station at the Wawawai boat landing and deep-water stations at the Blyton boat landing (river mile 119.5), Wawawai, and another deep canyon site (see illustration).

One of the surprising findings of the research was that salmon and steelhead apparently feed closer to the water's surface than was earlier believed.

"We found more land insects in the stomach contents of the salmon and steelhead in both the shallow-water stations and the deep-water stations, leading us to believe there is more near-surface feeding," Bennett said. "The low percentage of fish in the diet of chinook salmon and steelhead trout in all

seasons but winter suggests there might be a low availability of feed in the deep waters."

The researchers also found that fish apparently eat a greater diversity of food — insects, crayfish, small fish — in the shallow water stations than those living in deep waters, Bennett said.



"Young-of-the-year" smallmouth bass were collected by the hundreds from the Lower Granite Reservoir south of Lewiston for the research into how dredging affects the habitat and survival of game fish. Nearly 32,000 fish were captured during the two-year study. *Frank Shrier*

For smallmouth bass, crayfish were consistently the dominant food item in both shallow- and deep-water stations. Northern squawfish had a diet of nearly 70 percent crayfish and more than 25 percent aquatic and land insects.

The research found dramatic differences in the fish communities at the various sites. "Our observations suggest a higher abundance of resident game fish in the lower reservoir," Bennett said. "One of our more significant findings was the importance of shallow-water sites for feeding and/or resting by downstream-migrating juvenile salmon. Our data show that some juveniles move into the reservoir in the fall and remain there until the following spring when they continue their downstream migration."

During the sampling, numerous chinook salmon and rainbow trout juveniles were found in both the fall and winter sampling. "Many of the organisms washed from the stomachs were alive and moving, indicating very recent consumption," Bennett said the number of smolts (young steelhead and chinook salmon) at all of the shallow water stations suggested a high abundance and wide distribution throughout the Lower Granite Reservoir.

"Assuming we sampled a very limited area, the number of smolts at those sites must be extremely high to account for the high numbers collected," he said. The researchers believe predation on the young salmon in the reservoir must be extremely high to account for the high numbers they collected. Salmonids made up over 26 percent of the dietary items found in the smallmouth bass sampled at shallow-water stations and 13 percent of the diet of those taken at deep-water stations.

Extensive use of the sites by a large variety of fish was one of the more important findings of the study. "The numbers and variety of the fish were far more diverse than we expected," Bennett said. "We theorized we would find fewer species in areas that were subjected to more 'natural' sedimentation. But we found nearly as many game and nongame fish in the areas with natural sedimentation as in the others."

Bennett said the extensive use of the shoreline areas by juvenile salmon and steelhead in the late fall and winter pointed up the extreme importance of those areas for food production.

"We established the ecological importance of shallow water habitat in Lower Granite Reservoir," Bennett said. "These areas are unquestionably used for food production and feeding, resting habitat, rearing by salmonid fishes and spawning and rearing of resident game and nongame fishes."

Fish diversity, higher numbers of resident fish and catches of adult steelhead trout were most abundant at the station located near Wawawai boat landing and lowest at the Wilma (Whitman Port) site. Nongame fish were more abundant at the "upriver" sites, which suggests the importance of maintaining the integrity, quality and diversity of shallow water habitat in the lower reservoir, Bennett said.

The research findings lead the scientists to believe that habitat diversity in the lower reservoir is the reason for greater fish diversity and better habitat for game fish.

The focus of the study was to gain a database for what is happening to fish from an ecological perspective. The results suggest that disposing of dredged materials at deep-water sites would probably have little effect on the fish communities in those areas, but disposal should be critically examined before being conducted in the shallow areas so necessary for the spawning, feeding, rearing and resting migrating salmon and steelhead populations.



An aerial photo of a hopper dredge releasing dredged sediment onto a land disposal site near Wilma on the Lower Granite Reservoir. Scientists studied the effects of both land and water disposal on the spawning, resting and migrating fish populations. *David Bennett*

RESEARCH AT HANFORD RESERVATION EXPLORES POPULATION ECOLOGY OF COYOTE



Coyotes are rarely observed in areas isolated from man, but in a project conducted in the Arid Lands Ecology Reserve in the Hanford (Washington) Nuclear Reservation, researchers can study the animal in an area nearly free of human intrusion. *Bob Crabtree*

Investigators:

Ernest D. Ables
Bob Crabtree

A University of Idaho doctoral student in Fisheries and Wildlife, Bob Crabtree, under the direction of Dr. Ernest D. Ables, is investigating the population ecology of coyotes at the U.S. Department of Energy's Hanford Nuclear Reservation in south central Washington. A 120-sq. mile section of the Hanford site, called the Arid Lands Ecology Reserve (ALE), is the location of the study area. It is one of the last pristine islands of shrub-steppe ecosystem and serves as a refuge where the coyote is free from harassment and exploitation by man.

Numerous other coyote studies in exploited areas indicate a remarkable degree of flexibility in the coyote's behavior and social ecology. Concurrent with the decline of the wolf, coyote populations have extended across much of North and Central America. Hopefully, this study will provide information on "the way it was" for the coyote before the impact by man and civilization. Researchers hope the study will lend insight into the coyote's incredible adaptive abilities.

In the first phase of the study, a radioactive tablet that slowly releases a tracer amount of a radioisotope into the animal is implanted under its skin. This technology, derived from recent developments in medicine, uniquely marks each animal's urine and feces. This approach provides new information about social interactions and territorial behavior of the coyote that allows scientists to estimate the population size for coyotes and other animals, especially large carnivores,

whose secretive behavior, high mobility, and tendency to inhabit remote and rugged areas makes them difficult to study.

The major phase of the research project is field-oriented which requires the researchers to adapt to the nocturnal habits of the coyote. During the past 2 years, 56 coyotes have been live-captured and released after they have been carefully examined to determine their health and age. Before their release, they are marked with the radioactive implant, given colored ear flags, and fitted with a collar bearing a radio-transmitter. Crabtree and fellow researchers track the movements and behavior night and day with the aid of a directional antennae tracking system mounted atop ridges bordering the study area.

Preliminary results indicate a stable coyote population that is scarcely affected by man. The average age of the study animals is 4 years, with one male aged 14, which is the oldest coyote yet studied. The reproductive output of this population appears low with only the older females successfully breeding. About half the coyotes on the reserve form small social groups of 2 to 4 adults. The other half appear to be non-breeding transients and floaters that haven't secured a piece of ground possibly due to the lack of vacancies caused by unusually low mortality rates.

The coyote has previously been thought to be rather solitary with groups forming only to protect food, such as carcasses or to cooperate to kill large prey such as deer or elk. In the reserve's unexploited population, the coyotes feed entirely on smaller prey, but still exist in groups. Crabtree also was investigating coyote dens to determine the litter size and to mark these pups with a special expanding radio-collar to trace their fate — if and when they leave their parents.

AVIAN USE OF RIPARIAN HABITATS STUDIED IN NORTHERN UTAH



Streambank, or riparian zones, are used extensively by birds such as this American dipper and other wildlife. To help natural resource managers assess how these areas are used by birds is the focus of research by UI investigators in riparian areas near Logan, Utah. *Jennifer Blakesley*

Investigators:

Kerry P. Reese
Jennifer A. Blakesley

Riparian zones are used by wildlife more than any other type of habitat. The presence of water is critical to many animals and moist conditions produce plant species and structures that provide food and shelter unique to riparian zones.

How breeding birds use riparian habitat in northern Utah is the focus of research by Jennifer Blakesley, wildlife graduate student, and her major professor, Kerry P. Reese. The investigators are examining breeding bird use of USDA Forest Service campgrounds located in riparian zones and determining basic relationships of avian habitat use. "Our research is designed to better understand the use of riparian zones by birds," Blakesley said, "and to provide local resource managers with information to aid their decisions on habitat manipulation, land use, and new campground placement or expansion of existing campgrounds."

From May through August 1985, 193 study plots were established in Logan and Blacksmith Fork Canyons near Logan, Utah. These plots represented 9 major riparian community types, including box elder, birch, dogwood, cottonwood and willow, ranging from 4760 to 7400 feet in elevation. Thirty of the plots were located in campgrounds. Avian censuses were conducted 7 times on each plot, yielding 7482 observations of 64 species. Avian density estimates were calculated for each plot; habitat data were also collected.

The most abundant birds in the riparian zones were the yellow warbler, warbling vireo, song sparrow, fox sparrow, Swainson's thrush, robin, black-headed grosbeak, and broad-tailed hummingbird. The rarest species observed included the veery, yellow-breasted chat, common poorwill and white-crowned sparrow. Analysis of habitat-avian use relationships for the entire riparian area will be completed soon.

Preliminary comparisons of bird densities between campground and non-campground sites of similar vegetation reveal some interesting differences. There were higher densities of robins and lower densities of shrub-nesting McGillivray's warblers, lazuli buntings, fox sparrows, and song sparrows in campgrounds, probably due to sparser understories. Canopy dwellers seem to be less affected by campground development. For example, the warbling vireo, which nests and forages in the canopy, had similar densities in campground and non-campground sites.

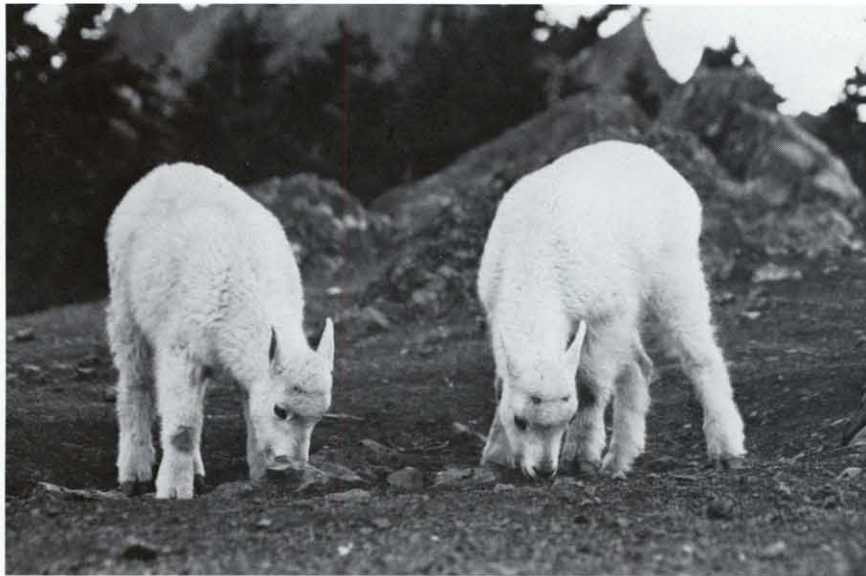
Riparian habitats are impacted by logging, mining, grazing, road construction, and human recreation. Basic ecological information to evaluate management strategies is often lacking.

While this research is being conducted in northern Utah, the relationships described should be useful in forest riparian habitat management throughout southeastern Idaho and western Wyoming as well.



One of the most abundant birds found in the study was the Swainson's thrush shown here in her nest. Birds that nest high in tree tops seem less affected by people's presence in campgrounds than those that nest in shrubs. *Jennifer Blakesley*

CONTROL OF MOUNTAIN GOAT POPULATIONS AT OLYMPIC NATIONAL PARK



Mountain goats, which are not native to Olympic National Park, are suspected of causing extensive damage to the native alpine flora. *Roger Hoffman*

Investigators:

**R. Gerald Wright
Roger Hoffman**

Mountain goats (*Oreamnos americanus*) were first introduced into the Olympic Mountain Range in the mid-1920s. There is no evidence that they existed on the Olympic Peninsula prior to that time as the peninsula has long been separated from other mountain goat populations by water or areas of inhospitable habitat. The mountain goats have since dispersed throughout the park, and are suspected of causing extensive damage to the native alpine flora.

National Park Service policy calls for the elimination of exotic species from parks. The mountain goats fall into this category, and Olympic National Park has recently been investigating a number of alternatives to remove the 500 to 600 mountain goats from the park. University of Idaho wildlife graduate student Roger Hoffman, under the direction of Professor R. Gerald Wright, has designed a two-part project to test alternatives. One is the development of a computer model designed to simulate the effectiveness of the many possible management programs to control or eliminate the park's mountain goat population. A second component is to test and refine methods to sterilize male and female goats.

To date, model projections have shown that without any management action, the goat population will continue to increase and spread to new areas of the park for 20 to 30 more

years before leveling off. Many removal scenarios have been simulated and the results analyzed. Some of the factors considered in these removal simulations include the time of year (spring or fall for example), the distribution of removals (whether randomly throughout the park or systematically-area by area), and the number of goats removed each year.

Removing goats in a systematic manner, such as concentrating efforts in a small area each year to create goat-free areas, was determined more efficient. This difference was most pronounced at lower removal rates (25 to 40 goats per year). The number of animals removed each year greatly influences the long-term effect of these removals on the population. Removals of more than 60 animals per year caused a significant decline in the park's population of mountain goats.

Between 1982 and 1984, 12 females were captured and a silastic implant of melengestrol acetate (MGA), a pregnancy-inhibiting synthetic hormone, was surgically implanted. The goats were fitted with a color-marked radio collar. Both fixed-wing and helicopter aircraft were used to repeatedly relocate and verify sterilant effectiveness each year by the presence or absence of kids with the treated females. The implant supplier indicates that MGA in this form may prevent pregnancy for between 1 and 3 years. The investigators are still uncertain about the overall length of effectiveness of the implants. They have found that the life expectancy of the implants is at least 1.8 years and could exceed 3 years. The 2 animals treated in 1982 have not reproduced

in the 3 years they have been monitored. Four of the 5 animals implanted in 1983 have not produced offspring. In the 20-goat years of observations on treated females, 2 kids have been produced yielding a 10 percent kidding rate. The rate observed in non-treated females is 77 percent over the same time period.

