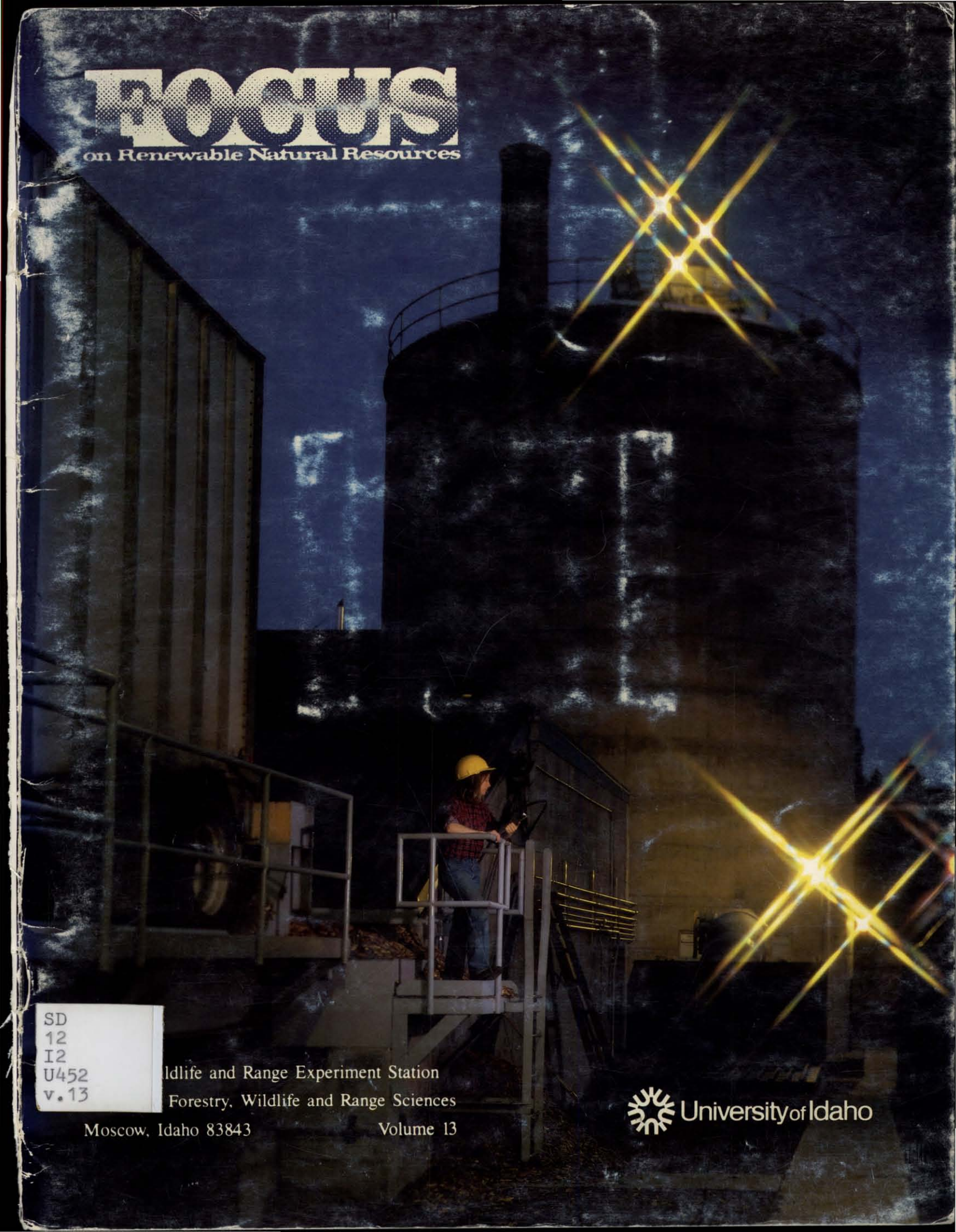
FOCUS

on Renewable Natural Resources



ldlife and Range Experiment Station
Forestry, Wildlife and Range Sciences
Moscow, Idaho 83843 Volume 13

University of Idaho

From the Associate Director

In the past, the Idaho Forest, Wildlife and Range Experiment Station's annual report—*Focus*—has examined individual projects conducted by scientists in the college's five departments: Forest Resources, Range Resources, Forest Products, Fish and Wildlife Resources, and Wildland Recreation Management.