A second sterilization technique was implemented during the summer of 1985 in an attempt to compare the effectiveness of female sterilizations with male sterilizations. Five males from one area were sterilized by injecting .75 cc chem-cast into the caudal epididymis of each testes. This substance has been found to render males of many different species permanently sterile, but it has not been tested on mountain

goats. The researchers believe the technique will not cause any changes in the hormonal levels and associated behavior patterns of the animals. They sought to select the largest males in the area to ensure their dominance and reproductive potential. Their hypothesis is that these males will court the available females and keep the less dominant nonsterilized males from breeding. These animals were also fitted with radio collars to facilitate their relocation. The investigators are particularly interested in being able to monitor their activities during the rut.

The investigators hope to incorporate the findings of the sterilization experiments into the simulation model to help evaluate their management utility.



A project to test methods to control the mountain goat population at Olympic National Park has UI scientists working on possible alternatives. *Roger Hoffman*

Department of Forest Products

RECOVERING FOREST RESIDUES MAY BE COST EFFECTIVE, RESEARCH SHOWS

Investigator:
Leonard Johnson

Forest managers making decisions about whether to utilize forest residues — the tree tops and wood waste left after timber cutting — are hampered by the cost of recovery and the lack of reliable markets for residue products.

But field experiments and demonstrations by the Department of Forest Products may have determined it is cost effective to recover these materials at certain locations.

Researcher Leonard Johnson, professor of forest products, compared concurrent and subsequent processing of residue in several field tests. Concurrent operations, called hot processing, involved processing the residue into firewood as it was delivered to a landing. Subsequent operations, called cold decking, allowed the recovery system to pile residue into decks that were processed later.

Johnson found that cold decking was more cost effective than hot processing. The primary product was 18-inch firewood produced with a hydraulic shear. The smaller pieces of material, and material not suitable as firewood, were fed into a hydraulic grinder and converted to "hog fuel," small wood particles that can be used as fuel.

The equipment tested in moving the residue to the landing included a two-drum-drive skyline machine (called the "Clearwater Yarder"), an International Model S8 wheeled skidder, a hydrostatic drive, a tracked skidder called the residue "Lucky Logger," and a Caterpillar Model D6 crawler tractor.

"The crawler tractor pushed material to an access road with techniques similar to those used in conventional dozer-piling operations," Johnson said. "The other machines dragged residue to a landing in a manner similar to conventional skidding and yarding. Residue processing utilized a hydraulic loader to feed variable-length residue material to a hydraulic shear."

The shear was designed specifically to produce firewood ranging from 18 to 48 inches in length. It was built by the

Clearwater-Potlatch Timber Protective Association (CPTPA), a quasi-governmental agency charged with fire protection and fire hazard abatement on state and private lands in north-central Idaho. CPTPA built the shear with surplus components and uses it to reduce the fire hazards created by piles of logging debris left at landings after a logging operation.

Field demonstrations of the recovery operations were conducted through a cooperative effort of the CPTPA and the UI Forest Products Department with funding provided by the U.S. Department of Energy's Pacific Northwest and Alaska Regional Biomass Energy Program. CPTPA supplied equipment, operators and the site for the studies. The university was responsible for the data collection and the analysis of the findings.

The work site during the 1985 field season was located near Pierce, Idaho, on 8.53 acres of industrial timberland that had been clearcut in 1984. One objective of the project was to create firelines along the edges of the harvest unit to help prepare the site for disposal through broadcast burning. Tests of the grinding operations were conducted during June 1986.



Firewood in 18-inch lengths was produced by this hydraulic shear from the wood waste left after timber cutting. *Leonard Johnson*

COMPUTER MODEL CALCULATES VENEER BLOCK CONDITIONING TIMES

Investigators:

H. Peter Steinhagen
Harry W. Lee

Veneer and plywood production managers are always concerned about producing the maximum quantity of usable material from veneer blocks. Conditioning of veneer blocks has been a management practice for many years. One problem is to determine how much conditioning is necessary to bring the blocks to the desired temperature.

Forest Products Professor H. Peter Steinhagen has developed a mathematical model to predict the time needed to bring a veneer block to a desired cutting temperature. This one-dimensional heat transfer model can be applied to logs that are "long," four times the diameter or more. The model assumes that conditioning occurs in a radial direction and not through the cut ends.

Steinhagen teamed up with Forest Products Professor Harry Lee to adapt this mathematical model to a

microprocessor. By using an IBM-PC, a complete conditioning history can be obtained for any given log. The expected temperature at 1-inch radial increments is calculated on a half-hour basis.

Data inputs into the model include the initial temperature of the log, the temperature of the conditioning chamber, the wood species, its moisture content and specific gravity, and the length of the log.

Outputs include a listing of all initial conditions, the temperature history of the log at 1-inch increments in a radial direction on a one-half hour time increment and the energy consumed to heat the log up to that time point.

The computer model has been checked against hand calculations and experimental data and gives satisfactory results. Industry is reviewing the model and it is anticipated that a number of veneer and plywood firms will use it as an aid to improving mill efficiency.

CHEMICAL VARIATION IN LODGEPOLE PINE

Investigators:

Alton Campbell
Peter Koch

Lodgepole pine occupies 63 million acres of commercial forest land in the western United States and Canada. Although it is the fourth most extensive commercial timber type in the United States west of the Mississippi River, it has historically been under-utilized over most of its range. A major barrier to achieving effective utilization of this resource is the lack of technical and economic conversion options for the size and quality of this timber resource.

In 1982 the Intermountain Research Station of the Forest Service initiated a comprehensive program of research to conceive and develop large-scale, profitable processes to utilize lodgepole pine of all diameter classes and conditions, especially those that now constitute significant barriers to management and utilization. A portion of this research project is presently being conducted in the Forest Products

Department at the University of Idaho under the direction of Alton Campbell, assistant professor, and Peter Koch, a forestry consultant.

The chemical variation in lodgepole pine over its entire geographical range is being studied. Samples from 279 lodgepole pine trees are being analyzed to compare the ash, extractive, cellulose, hemicellulose, and lignin content. The results from these analyses will be used to compare the variation among trees as a function of variety (*latifolia* and *murrayana*), latitude, elevation, tree diameter at breast height, longitudinal zone, and heartwood/sapwood differences.

"This study should contribute to a body of basic knowledge about lodgepole pine that can be used to develop new industrial products and processes," said Campbell.

"If we know more about its chemical composition, we can suggest better ways to use it for forest products."



A wood-cement composite being made in the Department of Forest Products laboratory in its computerized press. It is then examined for surface quality and other properties. A.A. Moslemi

WELL-SEASONED WOOD MAKES BETTER CEMENT-WOOD PARTICLE BOARD

Investigators:

A.A. Moslemi
Fernando L. de Almeida

Wood bonds easier with cement to form a tough, resilient particle board if it is well-seasoned before it is manufactured, a research study by the Department of Forest Products shows.

An investigation of the creation of cement-board using Douglas-fir (*Pseudotsuga menziesii*) and lodgepole pine (*Pinus contorta* Dougl.) by Fernando L. de Almeida, a graduate student under the direction of A.A. Moslemi, head of the department, has found Douglas-fir to be more compatible for mixing with cement after 17 weeks in storage while lodgepole pine seems to increase in compatibility up to 19 weeks before reacting adversely to mixing.

Fourteen experiments per species were performed in 84 wood-cement hydration tests. "This study shows there is an optimum storage time for each wood species and leads us to believe there might exist an optimum time in storage for different wood species prior to its processing and use," Moslemi said.

De Almeida's research showed that when a wood species fails to bond adequately with cement, the problem is usually the species' chemical constituents. The soluble sugars, carbohydrates, and wood extracts in the wood, and other factors such as the ratio to heartwood to sapwood and the amount of cellulose, hemi-cellulose, lignin, or decay, and even the felling time, can all influence cement-setting time.

Increasing the lignin content in wood seems to bring about good bonding, but a greater hemicellulose content inhibits cement-wood bonding as do wood components such as decay, fungi, heat, and excessive light exposure, Moslemi said.

The University of Idaho has been involved in many major studies of wood-cement bonding since 1979. Research in this field has shown a number of effective procedures can reduce the inhibitory effect of the wood components by adding such substances as chlorides of calcium and magnesium, silicates of sodium and potassium (waterglass) and a mixture of sulfate and lime water.

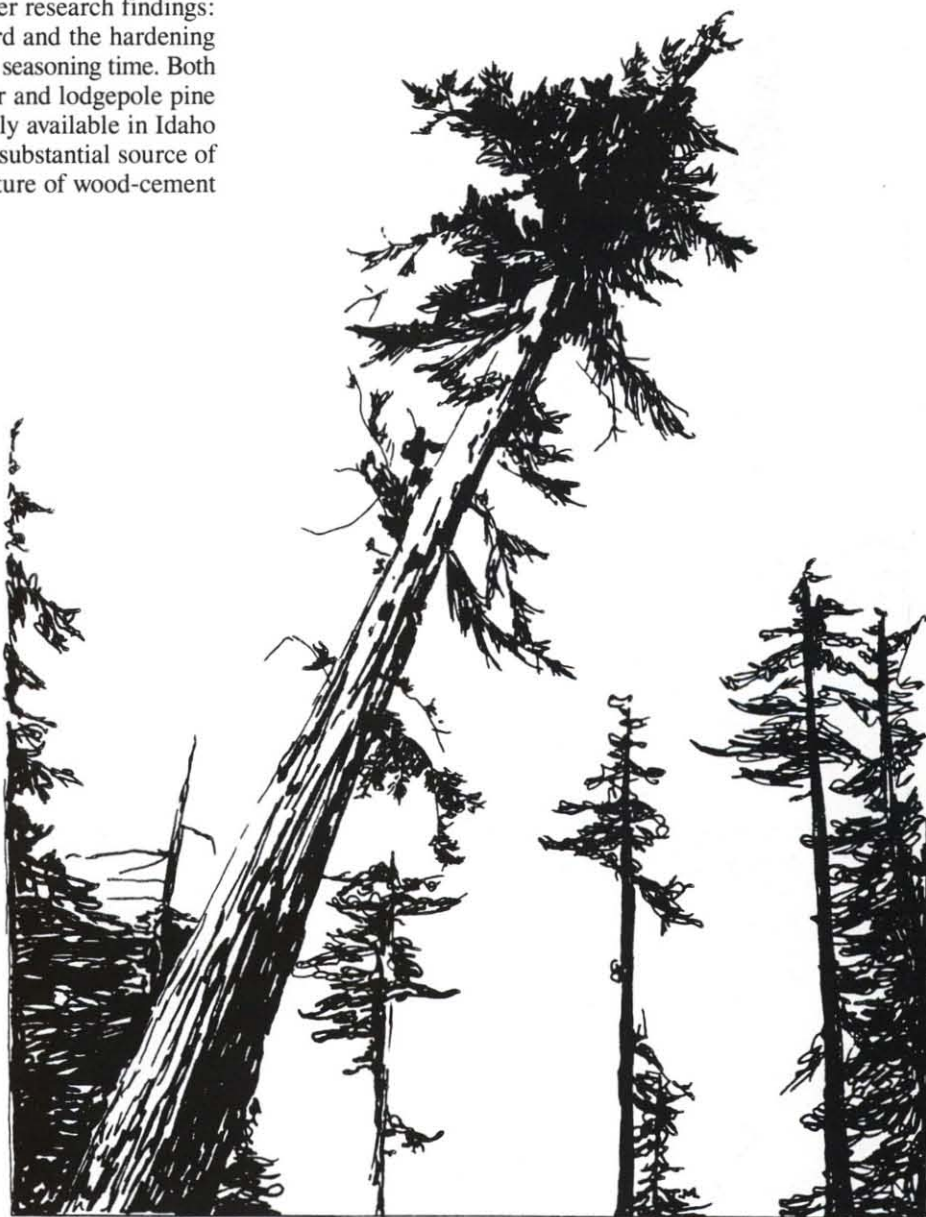
Some experiments have included the pre-treatment of wood particles with hot water or the chemical extraction of

water-soluble carbohydrates and extractives. Although no published literature was available on whether wood storage prior to its use in board manufacture could minimize the inhibitory characteristics of wood, it is believed wood loses some natural inhibitory chemicals during storage when petroleum ether-soluble extractives decrease.

Other research literature shows that freshly cut wood species generally have a greater starch content than seasoned woods, since the starch, sucrose, glucose and fructose components of the wood decrease as the wood ages.

Trees that were used in the investigation were cut from the university's Experimental Forest in June 1985 and were stored outdoors exposed to weathering from the sun, moisture from rain, snow and dew, and Idaho temperatures for a 28-week period from June 1 to December 17, 1985.

The investigations added to the other research findings: that the setting time of the cement board and the hardening depend both on the wood species and the seasoning time. Both species used in the study — Douglas-fir and lodgepole pine — were selected because they are readily available in Idaho and the Northwest and could provide a substantial source of the raw wood material for the manufacture of wood-cement composites.



Drawing by Tiki Mulvihill

Department of Forest Resources

RESEARCH CAN BE AN EXPLOSIVE SITUATION

Investigators:

**Arthur D. Partridge
Catherine L. Bertagnole
and others**

A University of Idaho professor is having a blast doing research in the Department of Forest Resources. Arthur D. Partridge is using explosives to lift soil to expose the entire root systems of trees, including those in the sawtimber stage.

"The advantage is that we can make rapid use of any forest site even if it is far away from roads," Partridge said. "If proper calculations are taken, little damage occurs to the roots of the trees and we can study root diseases that may affect up to 20 percent of Idaho's trees."

Partridge has directed research on root diseases for nearly 20 years at the university. His current research project is near Bovill, where an entire stand of ponderosa pine seems to be dying from black stain root disease and associated insect infestation and invasion by fungi.

Partridge, who was a demolitions expert in World War II, developed the idea of excavating tree roots while studying the connection between root-bark beetle infestation and fungi. University of Idaho crews have excavated more than 500 tree roots with explosives without injury or loss of equipment at a cost of \$30 per tree.

The researchers have shown that root disease often is caused by complexes of fungi and beetles rather than by a single organism as was believed before the research began. Previous research often examined only a small portion of the total root system and led earlier investigators to think root diseases had only single causes.

Examination of the entire root system enables scientists to scrutinize the root system, including the fine rootlets that are necessary for the proper diagnosis of tree-growth problems. Foresters can then make recommendations for the treatment and management of stands of timber used for pole and saw-timber.

"Research on root systems of large trees is extremely difficult and limited by the time and cost-consuming labor involved in the excavation of the roots," Partridge said. "Often only the root crown area and perhaps a small portion of the total root system is examined." Researchers were often limited

by funding or time considerations to examine only one or two trees, which could lead to incomplete results.

"A thorough study of a particular subsoil ecosystem can be accomplished by the examination of entire root systems of several neighboring trees by using explosives for root excavation," Partridge said.

Such excavation can help eliminate constraints of terrain, lack of equipment or time or other hardships.

"Other methods are limited because of heavy equipment, restriction to roadside areas and gentle slopes, the accumulation of mud using hydraulic pressure, or torn roots resulting from stump pulling," Partridge said. "To do root excavation by hand often requires intensive labor at a high cost. Explosives, however, can go anywhere, be placed in use rapidly, and will completely expose large tree root systems with little damage."

Partridge makes use of new technology in explosives. Plastic explosives are available now that are insensitive to impact, non-toxic, and cheaper than dynamite.

"It's a different ballgame than it was during the war. There we killed a number of men just setting the explosives that were highly unstable. Now we haven't had an accident of any kind," Partridge said.



Getting to the root of the problem — or the problem of the root — is the specialty of Dr. Arthur Partridge and researcher Cathy Bertagnole who are finding that root disease is caused by numerous factors. *Scott Spiker*



Dr. Arthur Partridge's experience as a demolitions expert in World War II came in handy when the Department of Forest Resources decided to study the causes of root diseases in Idaho's trees. He has developed a way to examine entire root systems of trees by using explosives to expose the entire root system. *Scott Spiker*

A favorite tool of Partridge's is Tovex, a water gel explosive that consists of oxidizing salts such as ammonium nitrate, sodium nitrate and calcium nitrate. It is combined with aluminum, gilsonite and oil fuels. All are dispersed on a continuous liquid phase.

The explosives are detonated with a detonating cord set downline from the tree. It is composed of an explosive core surrounded by waterproof textiles and plastics. The core contains a high velocity explosive (pentaerythritoltetranitrate). It requires a blasting cap to detonate.

The appropriate explosive for any job is selected based on the explosive strengths calculated by a formula developed by Partridge, the particle velocity of the explosive and the shock zone ahead of the reaction zone during the explosion.

"The explosives used for root excavation are rather mild compared to those used for hard-rock blasting, such as you would find in an Idaho mine," Partridge said. "The detonation cord, however, has to be of very high velocity yet low detonation pressure since it serves as a booster to the detonation of the other explosives having a higher burning rate.

The procedure for selecting the trees for study and setting up the blast is detailed in a paper and poster session Partridge wrote with doctoral candidate Catherine L. Bertagnole and presented at a symposium on "Roots in Forest Soils: Biology and Symbiosis" this summer in Victoria, British Columbia.

In the paper, the researchers tell how the size of the blast depends on the species of tree studied because each has different root systems. Some have shallow, lateral roots that grow in soil with a high water table while trees with fine rootlets — like western red cedar, or ponderosa pine growing in sandy, dry soil — require extra explosives to clear the roots. Badly decayed stumps and roots require about one-half the amount of explosives required for sound stumps.

"Our research has found using explosives is a rapid, inexpensive way to excavate the roots of large diameter trees," Partridge said, "This is only one example of applying explosive technology to forest research and management. Besides, I have a blast doing it."

*Catherine L. Bertagnole
and
Jane R. Pritchett*

THE MEANING OF CARRYING CAPACITY DEPENDS ON THE BEHOLDER

Investigator:

Brian Dennis

Most renewable resources are growing biological populations. Such resources can be wisely managed only if the amounts of their growth — or decline — can be quantified, measured, and predicted. Research conducted by Brian Dennis, professor of forest resources and applied statistics, is questioning current mathematical models for predicting population growth.

The concept of carrying capacity traditionally plays a central role in managing resources such as fish or wildlife populations. Ecologically, carrying capacity is the maximum number of organisms that a given, constant environment can support on a sustained basis, such as a lake, forest, or stream. Mathematically, carrying capacity is the population size where an S-shaped curve of population growth levels off (see Figure 1). Management of a harvestable population frequently is accomplished by manipulating the quantity and quality of its habitat, for example, by changing the value of its carrying capacity.

"Unfortunately," Dennis said, "natural environments are not constant. Temperature changes, rainfall changes, water level changes, chemical concentration changes, forage quality changes, snow level changes, water flow changes, everything changes."

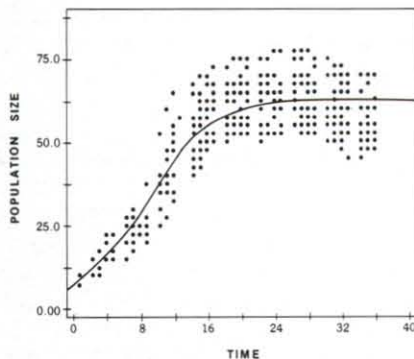


Figure 1. Dots replicate flour beetle populations grown in a lab. The solid line is the S-shaped curve found in textbooks.

The combined effects of these changes in environmental factors produce large, unpredictable fluctuations in the abundances of natural populations. Even laboratory populations, subject only to minute, microenvironmental changes, display fluctuations that deviate markedly from the textbook S-shaped curve (Figure 1).

"What is the meaning of carrying capacity when the world fluctuates?" Dennis asked. His research on mathematical modeling of population growth is aimed at

answering this question. Borrowing mathematical techniques from statistical physics and electrical engineering, Dennis represented the S-shaped growth curve as a "signal" and incorporated the effects of unpredictable environmental fluctuations in the form of "noise." The mathematical result: In a "noisy" world, carrying capacity is a probability distribution. In fact, it is a specific type of skewed (nonsymmetric) probability distribution known to researchers as a gamma or chi-square distribution. With this distribution, an ecologist could compute the probability, or chance, that a population will be found at any particular abundance level. Dennis reports that this prediction is showing astonishingly close agreement with laboratory population data collected by biologists at other universities (see Figure 2).

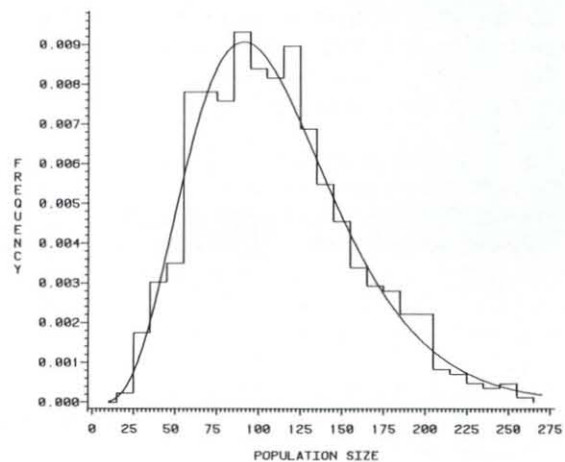


Figure 2. Frequency distribution of flour beetle populations. Smooth curve is the distribution predicted by Dennis' model.

"So far, I've only tried the model on flour beetle data," Dennis said. "For 50 years, flour beetles have been the favorite organism of population biologists for laboratory experimentation as the fruit flies have been with the geneticists. Now the big question is whether the model will work for natural populations in the field."

Stochastic is another buzzword these days among ecologists. The word describes mathematical models that incorporate chance. Meteorologists went stochastic years ago, Dennis explained. "That's when weather forecasters stopped saying rain today and started saying there is a 70 percent chance of rain."

"Imagine fishery scientists concluding that present harvest levels would give a 40 percent chance of poor salmon runs in 3 years," Dennis said. "Will resource decision-makers and the public be satisfied merely with such statements of chance? In an uncertain world," Dennis warns, "they'll have no choice."

IDAHO STUDY SHOWS MORE HOUSEHOLDS WILL ADOPT FIREWOOD FOR ENERGY

Investigator:

Jo Ellen Force

Firewood is used as a main or secondary heat source in nearly three of five Idaho households and research by the Department of Forest Resources indicates another one of those five households may adopt wood energy by 1990. A study by Jo Ellen Force, Associate Professor of Forest Resources, found 175,000 Idaho households use an average of 3.8 cords of wood a year to meet home heating needs. This means Idaho's forest lands must supply 660,000 cords of wood annually to meet current demands for wood energy.

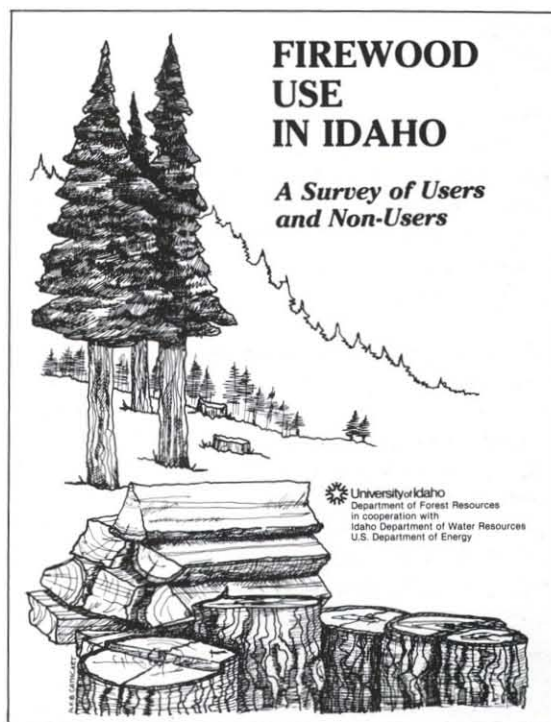
The statewide study indicates that an additional 200,000 cords of wood may be needed by 1990 if all of the estimated 50,000 households currently considering adopting wood energy do adopt it. One-third of these potential wood users say they may begin using wood even if there is no change in the cost of their present heat source.

The research was based on a 1985 mail survey with responses from about 800 of 1100 randomly selected Idaho households. One objective was to determine if there were any sociodemographic differences between wood users and nonusers. The survey found wood users are somewhat younger than nonusers, averaging 46.6 years old compared to the nonusers 50.9 years. People who heat with wood also are more likely to live in rural areas, have larger families and live in single family homes that they own. However, there is no difference between those who use wood and those who do not in average income, years of education or the number of years they have lived in the area where they now live.

Collecting behaviors of firewood collectors on Idaho's national forests were studied in 1981-82 and this new study found Idahoans collecting their own wood have changed their behavior very little during the past four years. Collectors still prefer standing dead wood to all other forms of wood, if it is available. They use a half-ton or 3-quarter-ton truck to make five trips each year for wood gathering and they drive an average of 45 miles, one way, to collecting sites. They burn an average of 3.8 cords of wood per heating season.

The most important reason they say they burn wood is still to save money on their heating bill. The second most important motivation is because they enjoy wood heat. Despite forest managers' beliefs to the contrary, Idahoans said the least important reason they collect wood is for the enjoyment of wood collecting as recreation.

The survey showed that one-fourth of all wood users burn their wood in relatively inefficient fireplaces, but only 9 percent of those who say wood is their main heating source use a fireplace.



What forest management practices would Idaho wood users like to see implemented on Idaho forests? The most strongly preferred practice is to allow collectors to get firewood before an area is burned for management purposes. Planting areas with trees that would be desirable firewood in the future also received considerable support from collectors.

All respondents are concerned about the future supply of wood from Idaho forests. The cutting of live trees and the over-cutting in forests are seen as the most important wood-related problems. Nonusers rated problems with using wood higher than did users, noting increased air pollution from burning wood and increased home fire hazards. They also said that wood collecting is inconvenient and that wood use requires additional time, labor and attention and creates additional dirt from debris, soot, and smoke.

Although many of the sociodemographic differences between wood users and nonusers are not surprising, prior to this study there were no empirical data to support or refute foresters' and social scientists' hypotheses on this relatively new, but demanding, forest user. Funding for the project was provided by the U.S. Department of Energy under a Bonneville Power Administration grant and the Idaho Department of Water Resources. Results of the study are presented in *Results of a Survey on Residential Wood Energy Use in Idaho*, Technical Report No. 19 of the Idaho Forest, Wildlife and Range Experiment Station.