This year, we're extending our focus, by examining the facilities, communications outlets, and special research units and cooperatives that support and extend individual research projects and connect the college with people, places, organizations, and agencies throughout the state and sometimes throughout the nation.

Consider our facilities for teaching and research. They stretch from the Clark Fork Field Campus near the tip of Idaho's Panhandle to the Lee A. Sharp Experimental Area in southern Idaho's sagebrush grasslands. For more than 30 years, research on the range experimental area has helped southern Idaho ranchers to use the range for the benefit of both this-year's beef and the future health of the range. Our Taylor Ranch Field Station in the Frank Church-River of No Return Wilderness is the nation's only university-run research station set in a congressionally designated wilderness. Our college nursery and experimental forest combine research and teaching with full-scale operations—and permit us to conduct research and cultivate young professionals that respond to real world demands.

Special research units and cooperatives housed in the college link us with other universities, public agencies, and private businesses. A major source of research depth and strength, units such as the Intermountain Forest Tree Nutrition Cooperative and the Inland Empire Tree Improvement Cooperative allow cooperators to share vital resources and produce research products at lower cost. They also support more than 50 of the college's graduate students.

For example, the Idaho Cooperative Fish and Wildlife Research Unit brings three full-time federal researchers to our college—researchers who guide our graduate students and teach graduate courses. During 1987, the unit's researchers applied themselves to 35 research projects and supervised 23 graduate students.

In our cooperative extension programs, extension personnel in range and forestry ensure that the results of research reach the intended beneficiaries—ranchers and forest landowners.

Our publications office and continuing education and outreach programs connect university-generated knowledge with a wide range of users. During 1987 alone, continuing education and outreach programs reached some 2,500 natural resource professionals and members of the public.

This issue of *Focus* does not depart entirely from tradition. As in the past, we include research highlights from each of the college's departments and lists of publications, research projects, theses and dissertations, continuing education and outreach offerings, and support and funding data. A new director's score card reports our productivity from 1985 to 1987.

I hope you enjoy this year's *Focus*.

Leon F. Neuenschwander

FOCUS

Volume 13 May, 1988

College of Forestry, Wildlife and Range Sciences

Teaching
Research
Service

University of Idaho

Idaho Forest, Wildlife and Range Experiment Station

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Cover: A chip truck backs onto a combined scale/hydraulic lift in this early evening scene at the UI Power Plant captured by photographer Gerry Snyder. The concrete storage silo at center holds some 21 truck loads of wood wastes, known as "hog fuel," hauled from northern Idaho mills. Inside the plant, a new 60,000-pound wood boiler for heating the university campus is also a full-scale laboratory for studying the relationships between wood fuel and combustion efficiency. The story begins on page 7.

1987 Annual Report

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Cooperative Extension

Communications

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Facilities

Experimental Forest

As one views the forested slopes of Moscow Mountain from a distance, they appear to be just that: forested. A closer inspection reveals a system of roads leading to and through selection cuts, seed-tree cuts, shelterwood cuts, and clearcuts. The visitor also finds natural areas; stands of various species, ages, and conditions; fenced and open areas; and grazed and ungrazed forests and meadows. An even closer look reveals trees with metal tags, plot stakes and photo points, informational and directional signs. The visitor may encounter graduate students, faculty members with their various classes, or members of the student logging crew. The University of Idaho Experimental Forest is a busy place.

The land for the experimental forest was acquired largely during 1932 to 1936 through donations from Forest Development Company, now a part of Potlatch Corporation. Other purchases and donations have resulted in a 7,200-acre area dedicated to teaching, research, demonstration, public use, and production.

The forest's terrain varies from gently rolling to steep, all dissected by draws and intermittent streams. Habitat types range from the dry Douglas-fir to the cold and moist subalpine fir. Turn-of-the-century logging has resulted in a mosaic of stands. Big game and other wildlife find the variable stand conditions to their liking. White-tailed deer are abundant, and mule deer, elk, moose, mountain lions, and black bears also inhabit the forest.

During 1987 the forest was the site of 16 research projects. A project on the management of mixed conifer stands for fuelwood will help landowners better manage their woodlots for fuelwood and for increased sawtimber production. A cattle grazing study is looking at the effects of length and timing of cattle grazing on post-burn site productivity. The results of an herbicide project will help silviculturists and forest landowners determine when and where to use forest herbicides for site preparation and conifer release.