INTERMOUNTAIN FOREST TREE NUTRITION COOPERATIVE

Investigators:

James A. Moore
James Mital
Lian-Jun Zhang

James Vander Ploeg
Peter Mika
Pedro Real
Donald Patterson

Since January of 1981 the Department of Forest Resources has served as the host institution for the Intermountain Forest Tree Nutrition Cooperative (IFTNC). The IFTNC is composed of 11 industrial, federal and state forest land management organizations in Idaho, western Montana, eastern Oregon, and eastern Washington. The IFTNC is governed by a steering committee composed of one person from each member organization. The steering committee receives advice and counsel from a technical advisory committee.



Taking a core sample helps researchers of the Intermountain Forest Tree Nutrition Cooperative determine how much tree growth has occurred in response to different fertilizer techniques.
James Vander Ploeg

The principal activities of the cooperative are:

1. to provide a better understanding of the mineral nutrient requirements of forest trees in the Intermountain Northwest;
2. to establish field trials to estimate tree growth response to soil nutrient amendments;
3. to develop predictive models of response to forest fertilization; and
4. to develop operational guidelines for forest fertilization.

One hundred and four fertilization field trials have been established throughout the region to study the effect of nitrogen fertilizer on tree growth. In addition to the primary activities listed above, companion studies on basic soil/site and forest productivity are being conducted, primarily by graduate students, at each test site.

Doctoral student James Mital is studying the association of forest understory plant communities with their mineral nutrient and soil moisture environments. Graduate student Lian-Jun Zhang is developing equations to relate soil chemical properties to tree foliar nutrient content and concentration, and investigating how these relationships change according to site quality.

Research Associate James Vander Ploeg has used over 1,200 stem analysis Douglas-fir trees, collected from each of the 572 study plots, to test existing site index and height growth equations. Based on the results of these tests, new equations are being formulated for the western Montana and central Washington regions.

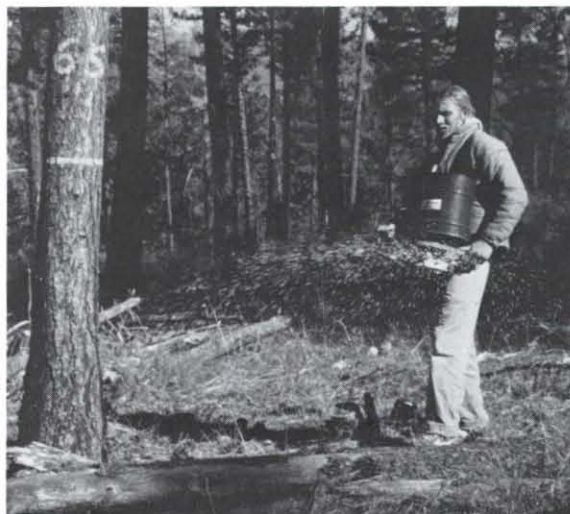
Data Analyst Peter Mika, in addition to the numerous statistical analyses directly involving the IFTNC's four major activities, is developing predictive models for Douglas-fir site index based on site and soil characteristics. Peter is also examining methodology for sub-sampling individual tree heights within a stand using Monte Carlo simulation techniques.

Doctoral student Pedro Real is developing individual tree taper and volume equations for managed second-growth Douglas-fir stands in the Intermountain Northwest. One interesting feature of this project is that stem form is predicted as a function of site and tree attributes such as site index and crown ratio.

In a project contributed to the IFTNC by Potlatch Corporation, doctoral student Bahman Shafii is quantifying the response of grand fir stands to nitrogen fertilization. In addition, he is formulating individual tree growth simulation models that will incorporate thinning and fertilization response in the equations. These data represent the longest period of growth monitoring after fertilization—14 years—in the region.

The Inland Northwest Growth and Yield Cooperative (INGY), located at the School of Forestry at the University of Montana, funded a project to collect additional growth and yield data on the control (untreated) plots at each IFTNC installation. The data are being used in another INGY funded study by graduate student Donald Patterson, under the direction of Dr. Charles Stiff, for testing and evaluating two commonly used growth and yield simulation models in the region, the Prognosis and Stand Projection System.

The results from all of these cooperative research projects should provide a great deal of useful information for forest managers in the region.



Spreading fertilizer and then monitoring tree growth helps scientists develop operational guidelines for forest fertilization that will stimulate the healthiest trees for timber production. *James Vander Ploeg.*

INLAND EMPIRE TREE IMPROVEMENT COOPERATIVE

Investigators:

Lauren Fins, Executive Director

Du Wei

Marc Rust

Boyd Wilson

The goal of the Inland Empire Tree Improvement Cooperative (IETIC) is to develop and demonstrate methods to produce genetically improved forest trees, seed and plant materials. Formed in the late 1960s to exchange information and scientific data to increase yields and improve timber and other forest products, the cooperative encompasses over 16 million acre of commercial forest land. It includes 20 member organizations from the timber industry, federal and state governmental agencies, tribal councils and local universities. The IETIC is governed by a steering committee comprised of representatives from each member organization and is coordinated by the College of Forestry, Wildlife and Range Sciences at the University of Idaho.

The cooperative was created primarily to work on ponderosa pine tree improvement, but expanded its work in 1977 to include 5 additional species — western white pine, Douglas-fir, western larch, lodgepole pine and grand fir.

Executive Director Lauren Fins said over the past 16 years, the members of the IETIC have selected thousands of

candidate trees and established nearly 100 test plantations on more than 1000 acres. These reproductive materials will be used in the reproduction of genetically superior stock for reforestation.

The cooperative has focused most recently on analyses and interpretation of test data to provide managers with information on the genetic potential of their selections. With most of the first-phase, long-term tests already established, the IETIC will begin to gather short-term information from these tests. Such information probably will include issues of young stand management in plantations of genetically improved forest trees.

Studies underway in the past fiscal year include work on modeling the potential growth and yield of genetically improved forest trees by doctoral student Du Wei. Marc Rust, the IETIC data analyst, Boyd Wilson, the Douglas-fir species director, and Fins will assess the value of data from a short-term Douglas-fir test in predicting long-term performance.

Additional studies include an assessment of growth of Douglas-fir seedlings that exhibit late-flushing from lateral buds, comparison of early heritability estimates of Douglas-fir seedlings ages 1 through 6 and an assessment of the stability of performance of early juvenile Douglas-fir selections.

Department of Range Resources



Is cattle grazing compatible with reforestation practices in planted clearcut areas? Researchers must identify and evaluate the causes of damage and mortality of conifer seedling development in areas that have both timber and range values. *James Kingery*

HOW ANIMAL USE AFFECTS TRANSITORY RANGE MANAGEMENT

Investigators:

James L. Kingery
Russell T. Graham

Forestlands of northern and central Idaho provide many resource values including timber, water, and forage. As demand for these and other resources increase, the potential for conflict among resource uses and users also increases. This is especially true with respect to animal use and tree regeneration efforts on transitory range sites, or forested range land.

Historically the removal of tree cover has provided a way to increase the carrying capacity for animal use. These cutover forested range areas are becoming a focal point of debate concerning compatibility of animal use with reforestation practices. This is especially true today since there are high costs associated with transplanting nursery-grown tree seedlings to cutover areas.

Before animal use, especially by livestock, can be effectively coordinated with reforestation practices, the causes responsible for tree seedling damage and mortality must be objectively identified and realistically quantified. To do this, investigators James L. Kingery, Department of Range Resources, and Russell T. Graham, USDA Forest Service Intermountain Forest and Range Experiment Station Forest

Sciences Laboratory, linked the Forest Service and the university in a cooperative project to measure the actual impact of livestock on tree regeneration.

During the summer and fall of 1982, three study areas were located on national forest land in northern and central Idaho to evaluate the effects of animal use and non-animal environmental factors on tree establishment and growth in selected cut-over areas. The three study areas were located on the Slate Creek Ranger District in the Nez Perce National Forest, the Palouse Ranger District of the Clearwater National Forest and the St. Maries Ranger District of the Idaho Panhandle National Forest. The specific objectives for the study were:

- To define and quantify the causes of damage and mortality to conifer seedling establishment for three different species.
- To assess the interaction among livestock, rodents, and tree regeneration.
- To develop management guidelines that will coordinate livestock use with tree regeneration.

To accomplish these objectives, it was necessary to design a project that would be truly representative of those areas that

have a high potential for both timber and range values. Consequently, silviculture and timber managers, as well as range managers, assisted in locating representative study areas. The criteria they used for the study design included creating a project that would be scientifically sound, studying conditions that were operationally representative, and providing a study based on objective, unbiased observations.

A damage assessment key was developed to code and record specific types of damage in the field. A vigor assessment was made for each tree at each observation. The tree height was measured at the beginning and the end of the first growing season. Later, the damage status, vigor, and growth information for each tree could be retrieved and summarized by a computer program developed specifically for the data set.

Results so far show that the intensity of livestock utilization and livestock management practices appear to influence not only damage directly associated with livestock, but also damage associated with wildlife, rodent, and non-animal related causes. Livestock damage to tree seedlings during the first year of the study resulted primarily from trampling injury. There was no difference in the susceptibility

of different tree species to livestock use, but there was a difference in species susceptibility to injuries from other causes. Livestock grazing influenced above-ground damage from rodents, both from pocket gophers and from rodents that normally forage above ground. Where cover was substantially reduced by grazing, there was an overall decrease in the amount of above-ground damage associated with rodents.

Range damage associated with big game did not appear to be influenced by livestock grazing activities. However, in an area where steep terrain limited livestock utilization, trampling damage from big game was much higher due to the "stair steps" provided by the scalped planting sites.

At the end of three years, results from this study indicate that proper grazing control will minimize damage to young tree seedlings. Western white pine, Douglas-fir and ponderosa pine were all equally susceptible to damage from livestock. In addition, it appeared that there was an interaction between livestock grazing and rodent damage, especially damage from pocket gophers. As a result of information obtained from the study, foresters and range managers have developed management practices to better complement grazing activities in areas critical for reforestation.



Scientists have developed a tree seedling damage assessment key to record and code the effects of grazing on tree regeneration.
James Kingery



Photo guides, such as this one for Bluebunch wheatgrass, have been developed by researchers to help north Idaho ranchers estimate their range utilization. Carol Boyd

PHOTO GUIDE USED TO EVALUATE GRAZING ON TRANSITORY RANGELANDS

Investigators:

James L. Kingery
Carol Boyd

Rangelands in northern Idaho tend to be somewhat different than the image most people have of western ranges. Instead of vast expanses of sagebrush and grass, many of northern Idaho's rangelands are transitory ones where grazing is a temporary use and the primary use is timber production. This unique type of rangeland has different management requirements. To ensure minimum damage to tree seedlings, cattle need to be managed intensively. One aspect of this management is the monitoring of utilization.

Methods for estimating utilization have been developed and well tested in many arid areas, but not in the cooler and moister growing conditions of northern Idaho. Many of the transitory rangelands are managed by foresters who do not have the training nor the time needed to use the common range utilization methods. There is a need for a method of estimating utilization that is rapid and simple to learn and to use.

This study is an attempt to fulfill this need. The grazed-class system was designed by Ervin Schmutz of Arizona State University and others in Arizona and meets the requirements of rapidity and simplicity. This method uses standard photographs, called photo guides, to estimate the percent of the current year's growth by the weight removed. The objective of this study is to determine the accuracy of the grazed-class method for estimating utilization of seven key forage species on transitory rangelands in northern Idaho.

The study consists of three different tests of the method and the associated photo guides developed for sites near Riggins, Emida, and Bovill in northern Idaho. The first test is to determine the accuracy of the method. This will be done by comparing the utilization estimates from the grazed class method with those of the paired plot method. The paired plot method uses the difference in dry weight between an ungrazed plot and an equivalent size grazed plot as the percentage of utilization. It is currently used by the U.S. Forest Service in Region 1. The second test is to determine the accuracy of the photo guides. This will be done by estimating the percentage of weight removed from plants clipped to simulate grazing and comparing it to the actual weight removed. A third test of the grazed class method will determine the difference in the experience of samplers. Different groups of range samplers, some experienced and some inexperienced, will estimate the percentage of weight removed from clipped plants. These estimates will be compared to the actual weight removed. The analysis used on all three tests will be with an analysis of variance.

The investigators expect that there will be no significant difference in any of these tests. This will mean that the grazed class method and the photo guides associated with it are acceptable for use in these areas. The U.S. Forest Service, Bureau of Land Management, and Soil Conservation Service in Idaho have expressed an interest in the study and in obtaining the photo guides for use once the testing is completed.

CANYON GRASSLANDS IMPORTANT RESOURCE

Investigator:

E.W. Tisdale

The canyon grasslands of the middle Snake River and lower Salmon River valleys provide vital watershed protection, recreational values and a major grazing resource in west-central Idaho. The grasslands occur in relatively narrow bands that vary from about 1.2 miles to 15.5 miles wide along the steep slopes and bottoms of the deep canyons that form the Snake and Salmon River systems.

Due to its rugged topography and dry climate much of the grassland region has remained uncultivated and the presence of high quality native forage makes these lands highly valuable for wildlife and domestic livestock. Extensive investigations by Edwin W. Tisdale, professor emeritus of range resources, have documented the canyon grasslands as a distinctive unit of the Pacific Northwest Bunchgrass Region, closely related to, but recognizably different from the Palouse Prairie of the Columbia Plateau.

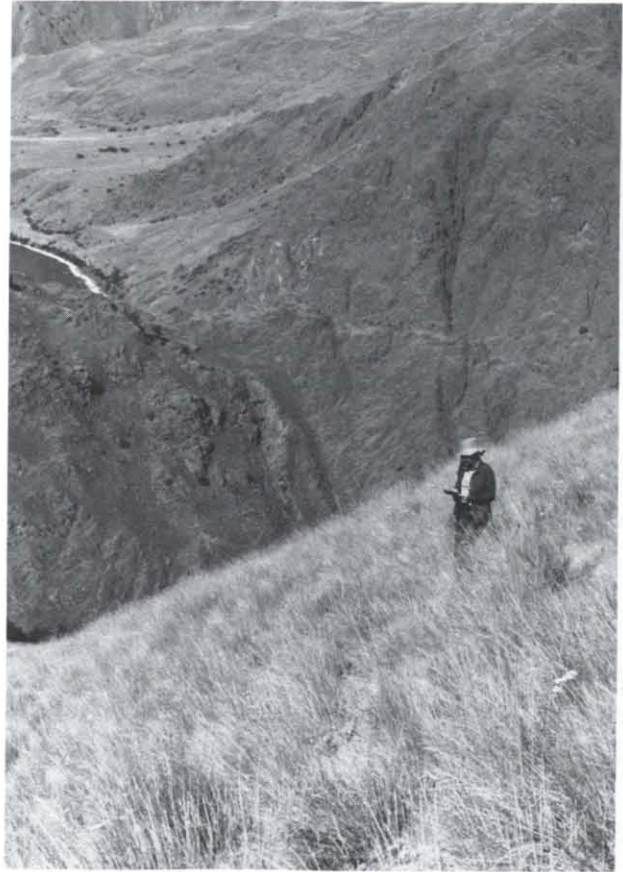
Tisdale recognized five grassland habitat types, five shrub types and two grassland community types of uncertain successional status. The two principal grasses are bluebunch wheatgrass (*Agropyron spicatum*) and Idaho fescue (*Festuca idahoensis*), while sandberg bluegrass (*Poa secunda*) is a common associate. The study found sedges are important in the highest grassland elevations, while sand dropseed (*Sporobolus crytandrus*) and red threeawn (*Aristida longiseta*) are important in the valley bottoms.

Features of the canyon environment that contribute to the special nature of the vegetation include rugged topography, with differences in elevation ranging from 700 feet to nearly 8000 feet. Steep slopes, with grades of 50 to 70 percent, are common and the marked differences in aspect create highly varied vegetation on nearby slopes, such as grassland on the southern slopes and coniferous forest on the northern slopes. The overall pattern of vegetation is one of vertical zonation, modified by aspect differences.

The results of the extensive study, which began in 1976, are detailed in a 42-page publication entitled *Canyon Grasslands and Associated Shrublands of West-central Idaho and Adjacent Areas* published as Station Bulletin No. 40 this spring by the Forest, Wildlife and Range Experiment Station of the University of Idaho.

The study notes the topographic and soil characters that are closely related to the canyon vegetation types and details the marked changes that have occurred in portions of the canyon grasslands that have been grazed too heavily in the past.

A major change has been the great reduction in the amount of native species and their replacement by introduced



Canyon grasslands of the Snake and Salmon River valleys provide high quality native forage. Investigator E.W. Tisdale has studied these range resources extensively. E.W. Tisdale

species such as the annual cheatgrass (*Bromus tectorum*) and other annuals. These stands are not stable and are changing as new and often less desirable invaders appear. The latest group is the knapweeds (*Centaurea species*), including yellow starthistle, which is spreading rapidly in the lower elevation grasslands.

Broad-leaved herbs are important also, especially in the less arid grassland types. Forty-two species were rated as common (occurring in 50 percent or more of the sites sampled) in one or more of the grassland types.

"These lands are easy to harm and harder to rehabilitate due to the steep topography that causes uneven grazing," Tisdale said. "The grasslands that are still occupied mainly by native species are a precious resource deserving of careful management to maintain them."

Continuing Education

SHORT COURSES, WORKSHOPS, AND SEMINARS

Research scientists in the Forest, Wildlife and Range Experiment Station conduct short courses, workshops, and seminars on campus, at the McCall and Clark Fork Field Campuses, throughout Idaho and the West. The following Continuing Education programs were sponsored, co-sponsored or produced in cooperation with the Experiment Station or departments of the College of Forestry, Wildlife and Range Sciences during the past fiscal year:

1985

July 20	Project Learning Tree Workshop — Clark Fork	February 26-28	Inland Empire Forest Engineering Conference — Moscow
July 20-July 26	McCall Elderhostel: Wild Nature of Idaho — McCall	March 3-5	Prescribed Fire in the Intermountain Region: Forest Site Preparation and Range Improvement Symposium — Spokane
July 27-August 3	Clark Fork Elderhostel: Wild Country Botanizing — Clark Fork	March 22	Beginning Fly Tying and Casting — Clark Fork
August 4-10	Advanced Fish and Wildlife Ecology Workshop for Teachers — McCall	March 24-April 11	Continuing Education in Fire Management — Applied Science (CEFM) — Moscow
August 9-10	Forest Products Marketing Conference — Moscow	March 31-April 1	Microcomputer Applications in Wildlife and Fisheries Biology — Moscow
September 20	Nature Photography — Clark Fork	April 1-2	Pesticide Licensing Workshop — Spokane
October 6	Mushroom Identification — Clark Fork	April 11	Shade Tree Workshop — Moscow
December 2-6	Dry Kiln Workshop — Moscow	April 30-May 1	Northwest Wood Products Clinic — Spokane

1986

January 18-19	Winter Life in Northern Idaho — Cross-country Skiing and Winter Survival — Clark Fork	May 2	Tree Pruning Workshop — Moscow
February 3	Community Forestry Workshop — Mountain Home	May 31-June 1	For (Bird) Lovers Only — Clark Fork
February 5	Shortcuts to Excellence — Moscow	May 26-July 4	Land Use Planning in Natural Resource Management — Moscow
February 11-14	Idaho Tourism Training Institute — Moscow	June 9-14	Central Idaho Natural Resources 4-H Workshop — Sun Valley
February 13	New Frontiers in Tree Improvement — Spokane	June 15-21	Inland Empire Natural Resources 4-H Workshop — Harrison
February 17-19	Below-Cost Sales: A Conference on the Economics of National Forest Timber — Spokane	June 22-28	Northwest Region 4-H Natural Resources Workshop — Sun Valley
February 22	Historical Archaeology of Idaho — Clark Fork	June 22-26	Forest Products Research Society Annual Meeting — Spokane
February 24-28	Statistical Methods and Data Analysis for Wildlife and Fisheries Biologists — Moscow	June 28	Fauna and Flora — Clark Fork

CONTINUING EDUCATION



FUTURE CONTINUING EDUCATION COURSES

Continue your education with us at the College of Forestry, Wildlife and Range Sciences! Take a short course, join us for a workshop, attend a symposium, or participate in the enrichment series planned for the coming year. Share our excitement with the many constituents we serve, from natural resource professionals to the general public, from energetic senior citizens to youngsters, from locals to those who come from across the country or around the world. Come to our campuses or field stations — we will offer courses in Moscow, Clark Fork, McCall, Boise, Twin Falls, Spokane, and elsewhere.

For more information call Dr. Penny Morgan at (208) 885-7400 about any of these courses or write her at the College of Forestry, Wildlife and Range Sciences, University of Idaho, Moscow, ID 83843.

1987 TENTATIVE SCHEDULE

January 5-9	Microcomputer Applications for Wildlife and Fisheries Biologists — Moscow	June 13	Spring Mushrooms for Beginners — Clark Fork
January 17-18	Cross-Country Skiing and Basic Back Country Skills — Clark Fork	June 14-20	Inland Empire 4-H Natural Resources Youth Camp — Harrison
January 20-22	Managing Grazing Lands for Recreation and Profit. Pacific Northwest Range Management Short Course — Pendleton, Oregon	June 15-July 24	Land Use Planning in Natural Resource Management Workshop — Moscow
January 26-30	Statistical Methods and Data Analysis for Wildlife and Fisheries Biologists — Moscow	June 22-26	Fish and Wildlife Ecology Workshop — McCall
February 3-6	Idaho Tourism Training Institute — Moscow	June 22-26	Riparian Area Ecology and Management Workshop — Idaho Falls
February 12	Nursery Soils Management Workshop — Sandpoint	June 27	Ethnobotany — Clark Fork
February 12-13	Inland Empire Forest Engineering Conference — Moscow	July 6-12	Fish and Wildlife Ecology Workshop — McCall
February 21	Pre-history on the Northwest — Clark Fork	July 12-15	Wildlife Issues Workshop — McCall
March 10-11	Range Computer Workshop — Boise (by invitation only)	July 12-18	Elderhostel - Wild Country Botanizing — Clark Fork
March 21	Beginning Fly Tying and Casting — Clark Fork	July 19-25	Elderhostel - Wild Nature of Idaho — McCall
March 23-25	Animal Damage Management in Pacific Northwest Forests — Spokane	July 25	The Nature of Forests — Clark Fork
April 4	Waterfowl Identification and Management — Clark Fork	August 15	Big Game Afield — Clark Fork
April 18	Lakes and Streams of the Northwest — Clark Fork	August 24-Sept. 4	Regeneration and Site Preparation, Advanced Education in Western Silviculture, Module 1 — Moscow
April 20-25	Executive Leadership of Political and Social Forces in Natural Resources — Moscow	September 26	Fall Mushrooms (Intermediate and Advanced) — Clark Fork
May	Non-supervisory Leadership — Moscow	September 29-October 2	Ponderosa Pine: The Species and Its Management — Spokane
May	Remote Sensing Workshop — Moscow	October 2	Uneven-aged Management Workshop and Field Tour — Spokane
May 12-13	Expert Systems in Natural Resource Management: An Introduction — Moscow	October 10	Fossil Collecting and Geologic Tour of the Lake Pend Oreille Area — Clark Fork
May 30-31	For (Bird) Lovers Only (Intermediate and Advanced) — Clark Fork	October 12-16	Dry Kiln Workshop — Moscow
Summer	Habitat Typing Workshop (1, possibly 3) — TBA	November 7	No Insect Is Really A Pest! — Clark Fork
June 1-5	Idaho Outdoors: A Writing Workshop — McCall	November 17-19	Land Classifications Based on Vegetation - Applications to Management Decisions — Moscow
June 8-13	Central Idaho 4-H Natural Resources Workshop — Ketchum	Ongoing	Project Learning Tree Workshops (10 workshops planned, to be held throughout the state)
June 13	The Nature of Forests — McCall	Ongoing	Project Wild Workshops (15 workshops planned, to be held throughout the state)

TBA means To Be Announced

MASTER'S THESES

- Almack, Jon A. 1985. An evaluation of grizzly bear habitat in the Selkirk Mountains of north Idaho. *Major professor M.G. Hornocker*
- Bellitto, Michael W. 1985. Site impacts for three inexpensive cable yarders. *Major professor L.R. Johnson.*
- Bernatas, Susan. 1986. The relationship of site characteristics to fuelwood collecting following timber harvest. *Major professor J.E. Force*
- Bowles, Edward C. 1985. Recruitment and survival of young-of-the-year largemouth bass (*Micropterus salmoides*) in the Coeur d'Alene Lake system, Idaho. *Major professor D.A. Bennett*
- Boyce, Robbin B. 1985. Conifer germination and seedling establishment on burned and unburned seedbeds. *Major professor D.L. Adams*
- Bratovich, Paul M. 1985. Reproduction and early life histories of selected resident fishes in lower Snake River reservoirs. *Major professor D.A. Bennett*
- Bugert, Robert M. 1985. Microhabitat selection of juvenile salmonids in response to stream cover alteration and predation. *Major professor T.C. Bjornn*
- Butterfield, Bart R. 1985. Avian community development along a primary successional gradient. *Major professor R.G. Wright*
- Du, Wei. 1985. Genetic variation among giant sequoia (*Sequoiadendron giganteum* Lindl. Buchh) populations planted in Moscow, Idaho. *Major professor L. Fins*
- Eramian, Aram D. 1986. A comparison of broadcast burn vs. dozer site preparation methods on the growth of bare root Douglas-fir seedlings. *Major professor L.F. Neuenschwander*
- Foushee, David L. 1986. Early detection of graft incompatibility for inland Douglas-fir (*Pseudotsuga menziesii* var. *glauca*) and the selection of compatible rootstock. *Major professor L. Fins*
- Geier-Hayes, Kathleen A. 1986. Occurrence of conifer seedlings and their microenvironments in disturbed areas in central Idaho. *Major professor F.D. Johnson*
- Hassemer, Peter F. 1985. Spawning ecology and early life history of kokanee (*Oncorhynchus nerka*) in Coeur d'Alene and Pend Oreille Lakes, Idaho. *Major professor D.A. Bennett*
- Lam, Devona L. 1985. Smoltification of hatchery chinook salmon and steelhead trout as related to fish size and time of release. *Major professor C.M. Moffitt*
- Lange, David. 1985. Computer-aided information management in the forest products industry. *Major professor R.L. Govett*
- Ludwig, Steven L. 1986. A comparison of root growth potential tests on north Idaho bare root and containerized seedlings. *Major professor D.L. Wenny*
- Mendoza-Briseno, Martin A. 1985. Response of ponderosa pine stands with a history of selective management to simulated even-aged silviculture. *Major professor K.J. Stoszek*
- Mengel, Dennis L. 1985. Small tree height increment models for commercial forest species in northern Idaho and western Montana. *Major professor C.T. Stiff*
- Neilsen-Gerhardt, Marci. 1986. Effects of logging and mechanical site preparation on levels of ammonium nitrogen and organic matter in forest soils. *Major professor H. Loewenstein*
- Pedevillano, Catherine. 1986. Mountain goat behavior at the Walton Lick and Highway 2 underpasses in Glacier National Park. *Major professor R.G. Wright*
- Pfister, Stephen C. 1985. The influence of cement/wood ratio and cement type on bending strength and dimensional stability of wood cement particleboard. *Major professor A.A. Moslemi*
- Sewing, Daphne R. 1986. Barriers to environmental education: perceptions of elementary teachers in the Palouse region of Washington and Idaho. *Major professor S.H. Ham*
- Siebe, Michael A. 1985. Effects of a high-intensity short-duration grazing system on soil compaction and water infiltration in southern Idaho. *Major professor K.D. Sanders*
- Soderstrom, L. Magnus G. 1986. Descriptive study of visitors at Oulanka National Park in Finland. *Major professor W.J. McLaughlin*
- Sun, Minggao. 1986. Treatment of grand fir seed affects associated pathogenic fungi and germination. *Major professor A.D. Partridge*
- Vineberg, Stacey A. 1986. Conditions related to heartwood decay in deciduous shade trees of Idaho. *Major professor A.D. Partridge*
- Walsh, Allan R. 1985. An investigation of some of the chemical and physical properties of kraft lignin and kraft lignin-phenol formaldehyde wood adhesives. *Major professor A.G. Campbell*
- Weilgus, Robert B. 1986. Habitat ecology of the grizzly bear in the southern Rocky Mountains of Canada. *Major professor J.M. Peek*