Student use of the experimental forest is constantly increasing. Most visible is the student logging crew. Each year seven to ten students from the college help manage and harvest up to 2 million board feet of sawtimber. Student loggers assist in the layout, harvest prescriptions, and timber marking, then conduct timber harvests by falling, skidding, and bucking the timber into sawlogs. Students also do the slash disposal, prescribed burning, resource inventories, general facilities maintenance, and tree planting. In 1987, 26 student employees performed 12,000 hours of labor on the forest. In addition to the "hands-on" work, students in a wide variety of classes visit the forest for laboratory and field trips. An example is Low Volume Roads, a class whose field project includes the layout and design of a forest road.

Harold Osborne

Members of the Experimental Forest's student logging crew help to harvest some 2 million board feet of sawtimber each year.

In 1987, the experimental forest served as a focal point for local ranchers, landowners, and elected officials who came to view management activities, especially new forest plantations, and to discuss and dispute the legal and ecological issues of open range. On a less controversial note, 230 boy scouts, leaders, and parents spent a weekend at the forest for the Boy Scout Camporee. Formal trips also were conducted for tree farmers, students, and others, and the forest hosted Community Forestry Day, when local foresters met the public to view and discuss forest management activities and practices.

The general public uses the experimental forest for a wide variety of recreational activities that include hunting, hiking, cross-country skiing, and other day-use activities. So, what appears at a distance to be just trees is much more: The experimental forest is an outdoor laboratory for students and faculty, a demonstration and research area for the state of Idaho, and a recreation area for the people of Latah County and adjacent areas.

Harold Osborne

Forest Research Nursery

During 1987, the Forest Research Nursery expanded, adding one new greenhouse and increasing production by 240,000 seedlings. Income from seedling sales funds the nursery's operations and research projects, which together employ 20 to 30 students each year. "The nursery's goal," said Nursery Manager David Wenny, "is to serve the region as a center for research and teaching excellence in the areas of seedling-nursery production technology and forest regeneration."

Gerry Snyder

Nine-month-old ponderosa pine seedlings surround Nurseryman Kenneth Quick and Tree Packer Gary Asbridge. During 1987, 750,000 conifer and hardwood seedlings were grown in containers at the Forest Research Nursery. Seedling sales fund the nursery's extensive research program.

The nursery's three greenhouses now produce more than 750,000 containerized seedlings annually. About 450,000 seedlings are grown for the Idaho Department of Lands and local forest industry. The rest are planted by private landowners throughout the state in windbreaks, shelterbelts, and other conservation plantings.

"Now that we've demonstrated our ability to produce quality containerized seedlings, we're sharing our expertise with nursery operators and foresters all over the Pacific Northwest and expanding our research program to better meet their needs," said Wenny, associate professor of forest regeneration.

Currently the nursery staff and graduate students are involved with 24 research projects. Research includes studies in seed physiology, seed stratification, fertilization, seedling stress physiology, seedling disease, root and bud development, chemical root pruning, container design, hybrid poplar culture, and studies in micropropagation of several conifer and hardwood species in a new biotechnology laboratory.

In the nursery's micropropagation facility, test tubes filled with agar replace styroblocks filled with peat and vermiculite for growing tiny new plants. Ph.D. candidate Carol Stiff and her fellow researchers in the unit use tissue culture techniques to grow seedlings from needle fascicles, shoot tips, and other plant parts. Such asexual methods allow researchers to grow trees with the same desirable genes as their single parents, genes such as those producing resistance to white pine blister rust or herbicides.

In 1987, research at the nursery resulted in nine publications helpful to nursery operators (e.g., "Germination of Conifer Seeds Surface Sterilized with Bleach"), and to landowners (e.g., *How to Plan, Plant, and Care for Windbreak, Reforestation, and Conservation Plantings*). Wenny and Research Associate R. Kasten Dumroese this year published the first two articles in a series of growing regimes that eventually will cover all 14 conifer and 13 hardwood species grown at the nursery.

Because the nursery is both a research and production facility, research results are directly applicable to the commercial nursery industry. "Our direct relationship with the forest industry also means that we get feedback on how to improve seedling quality, storage, handling, and planting practices," said Wenny.