PH.D. DISSERTATIONS

- Clausen, Russell W. 1986. Ecological energetics of Douglas-fir cone and seed insects in Idaho. *Major professor J.A. Schenk*
- Jenkins, Kurt J. 1985. Winter habitat and niche relationships of sympatric cervids along the North Fork of the Flathead River, Montana. *Major professor R.G. Wright*
- Kingery, James L. 1985. The relationship of animal use to tree establishment, survival, and growth in three different habitat types in northern and central Idaho. *Major professor L.A. Sharp*
- Martin, Niels L. 1986. Classification and ordination of the plant communities of Lesotho. *Major professor D.A. Bryant*
- Parker, Tracey. 1986. Ecology of western redcedar groves. *Major professor F.D. Johnson*
- Pedersen, Richard J. 1986. Elk habitat use of an unlogged and logged forested environment. *Major professor J.M. Peek*

Appendix

EXPERIMENT STATION SCIENTISTS

Hendee, John C.

Dean, College of Forestry, Wildlife and Range Sciences
Director, Forest, Wildlife and Range Experiment Station

Nutrition Laboratory

Pym, Geneva
Research Technician

DEPARTMENT OF FISH AND WILDLIFE RESOURCES

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

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

Bizeau, Elwood G.
Professor Emeritus
Birds, principally waterfowl and marsh

Bjornn, Theodore C.
Professor
Assistant Leader, Cooperative Fish & Wildlife
Research Unit
Fish ecology and management

Congleton, James
Associate Professor
Assistant Leader, Cooperative Fish and Wildlife
Research Unit
Marine ecology, environmental physiology

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

Falter, C. Michael
Professor
Reservoir limnology, stream ecology

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

Hornocker, Maurice G.
Professor
Population ecology, predator-prey interactions

Hungerford, Kenneth E.
Professor Emeritus
Wildlife management

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

MacPhee, Craig
Professor Emeritus
Fish behavior, ecology, toxicology

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

Nelson, Lewis, Jr.
Extension Professor
Continuing education, communications

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

Reese, Kerry P.
Assistant Professor
Wetland ecology

Ringe, Rudy
Fishery Research Associate

Scott, J. Michael
Leader, Cooperative Fish and Wildlife Research
Unit
Professor
Ecology and management of nongame and
endangered species, bird census sampling, systems
approaches to conservation ecology

Wright, R. Gerald, Jr.
Cooperative Park Studies Unit Project Leader —
Biology
Associate Professor
Wildlife habitat management and National Park
wildlife management

DEPARTMENT OF FOREST PRODUCTS

Campbell, Alton G.
Assistant Professor
Wood chemistry

Govett, Robert L.
Assistant Professor
Forest products marketing

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

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

Lee, Harry W.
Assistant Professor
Forest engineering

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

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

DEPARTMENT OF FOREST RESOURCES

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

Bassler, Gregory
Logging Superintendent, Forester and
Research Associate

Belt, George H.
Professor
Hydrology, meteorology, planning, forest
management

Brunsfeld, Steven
Research Associate
Dendrology, forest ecology, systematic botany

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

Canfield, Elmer R.
Associate Professor Emeritus
Forest pathology

Dennis, Brian
Associate Professor
Statistical ecology

Deters, Merrill E.
Professor Emeritus
Silviculture

Dumroese, R. Kasten
Research Associate
Nursery Management

Fins, Lauren
Executive Director, Inland Empire Tree
Improvement Cooperative
Associate Professor

Force, Jo Ellen
Associate Professor
Modeling, land use planning, forest policy

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

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

- Hendee, John C.
Dean
College of Forestry, Wildlife and Range Sciences
Director — Forest, Wildlife and Range Experiment Station
Professor
Human behavior aspects of renewable resource management, conflict resolution, public involvement
- Johnson, Frederic D.
Professor
Forest ecology, forest communities, forest botany
- Loewenstein, Howard
FWR Experiment Station Assistant Director and Professor
Forest soils and tree nutrition
- Machlis, Gary E.
Cooperative Park Studies Unit Project Leader — Sociology
Associate Professor
Interpretation, human ecology, environmental sociology
- Mahoney, Ronald
Extension Forester
Assistant Extension Professor
- McKetta, Charles W.
Associate Professor
Timber production economics, forest management, forest taxation
- Medema, E. Lee
Associate Professor
Forest resource economics, forest policy, stumpage market analysis
- Mika, Peter G.
Research Associate
Biometrics, forest nutrition
- Moore, James A.
Director, Intermountain Forest Tree Nutrition Cooperative
Professor
Silviculture, quantitative methods, forest production
- Neuenschwander, Leon F.
Associate Dean for Research and International Programs
Professor
Fire ecology, fire management, prescribed burning, general ecology
- Osborne, Harold L.
Manager, University of Idaho Experimental Forest
Assistant Professor
Silviculture, harvesting
- Partridge, Arthur D.
Professor
Forest pathology
- Rust, Mark
Data Analyst
Forest Genetics
- Schenk, John A.
Assistant Department Head and Professor
Forest entomology, insect ecology, silvicultural, and biological control of forest insect pests
- Seale, Robert H.
Professor Emeritus
Forest economics
- Stark, Ronald W.
Professor Emeritus
Population dynamics and integrated pest management of forest insects
- Stiff, Charles
Assistant Professor
Mensuration, mathematical tree and stand modeling
- Stock, Molly W.
Professor
Forest insect population genetics and biosystematics
- Stoszek, Karl J.
Professor
Silviculture, forest protection, forest entomology
- Tennyson, Larry C.
Associate Professor
Watershed
- Ulliman, Joseph J.
Professor
Aerial photography, mapping, aerial photo interpretation, remote sensing
- Vander Ploeg, James
Research Associate
Growth-yield, forest nutrition
- Wang, Chi-Wu
Professor Emeritus
Forest genetics
- Wenny, David L.
Forest Research Nursery Manager
Associate Extension Professor
Silviculture, forest regeneration

DEPARTMENT OF RANGE RESOURCES

- Bryant, David A.
Professor and Department Head
Coordinated management planning, range nutrition
- Bunting, Stephen C.
Associate Professor
Fire ecology, range ecology, range management
- Ehrenreich, John H.
Professor
Range ecology, international forestry
- Hironaka, Minoru
Professor
Range ecology, rangeland classification, soil-plant relationships
- Kingery, James L.
Assistant Professor
Rangeland rehabilitation, range economics, forest grazing policy
- Neuenschwander, Leon F.
Professor
Fire ecology, fire management
- Robberecht, Ronald
Assistant Professor
Ecophysiology, autecology, range ecology
- Sanders, Kenneth D.
Professor
Range extension, range nutrition, range livestock
- Sharp, Lee A.
Professor
Integrated range resource management, range management planning, grazing systems
- Tisdale, Edwin W.
Professor Emeritus
Vegetation classification, vegetation habitat relationships
- Wright, R. Gerald, Jr.
Associate Professor
Range systems ecology, simulation modeling

DEPARTMENT OF WILDLAND RECREATION MANAGEMENT

- Fazio, James R.
Associate Dean of Academics and Professor
Communication and principles of natural resource management, environmental interpretation, continuing education delivery systems, conservation history
- Frome, Michael
Visiting Associate Professor
Environmental communications
- Ham, Sam H.
Associate Professor
Interpretation, communication, environmental education, family decision making and consumer behavior in recreation and tourism, natural resource tourism, international park management and training
- Harris, Charles C., Jr.
Assistant Professor
Economic evaluation of recreation resources, consumer behavior, recreation management and planning, natural resource tourism
- Krumpe, Edwin E.
Director of Wilderness Research Center and Associate Professor
Ecological impacts of recreation, social psychology, decision processes in recreation, communications and interpretation, wilderness management
- McLaughlin, William J.
Department Head and Associate Professor
Regional and recreation planning methods, citizen participation, recreation behavior, perception of natural resources, and international recreation management

FISCAL 1986 RESEARCH PROJECTS AND INVESTIGATIONS

This listing of projects shows the range of work in progress through the Forest, Wildlife and Range Experiment Station. To save space, abbreviated project titles are given. If additional information is needed, write to the principal investigators or the Associate Director for Research, at the Forest, Wildlife and Range Experiment Station, University of Idaho, Moscow, ID, 83843.

DEPARTMENT OF FISH AND WILDLIFE RESOURCES

- Population estimation techniques for coyotes. E.D. Ables, R. Crabtree
- Behavioral interactions of bighorn sheep with deer and elk. E.D. Ables, H. Akenson
- Fish and habitat inventory of the Lewiston levee ponds and development of a management plan. D.H. Bennett, F. Shrier
- Dynamics and ecology of salmonid fishes as affected by project operations of Post Falls Dam on the upper Spokane River, Idaho. D.H. Bennett, T. Underwood
- Effects of sediment dredging and in-water disposal on fishes in Lower Granite Reservoir in Idaho and Washington. D.H. Bennett, L. Dunsmoor
- Forage fish availability for smallmouth bass (*Micropterus dolomieu*) in Brownlee Reservoir, Idaho. D.H. Bennett, F. Shrier
- Experimental releases of captive-reared greater sandhill cranes. E.G. Bizeau, R.C. Drewien, W. Brown
- Impact analysis of livestock grazing on fisheries and riparian habitat in Idaho, Nevada and Utah. D.H. Bennett, J. Van Deventer
- Effects of cottonwood plantings on the habitat and abundance of fish invertebrates in small Alaska streams. T.C. Bjornn, M. Brusven, R. Bugert, S. Kirking, W. Duncan
- Carrying capacity of streams as related to physical and biological factors. T.C. Bjornn, W. Meehan, C. Steward
- Development and testing of models to estimate supplementation requirements. T.C. Bjornn, J. McIntyre, A. Byrne
- Viability of progeny from steelhead spawning early versus at normal time. T.C. Bjornn, R. Reisenbichler, G. Meyer
- Production of kamloops and bull trout in Pend Oreille Lake tributaries. T.C. Bjornn, B. Hoelscher
- Cascade reservoir. T.C. Bjornn, B. Griswold
- Boise River habitat study. T.C. Bjornn, G. Asbridge
- Northwest Power Planning Council research issues. T.C. Bjornn, J. McIntyre
- Offsite benefits study — Tucannon River and other Columbia Basin streams. T.C. Bjornn, R. Ringe
- Evaluation of methods for controlling bacterial kidney disease in Snake River chinook salmon. T.C. Bjornn, C.M. Moffitt, J. Schreck
- Cutthroat trout production in Priest Lake tributaries. T.C. Bjornn, D. Irving, P. Cowley
- Evaluation of the proposed use of Bear Lake National Wildlife Refuge as a sediment and nutrient trap for inflows into Bear Lake. T.C. Bjornn, C.M. Falter, J.H. Milligan, C.M. Moffitt, K.P. Reese, R. Tressler, R. Myers, C. Cleveland
- Survival of chinook salmon as related to stress at dams and smolt quality. T.C. Bjornn, J.L. Congleton, R. Ringe
- Effects of small hydro developments on aquatic invertebrates and fish. T.C. Bjornn, W. Minshall, S. Rubin
- Comparison of three prototype flumes for downstream passage of juvenile salmonids. J.L. Congleton
- Reestablishment of the whooping crane in western North America. R.C. Drewien, E.G. Bizeau
- Algae toxicity in Black Lake, Kootenai County, Idaho. C.M. Falter, J. Kann
- Trophic status of Twin Lakes, Idaho. C.M. Falter, D. Hallock
- Limnology of the Bear Lake Marsh. C.M. Falter, R. Myers
- Attached algae in Pend Oreille Lake. C.M. Falter, J. Kann
- Population ecology of trumpeter swans. E.O. Garton, R. Gale and J. Bull
- Status and habitat requirements of boreal owls in the northern Rocky Mountains. E.O. Garton, G. Hayward
- Bighorn sheep reintroduction to Lee Vining Canyon, California. E.O. Garton, J. Keay
- Home range analysis methods. E.O. Garton, M.D. Samuel, B. Ackerman
- Aerial census methods for elk and mule deer populations. E.O. Garton, M.D. Samuel, B. Ackerman
- Baseline data-gathering systems for Research Natural Areas. E.O. Garton
- Avian predators of the Western spruce budworm. E.O. Garton
- Mountain lion ecology in New Mexico. M.G. Hornocker, H. Quigley
- Mountain lion ecology in New Mexico. M.G. Hornocker, K. Logan, L. Sweanor
- Lynx population parameters in N. Washington. M.G. Hornocker, G. Koehler, T. Koehler
- Bobcat ecology in the River of No Return Wilderness. M.G. Hornocker, G. Koehler
- Mountain lions in Yellowstone National Park. M.G. Hornocker, G. Koehler
- Proliferative kidney disease in rainbow trout. G.W. Klontz
- Epidemiology of proliferative kidney disease in rainbow trout. G.W. Klontz
- Computerized production forecasting for hatcheries. G.W. Klontz
- Evaluation of ornamental fish diets. G.W. Klontz
- Endangered and threatened species. L. Nelson, Jr.
- Umatilla Indian Reservation white-tailed deer investigations. J.M. Peek, J.H. Bell