In addition to writing publications, Wenny and his coworkers share their expertise through presentations, workshops, continuing education classes for professional foresters, and direct contacts with seedling growers and foresters. A Nursery Advisory Committee formed in 1986 furthers communication between the forest nursery and

other northern Idaho nurseries. This group of private, state, and federal nursery owners and foresters meets with college personnel twice each year to discuss mutual interests and concerns.

"The College of Forestry is unique among U.S. forestry schools in having an operational nursery," said Wenny. "Our students in nursery management and forestry gain knowledge from practical experience, giving them a head start over students trained at other schools." Wenny's students come from as far as India, China, Chile, and Honduras to acquire nursery skills.

Wenny's greenhouse staff includes Greenhouse Technician Kenneth Quick, Nursery Technician Mark Montville, Research Associate R. Kasten Dumroese, and Assistant Nursery Manager John Edson. In addition, five master's and three doctoral students are under Wenny's direction.

Wenny's students benefit not only from their own nursery experience, but from the practical and research experience Wenny brings to his nursery management and forest regeneration classes.

Teaching, research, and production: these, said Wenny, are keys to the nursery's continued success as a regional hub for the nursery industry.

David Wenny and Focus *staff*

More than 8,000 acres of southern Idaho rangeland bear the name of Professor Lee A. Sharp.

Lee A. Sharp Experimental Area

The Lee A. Sharp Experimental Area, located in extreme south-central Idaho about 30 miles south of the city of Burley, has for almost 35 years been dedicated to livestock grazing studies related to crested wheatgrass. The area consists of 12 80-acre experimental pastures, a 100-acre holding pasture, and about 7,000 additional acres used in extensive grazing trials.

The origins of the experimental area are found in halogeton, a poisonous weed that moved into western rangelands in the 1930s and 1940s, threatening their usefulness for grazing. In response to the halogeton threat, the Bureau of Land Management (BLM) began planting crested wheatgrass—a hardy perennial imported from Asia in the 1890s. The idea was to control halogeton not by spraying it with chemicals, but by putting it up against a tougher competitor.

The crested wheatgrass proved an effective halogeton control. In that respect, the exercise succeeded. But little was known of the crested wheatgrass itself. How effective would it be for grazing? What were the best strategies for managing it?

Lee A. Sharp, then assistant professor of range resources, felt the questions sufficiently compelling that, in the early 1950s, he and colleagues in the College of Agriculture circulated among University of Idaho officials, southern Idaho ranchers, and BLM officials, selling the need for a long-term study of crested wheatgrass.

He was persuasive. In 1954, the university, the BLM, and the Point Springs Grazing Association initiated a memorandum of understanding creating the Point Springs Range Experimental Area. The BLM provided the land—960 acres planted to crested wheatgrass in the agency's Burley District—and shared with the university the cost of buildings, water troughs, fencing materials, and other improvements. The ranchers of the Point Springs Grazing Association provided the livestock and defrayed the costs of fence maintenance and water troughs.

The experimental work began that year with Sharp's two-year study to test three grazing intensities.

Since then, the research area has grown to encompass over 8,000 acres. The additional land was provided by the BLM and by cooperating ranchers who became convinced of the value of the work done there.

Indeed, some of the ranchers have attributed their remaining in business to the work done on the experimental area. Studies show that applying the findings of the grazing research has doubled the area's grazing capacity. And looking back, a BLM official declared that "we had crested wheatgrass then [early 1950s], but we didn't know how to manage it. Lee came in and showed us how with his experiments."

The grazing studies begun, and still being directed, by Lee Sharp at Point Springs may well constitute one of the longest-running research projects now extant anywhere. Over the past 34 years, the work done there has provided rangeland management strategies currently used throughout the Intermountain Region as well as a unique record: over 30 years of seasonal livestock weights, 15 years of forage production and utilization data, a 34-year photographic series of grazing-land succession.

Over the years the area has helped to train a number of graduate students. In addition, numerous undergraduate students have spent summers at the range area, helping with forage studies and cattle weighing.

In 1984, on the occasion of the area's 30th anniversary, Sharp was lauded by BLM Director Robert Burford and received a letter of commendation from Secretary of the Interior William Clark. And, fittingly, since Sharp had become virtually synonymous with crested wheatgrass and the Point Springs Range Experimental Area, the area officially was renamed the Lee A. Sharp Experimental Area.

Today some 1.5 million acres of western rangelands have been seeded to crested wheatgrass. Current research projects at the experimental area address a multitude of range management concerns including animal-mineral relationships, salt consumption, forage nutritive value, forage digestibility, soil compaction, water infiltration, animal behavior, the economics of range improvement, land rehabilitation, combating sagebrush invasion, livestock breeding, and alternative range plant species.

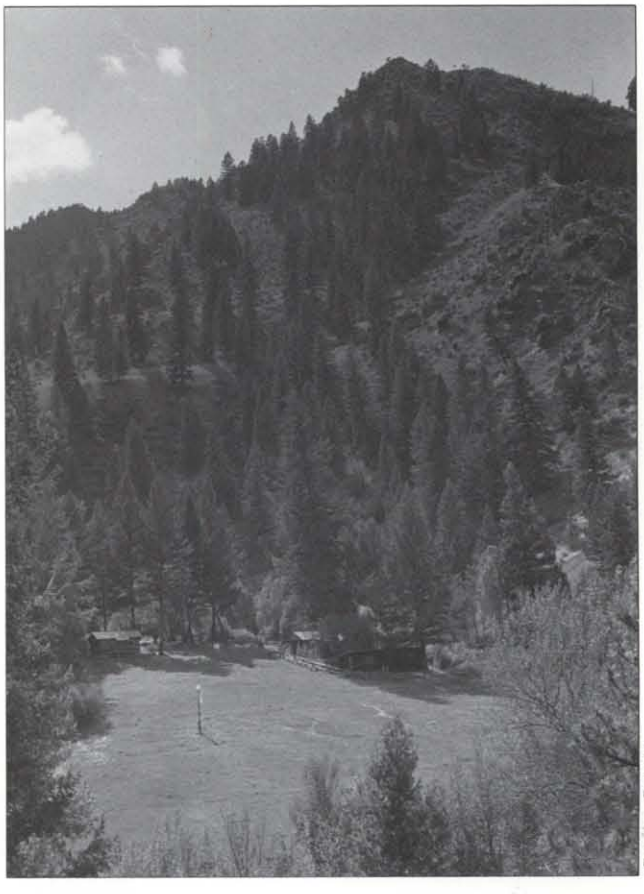
But what is particularly special about the Lee A. Sharp Experimental Area is neither research results nor longevity. It is that few research projects have so intimately united a university, public agencies, and private citizens in working toward a common goal. Said University of Idaho President Richard Gibb, "This is the kind of service, education, and cooperation that land-grant universities were established to do, and we need to do more of it."

Lee A. Sharp and Focus *staff*

Taylor Ranch Field Station

There's a special place in Idaho's Salmon River country, down the Middle Fork, up Big Creek, where there's no electricity, no gasoline engines (except for the weekly mail plane), where firewood is hand bucked and mule-back hauled, and the loudest noise is usually the background mumble of Big Creek. This place is neither retreat nor resort, but indeed a place of confrontation, a place where scientists seek to unlock nature's elusive secrets. This place is Taylor Ranch Field Station, operated by the University of Idaho's Wilderness Research Center, and located literally in the heart of the Frank Church-River of No Return Wilderness.

Taylor Ranch has a special past, too. Its modern history begins in 1875, when U.S. Army scout Dave Lewis rode into the Big Creek country with a U.S. Cavalry detatchment sent to "pacify" the Sheep Eater Indians. He survived a skirmish, liked the country, and returned five years later to stay for 55 years more and to create the legend of



George Savage

Since the 1960s, Taylor Ranch has been a base for university researchers in the Frank Church-River of No Return Wilderness.

"Cougar" Dave, outfitter, guide, and renowned lion killer. In 1924, Lewis patented the 65 acres of Taylor Ranch. That's Chapter One.

Chapter Two opens in the early 1930s, when Jess Taylor, hunting the Big Creek drainage, met Lewis, then 92. The two struck up a friendship, and Taylor purchased from Lewis the parcel of land that bears his name. Eventually, Jess and Dorothy Taylor moved from Boise to Big Creek, scraped out an airstrip, and started their own outfitting/guiding operation. End of Chapter Two.