Umatilla Indian Reservation mule deer investigations. J.M. Peek, T. Bodurtha

Colville Indian Reservation mule deer investigations. J.M. Peek, D.B. Griffith, B. Youtie

Sitka black-tailed deer habitat use investigations. J.M. Peek, J. Mankowski

Bull moose behavior and habitat use investigations in the Denali National Park and Preserve, Alaska. J.M. Peek, D.G. Miquelle

Mountain goat habitat use investigations at Pend Oreille Lake, Idaho. J.M. Peek, K. Naylor

Citizens' survey — Idaho Nongame Wildlife Program. K.P. Reese, W.E. Melquist

Avian habitat relationships in riparian zones of northern Utah. K.P. Reese, J. Blakesley

Reintroduction of sage grouse into the Sawtooth Valley. K.P. Reese, D. Musil

Waterfowl use of wetland habitats at Bear Lake National Wildlife Refuge. K.P. Reese, R. Tressler

Gray partridge population index. K.P. Reese

Characteristics of islands when selected by nesting Canada geese. K.P. Reese, J.M. Kodler, L.M. Smith

Limiting factors of Hawaiian forest birds. J.M. Scott, C.B. Kepler, S. Mountainspring, F. Ramsey

Factors limiting population size of the California condor. J.M. Scott, P. Bloom, S. Wiemeyer

Habitat requirements of grizzly bears in the Selkirk mountains. J.M. Scott, D. Volsen, J. Lyons

Release programs as a tool for establishing or augmenting wildlife populations. J.M. Scott, J. Carpenter, B. Griffith

Habitat requirements of the Hawaiian crow. J. Griffin, J.M. Scott, S. Mountainspring

Lead levels in golden eagles. P. Bloom, J.M. Scott, H. Pattee

Regional management strategies for endangered species. J.M. Scott, B. Csuti

Mountain goat population dynamics and population control alternatives at Olympic National Park. R.G. Wright, R. Hoffman

Baseline resource inventory at Craters of the Moon National Monument. R.G. Wright

Computer-based natural resource data management plans for national parks. R.G. Wright

Restoration of native grassland vegetation at Nez Perce National Historical Site. R.G. Wright

Park management models. R.G. Wright, G.E. Machlis

DEPARTMENT OF FOREST PRODUCTS

Supercritical fluid extraction of turpentine and tall oil from wood chips prior to pulping. A.G. Campbell, D.C. Ritter

Chemical variation lodgepole pine as a function of longitude, latitude, elevation, and stem height. A.G. Campbell, W-J Kim

Decolorization of pulp and paper mill waste. A.G. Campbell, A.L. Prouty

Evaluation of the MyCoR process for decolorization of pulp mill effluent. A.G. Campbell

Practical considerations in the export of forest products. R.L. Govett, K.A. Blatner

Technical and economic assessment of small- and medium-sized processing equipment to produce densified fuels for small and local markets. R.L. Govett, H.W. Lee

Preliminary technical/economic feasibility analysis in the Philippines. R.L. Govett, A.A. Moslemi

Economic feasibility of Honduran pine-cement structural products. R.L. Govett, A.A. Moslemi

Economic feasibility of wood-cement production in the United States. R.L. Govett, A.A. Moslemi

Practical considerations in the export of forest products. R.L. Govett, WSU Forestry

Developing and testing wood residue delivery systems. L.R. Johnson

Computer simulation of logging systems for analysis of mechanized systems. L.R. Johnson

Measures used to estimate the effect of residential housing construction activities on wood consumption. R.L. Govett, D.E. Lange

Changes in the repair and remodeling segment of the U.S. lumber market. R.L. Govett, D.E. Lange

A profile of Korea as a market for U.S. softwood and hardwood products. R.L. Govett, K.A. Blatner, W-J Kim

Recovery of forest residues after logging. L.R. Johnson, H.W. Lee

Mechanization of forest operations. L.R. Johnson

Non-industrial private forest/and owner survey. H.W. Lee, J.E. Force, R.L. Mahoney

Economic evaluation of the results of NIPF survey. H.W. Lee

Energy requirements of an Alaskan village. H.W. Lee, T. Pastro

A statistically designed log quality analysis. H.W. Lee, L.C. Gregory

Analysis of soil disturbance from three low cost skidding machines. H.W. Lee, M.W. Bellitto

Effect of wood storage time on wood-cement compatibility. A.A. Moslemi, F. Almeida

Water requirement for wood-cement control. A.A. Moslemi, M. Hachmi

An electron microscopic examination of wood-cement bond development. A.A. Moslemi, P. Miller

The influence of basic wood constituents in cement-wood hydration. A.A. Moslemi, P. Miller

Delineation of extractives in wood in relation to cement compatibility. A.A. Moslemi

The effect of fly-ash ion reducing composite density in wood-cement composites. A.A. Moslemi

The role of certain additives for new product development with inorganic binders. A.A. Moslemi

Computer program for log heating. P.H. Steinhagen

Heat conditioning of veneer blocks. P.H. Steinhagen

Heating and drying of wood by microwave energy. P.H. Steinhagen

Drying of particles. P.H. Steinhagen

DEPARTMENT OF FOREST RESOURCES

- Bear damage in 50-year-old larch-lodgepole pine stands in northwest Montana. D.L. Adams, A. Mason
- Seed wafer development: physiology of seed germination, rodent repellents, soil-site relations. D.L. Adams, C. Dirks
- Shade effects on survival and growth of nursery and field-grown western redcedar. D.L. Adams, R.L. Mahoney
- Comparison of natural and artificial regeneration on six habitat types on the Flathead Indian Reservation. D.L. Adams, K.J. Stoszek, R. Becker
- Habitat and visitor mapping in the Two-Medicine area of Glacier National Park. S.B. Baldwin, B.R. Butterfield, R.G. Wright, G.E. Machlis
- Ecology and taxonomy of Idaho willows. S. Brunsfeld, F. Johnson
- Bog birches of N. Idaho. S. Brunsfeld, F. Johnson
- Ecology and systematics of *Salix* section *longifoliae*. S. Brunsfeld
- Stochastic differential equations as models of population abundance. B. Dennis
- Stochastic models of insect phenology. B. Dennis
- Statistics of species abundance and diversity. B. Dennis
- Graft incompatibility in inland Douglas-fir. L. Fins, D. Foushee
- Population differences in cold hardiness of giant sequoia trees. L. Fins, W. Du
- Isozyme variation in western larch from N. Idaho and E. Washington. L. Fins, L. Seeb
- Environmental assessment as a natural resource policy implementing tool. J.E. Force, J. Carbone
- Public involvement in the national forest planning process. J.E. Force, K. Williams
- Evaluation of user's role in wood energy for residential heating in Idaho. J.E. Force
- The relationship of site characteristics and fuelwood collecting following timber harvest. J.E. Force, S. Bernatas, L. Neuenschwander
- A study of nonindustrial private forest landowners in northern Idaho. J.E. Force, H. Lee, R. Folk, R.L. Mahoney
- Conflict resolution. J.C. Hendee
- Human behavior aspects of renewable resource management. J.C. Hendee
- Human resource development through natural resource use. J.C. Hendee
- Resource policy analysis. J.C. Hendee
- Critical levels of N and P for satisfactory growth of Douglas-fir. H. Loewenstein, J. DeGroot
- Relating soils and habitat types in N. Idaho. H. Loewenstein, P. Patterson
- Soil-site relations in regeneration. H. Loewenstein, D. Page, R.K. Dumroese
- Site preparation and logging effects on forest soils. H. Loewenstein, M. Gerhardt
- The development of a National Park Service system-wide technique for visitor studies: The Visitor Services Project. G.E. Machlis, S.B. Baldwin
- A visitor study at White Bird in the Nez Perce National Historical Park. G.E. Machlis, S.B. Baldwin
- A study of the social impact of the timber industry downturn in Clearwater County, Idaho. G.E. Machlis, D. Ellis
- Evaluating national park service interpretive programs. G.E. Machlis, S.H. Ham, S.B. Baldwin
- Visitor data for park management. G.E. Machlis
- Resource management in the world's parks. G.E. Machlis, D.L. Tichnell
- Nez Perce National Historical Park visitor studies. G.E. Machlis, S.B. Baldwin
- North Cascades National Park visitor study. G.E. Machlis, S.B. Baldwin, D.R. Johnson
- National Parks in the neo-tropical realm. G.E. Machlis, R.P. Neumann
- Ecological energetics of Douglas-fir cone and seed insects in Idaho. J.A. Schenk, R.W. Clausen
- Association of lodgepole pine tree vigor with incidence of mountain pine beetle attack. J.A. Schenk, S. Zimmer
- Using habitat types to hazard rate Douglas-fir susceptibility to mottle root disease. J.A. Schenk, B. Quinn
- Cutting practices in lodgepole pine stands to preserve entomophagous insects associated with mountain pine beetle. J.A. Schenk, M. Chatelain
- Residual analysis of prognosis and SPS. C.T. Stiff
- Development of geographical variants of the stand prognosis model. C.T. Stiff
- Classification of the upland pine forests of central Honduras for site quality and productivity. C.T. Stiff, F.D. Johnson
- Small tree height growth models for mixed-species conifer stands in northern Idaho and western Montana. C.T. Stiff
- Alternative density expressions for diameter increment models in central Idaho. C.T. Stiff
- Evaluation of the growth of western white pine and Douglas-fir seedlings planted in soils pretreated with Vapam. D.L. Wenny, S. Rainville
- A comparison of root growth potential tests on northern Idaho bareroot and containerized seedlings. D.L. Wenny, S. Ludwig
- Seedcoat sterilization to minimize pre- and post-germination damping-off. D.L. Wenny, R.K. Dumroese
- Development of computer software for nursery applications. D.L. Wenny
- Development of growth regimes for northern Idaho greenhouse facilities. D.L. Wenny, R.K. Dumroese
- Root morphology after copper compound application to container walls. D.L. Wenny, R. Woolen
- Quick tests for seedling physiological status. D.L. Wenny
- Containerized production of hardwoods for conservation planting. D.L. Wenny
- Western white pine seed-sizing for container nursery application. D.L. Wenny, R.K. Dumroese

DEPARTMENT OF RANGE RESOURCES

- Implementation/evaluation guidelines for prescribed burning in sagebrush/grasslands. S.C. Bunting
- Successional status of a tall forb community in the Centennial Mountains. S.C. Bunting, R. B. Murray
- Prescribed burning in *Pinus pinaster* forests of northern Portugal. S. C. Bunting, F. Rego
- Effects of length and timing of grazing on postburn productivity. S.C. Bunting, R. Robberecht
- Evaluation of the frequency plot method as an improved technique for the measurement of succession. S.C. Bunting, M. Hironaka
- Habitat type classification for the grasslands and shrublands of southern Idaho. M. Hironaka, M. Fosberg
- Effects of western juniper occupancy on soils and plant distribution. M. Hironaka, S.C. Bunting
- Classification of community types of major sagebrush-grass habitat types of southwest Idaho. M. Hironaka
- Secondary succession and soils relationships in forest communities of northern Idaho. M. Hironaka, K. Neiman
- Vegetation change analysis by the frequency plot method: development and procedures. M. Hironaka, S.C. Bunting
- Effects of vegetative cover loss on runoff and erosion in Lesotho. C. Keta, D.A. Bryant
- The relationship of wildlife and livestock use in tree establishment, survival and growth in three different habitat types in northern Idaho. J.L. Kingery
- Development of grazed-class photo guides to determine livestock utilization on transitory range in northern and central Idaho. J.L. Kingery, C. Boyd
- Effectiveness of nested quadrat frequency for monitoring succession in transitory range. J.L. Kingery, J. White, C. Boyd
- Analysis of cattle, deer, and elk diets in cutover areas of northern Idaho. J.L. Kingery, D.A. Bryant
- Phytosociology of Lesotho's plant communities. N.L. Martin, D.A. Bryant
- Economics of public land grazing and multiple use. N. Rimbey, K.D. Sanders
- Range management in northern Tanzania. R. Robberecht, E. Chausi
- Effect of fire and timing of grazing on plant mortality and productivity. R. Robberecht
- Plant and soil water relations of *Festuca idahoensis* and *Agropyron spicatum* in response to fire. R. Robberecht
- Intra- and inter-specific competition between two bunchgrass species in the post-fire regeneration stage of grassland communities. R. Robberecht, G. Defosse
- The response of two bunchgrass species to grazing and water stress. R. Robberecht, J.B.M. Alcocer-Ruthling
- Measuring effects of compaction under short-duration grazing. K. D. Sanders, L.A. Sharp

- Short duration grazing of crested wheatgrass. K.D. Sanders, L.A. Sharp
- Cattle preference for selected grasses and shrubs. K.D. Sanders
- Evaluation of grazing practices on seeded rangeland in southern Idaho. L.A. Sharp
- Salt-desert shrub rangeland ecology. L.A. Sharp
- Computer-based range/ranch informational system. L.A. Sharp, R.L. Richmond
- Forage production in Benewah County. L.A. Sharp, D.A. Bryant, D. Cooper
- Ecology of the grasslands of the Snake and Salmon river systems in Idaho. E.W. Tisdale

DEPARTMENT OF WILDLAND RECREATION MANAGEMENT

- Controlled burning use by non-industrial private forest owners in Alabama: a study of adoption. J.R. Fazio, D. McConnell
- State river conservation programs and natural resource policy implementation. M.D. Feldman, W.J. McLaughlin
- Barriers to environmental education in Washington and Idaho public schools. S.H. Ham, D. Sewing
- A statewide survey of travelers, tourists and outdoor recreationists in Idaho. C.C. Harris, N. Sanyal, S.H. Ham, E.E. Krumpe, W.J. McLaughlin
- Assessing the impacts of natural resource tourism on the small community in Idaho: A case study. C.C. Harris
- BLM lower Salmon River recreation management planning and evaluation project. C.C. Harris, W.J. McLaughlin, D. Rawhouser
- Integrating economic and psychological knowledge in valuations of public amenity resources. C.C. Harris
- A statewide survey of travelers, tourists, and outdoor recreationists in Idaho. C.C. Harris, N. Sanyal, S.H. Ham, E.E. Krumpe, W.J. McLaughlin
- User fees for public recreation: Free enterprise and recreation resource management. C.C. Harris
- Interpretation in southeast Alaska. S.H. Ham
- American Indians and national parks. S.H. Ham
- Evaluation of indicators of wilderness resource conditions. E.E. Krumpe, L. Young-Merigiano
- Recreation trails and trail users. E.E. Krumpe, R.C. Lucas
- Wilderness management. E.E. Krumpe, R.C. Lucas
- Risk recreation and mountain climbing. E.E. Krumpe, J. Tangen-Foster
- Natural resources management literature synthesis for President's Commission on Americans Outdoors. E.E. Krumpe, R.C. Lucas
- Evaluating national park service interpretive programs. G.E. Machlis, S.H. Ham, S.B. Baldwin
- Visitor data for park management. G.E. Machlis
- Resource management in the world's parks. G.E. Machlis, D.L. Tichnell

Nez Perce National Historical Park visitor studies. G.E. Machlis, S.B. Baldwin

North Cascades National Park visitor study. G.E. Machlis, S.B. Baldwin, D.R. Johnson

National parks in the neo-tropical realm. G.E. Machlis, R.P. Neumann

Park management models. G.E. Machlis, R.G. Wright

The development of a National Park Service system-wide technique for visitor studies: The Visitor Services Project. G.E. Machlis, S.B. Baldwin

A visitor study at White Bird in the Nez Perce National Historical Park. G.E. Machlis, S.B. Baldwin

A study of the social impact of the timber industry downturn in Clearwater County, Idaho. G.E. Machlis, D. Ellis

FISCAL 1986 PUBLICATIONS AND REPORTS

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

DEPARTMENT OF FISH AND WILDLIFE RESOURCES PUBLICATIONS LISTING

- Ables, E.D., and K.P. Reese. 1985. Analysis of fish and wildlife research contained in the CRIS system with emphasis on Hatch and McIntire-Stennis funds. Project Completion Rep. for USDA Coop. State Research Serv., Washington, D.C. 64 pp.
- Allredge, J.R., and J.T. Ratti. 1985. Comparison of some statistical techniques for analysis of resource selection. *J. Wildl. Manage.* 50:157-165.
- Bennett, D.H., and E.C. Bowles. 1985. Recruitment and survival of largemouth bass (*Micropterus salmoides*) in the Coeur d'Alene Lake system. Completion Rep. Proposal No. 2 to the Washington Water Power Co. 97 pp.
- Bennett, D.H., and C.M. Falter. 1985. Pend Oreille River environmental assessment: aquatic resources assessment. Submitted to the Dept. of Ecology, State of Washington, S.E.P.A. Lead Agency by Rust International Corp.
- Bennett, D.H., and T.J. McArthur. 1985. Assessing habitat suitability for walleye (*Stizostedion vitreum*) and possible species interactions with salmonid fishes. Completion Rep. for Idaho Water and Energy Resources Research Institute. Res. Tech. Compl. Rep. G839-07. Moscow, Idaho.
- Bjornn, T.C., and J.D. McIntyre. 1985. Anadromous fish research planning, Task 4: Review of research issues. Final Rep. to The Northwest Power Planning Council, Portland, Oregon.
- Bjornn, T.C., J.L. Congleton, R.R. Ringe, C.M. Moffitt. 1985. Survival of chinook salmon smolts related to stress at dams and smolt quality, 1984. Tech. Rep. 85-1 Idaho Coop. Fish and Wildlife Res. Unit. 25 pp.
- Bjornn, T.C. 1986. A model for predicting production and yield of salmon and trout as related to land management practices. Idaho Coop. Fish and Wildl. Res. Unit Tech. Rep. 86-1. Univ. of Idaho, Moscow.
- Bjornn, T.C., J.L. Congleton, and R.R. Ringe. 1986. Survival of Chinook salmon as related to stress at dams and smolt quality, 1985. Idaho Coop. Fish and Wildl. Res. Unit Tech. Rep. 86-2. Univ. of Idaho, Moscow.
- Brower, L.P., B.E. Horner, M.A. Marty, C.M. Moffitt, and B. Villa-R. 1985. Mice (*Peromyscus maniculatus*, *P. spicilegus* and *Microtus mexicanus*) as predators of overwintering Monarch butterflies (*Danaus plexippus*) in Mexico. *Biotropica* 17:89-99.
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Agency and Funding Support

Abbott Labs
Agency for International Development
AID Bureau for Science and Technology
Alaska Fish and Game Department
American Fishing Tackle Manufacturing Association
American Forest Institute
Bennett Lumber Company
Boise Cascade Corporation
Boise National Forest
Bonneville Power Administration
Champion Timberlands
Clearwater National Forest
Clearwater - Potlatch Timber Protective Association, Inc.
Cocolalla Lake Association
Colville Confederated Tribes
Consortium for International Development
Crown Zellerbach
Curt Berklund
Diamond International Corporation
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Environmental Protection Agency
Flathead National Forest
Glacier National Park
Government of Honduras
Idaho Department of Fish and Game
Idaho Department of Health and Welfare
Idaho Department of Parks and Recreation
Idaho Department of Lands
Idaho Fish Food Industry
Idaho Forest Industries
Idaho Nuclear Energy Commission

Idaho Power Company
Idaho Potato Commission
Idaho Research Foundation, Inc.
Idaho Water Resources Board
Idaho Water Resources/Research Institute
Inland Empire Paper Company
Inland Empire Tree Improvement Cooperative
Inland Northwest Growth and Yield Cooperative
International Society of Arboriculture
Mardel Labs, Inc.
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National Science Foundation
National Wildlife Federation
Nature Conservancy
North Idaho Forestry Association
Pacific Northwest Power Company
Pack River Lumber Company
Payette Lakes Water & Sewer District
Payette National Forest
Potlatch Corporation
Rust International Corporation
South Idaho Forestry Association
Stillinger Trust
St. Regis Paper Company
The Wildlife Society
U.S. Army Corps of Engineers

USDA Cooperative Research
USDA Extension Service
USDA Forest Service, Intermountain Forest and Range Experiment Station
USDA Forest Service, Northeastern Forest Experiment Station
USDA Forest Service, Pacific Northwest Forest and Range Experiment Station
USDA Office of International Cooperation and Development
U.S. Department of Commerce
U.S. Department of Energy
USDI Bureau of Indian Affairs
USDI Bureau of Land Management
USDI Bureau of Reclamation
USDI Fish and Wildlife Service
USDI National Park Service
U.S. Department of Navy/Naval Undersea Center
University of Idaho Experimental Forest
University of Idaho Forest Nursery
University of Maine
University of Minnesota
University of Montana
University of California
University of Washington
Washington State Department of Natural Resources
Washington State University
Washington Water Power Company
Western Forestry and Conservation Association
Weyerhaeuser Company
Wildlife Management Institute

Fiscal Year 1986 Financial Picture

Research expenditures, shown by funding source, totaled \$5,158,000 for the Fiscal year 1985-86.

	SOURCE	AMOUNT	PERCENTAGE OF TOTAL
GRANTS AND CONTRACTS _____			30.9%
	Federal Appropriations	\$ 278,000	5.4%
	Miscellaneous Research***	365,000	7.1%
	State Appropriations**	1,375,000	26.7%
	Research Funding Support*	1,545,000	29.9%
	Grants and Contracts	1,595,000	30.9%
	TOTAL	\$5,158,000	100.0%
RESEARCH FUNDING SUPPORT* _____			29.9%
STATE APPROPRIATIONS** _____			26.7%
MISCELLANEOUS RESEARCH*** _____			7.1%
FEDERAL APPROPRIATIONS _____			5.4%

*Includes overhead allowances, external matching, outside federal unit support, and external cooperative research support.

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

***Includes Forest Nursery, Experimental Forest, Idaho Research Foundation, Taylor Ranch and Clark Fork Field Campus

DIRECTOR'S MESSAGE

John C. Hendee

The Idaho Forest, Wildlife and Range Experiment Station is the coordinating unit for the College's research program, including all the natural resource topics with which the College is concerned: forest products, forest resources, wildlife, fisheries, range, wildland recreation management and tourism. This breadth of renewable resource research is a strength of our College, adding to its distinction as one of the leading natural resource schools in the nation.

*Last year, a major activity in the College was planning, as we completed a strategic plan for the future in a process called a "Quest for Excellence," or Q4E. In that process, each Department's faculty identified the broad areas on which they would focus based on their **capabilities to excel**, anticipated **future need** in their fields, and the **feasibility** of accomplishment considering such things as support and funding. College-wide, 15 quests were identified; many of them include specialized areas of emphasis under a broader designation. For example, one of our specialties, forest regeneration, is included under the broader Quest for Excellence in "Silviculture of Northern Rocky Mountain Forests," in the Department of Forest Resources.*

Last year, we also strengthened constituent involvement through establishment of a Forest Research Nursery Advisory Committee and a College Guidance Council, with members representing our full range of natural resource interests. The advice of these groups is helping make our research program more timely and relevant. This year, we will be giving emphasis to operating plans and management of facilities that help support our research program, including the Clark Fork and McCall Field Campuses, the Experimental Forest, the Forest Nursery, the Taylor Ranch Field Station and the Lee A. Sharp Experimental Area. The overall objective is to strengthen these operations as important support units of the College and the Idaho Forest, Wildlife and Range Experiment Station.

*Traditionally, the Idaho FWR Experiment Station report, **Focus**, highlights research in one of the Departments. This year, the Department of Wildland Recreation Management is emphasized. The Department's Quests for Excellence include Wilderness Management and Natural Resource-Based Tourism. The Department also provides leadership for a College-wide Quest for Excellence in "Natural Resource Communications."*

Established in 1974, the Department of Wildland Recreation Management remains the smallest of the College's five Departments, but has established a national reputation for the quality of its teaching, research, and service, as recognized this past year when three Department faculty were requested to prepare special background papers for the President's Commission on Americans Outdoors.

In Wilderness Management, the Department has attained truly national excellence by hosting, in 1983, the first National Conference on Wilderness Management. The following year, the Department published the first National Wilderness Management Plan, an effort growing out of the National Conference and including participation by all the federal wilderness managing agencies. This year, Dr. Ed Krumpe, Director of the College Wilderness Center, was named Chairman of the newly-formed Society of American Foresters Task Force on Wilderness Management. A key asset to the Department's wilderness management teaching and research is the Taylor Ranch Field Station in the middle of the Frank Church-River of No Return Wilderness. Taylor Ranch, widely known for wilderness wildlife studies such as Maurice Hornocker's cougar research, figures prominently in future plans for studies of natural ecosystems.

The Department's focus on natural resource tourism was featured the past two years in the Idaho Travel and Tourism Institute, a week-long course we offered for owners of small travel and tourism enterprises in Idaho and the Inland Northwest. This year, the Department also provided staff assistance to the Governor's Task Force on Idahoans Outdoors and began the first state-wide study of the economic importance of tourism in Idaho to develop information for guiding this fast-growing industry.

*The College takes pride in a balanced, data-based and reasoned approach to renewable resource issues. During the past year, College experts have been called on for information to help improve land management for all the renewable resource interests, their industries, and related economic enterprises. We are emphatic in our search for balance and our belief that **Idaho and the Northwest need to make the most of all our natural resources in combination, and not emphasize one use at the expense of others.** This is especially important in the Department of Wildland Recreation, where our programs emphasize recreation as the natural resource economy and not a replacement for basic renewable resource industries.*

*I hope you enjoy this year's **Focus**. Let us hear from you. We would like your views on how our programs and information can serve you better.*

John C. Hendee



University
of Idaho

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