Chapter Three begins in the mid-1960s. Maurice Hornocker, then a Ph.D. student at the University of British Columbia, came into Big Creek country to conduct a four-year mountain lion research project. He rented part of Taylor Ranch for his headquarters, and he and an aging Jess Taylor became good friends. When Taylor eventually mentioned selling the ranch, Hornocker suggested that the University of Idaho would be the ideal purchaser.

In 1969, the university did purchase Taylor Ranch and became the proprietor of a unique laboratory and headquarters for wilderness research. That's Chapter Three.

Hornocker is now a UI professor of wildlife resources, director of the UI Wildlife Research Institute, and an internationally known wildlife scientist. His Taylor Ranch lion study changed profoundly the perception of the big cats. Once considered "varmints" and hunted without restriction, even for bounties, the mountain lion was shown to be an integral and significant member of its ecosystem.

Chapter Four—just begun: Today, Taylor Ranch Field Station, managed year-round by James and Holly Akenson and directed by Edwin Krumpe of the Department of Wildland Recreation Management, has been the headquarters for a variety of wilderness-related research projects. Hornocker himself conducted a four-year bobcat and coyote study through the early 1980s. A behavioral study of bighorn sheep continues.

Not all Taylor Ranch studies are wildlife centered. Professor Frank Leonhardy of the UI Anthropology Department has for several years been involved in a major study of the Sheep Eater Indians. Several years ago a study focused on the artifacts of early settlers. Others have addressed ethnobotany and plant communities.

Upcoming studies will involve using the Taylor Ranch as a base for determining the effects of recreational use on wilderness, for analyzing area water quality, and for studying natural fire as a forest management tool. The area will also be used as a comparison environment in acid rain studies.

It may be as a comparison environment that Taylor Ranch will find its greatest research significance. "Wilderness is a balanced, healthy system," says Hornocker. "It provides a baseline for evaluating land condition—not just in terms of wildlife, but soils, water, fish—you name it. It's the ideal outdoor laboratory against which we can measure the effects of our activities in nonwilderness environments."

Although it's always hazardous to toss around the word "unique," it seems safe enough to apply it to Taylor Ranch, a resource found nowhere else: a permanently staffed wilderness field station squarely in the heart of a designated wilderness area.

Wilderness Research Center

Taylor Ranch is administered through the University of Idaho Wilderness Research Center, established in 1972 and headquartered in the College of Forestry, Wildlife and Range Sciences. The center's purpose is to administer and unify wilderness-related research and to encourage research and educational programs that lead to a better understanding of the structure and function of natural ecosystems and of our relationship to them.

Taylor Ranch is the subject of a new, award-winning video program, "Taylor Ranch: America's Wildest Classroom." Produced at the university, the program is scheduled to air over Idaho public television during 1988 and can be borrowed from the Wilderness Research Center.

The Wilderness Research Center also sponsors the annual Wilderness Resource Distinguished Lectureship, which, since its inception in 1977, has brought to the campus such speakers as the late Senator Frank Church, Idaho Governor and then Secretary of the Interior Cecil D. Andrus, and, most recently, Jay D. Hair, President of the National Wildlife Federation. Edwin Krumpe, associate professor of wildland recreation management, is the center's current director.

Edwin Krumpe and Focus *staff*

McCall Field Campus

A cool lakeshore breeze, the smell of pine forests, log cabins, and a rustic log dining lodge make one feel far from the halls of academe, yet the McCall Field Campus plays an important role in educating natural resource students. Since 1940, students from the College of Forestry, Wildlife and Range Sciences have come here for Forestry Summer Camp—a summer's study of forestry in the field.

Shaded by old ponderosa pines on the shore of Payette Lake, the 11-acre University of Idaho field campus was

inaugurated in 1940 on state endowment lands under a permit from the Idaho Department of Lands. In 1984, the easement was changed to a lease, and restrictions limiting use to summer camp only were removed.

Since then, the college has stepped up its use of the field campus. Activities now include continuing education courses for natural resource professionals, enrichment programs for the public, and Elderhostel programs for senior citizens. The college also welcomes use by organizations outside the college.

Over the years, Forestry Summer Camp changed in duration and content and now is a four-week wildland ecology course open to students from the college and from other schools. Its field trips take students to the parched walls of the Snake River's Hell's Canyon and to subalpine forests high in the national forest surrounding McCall.

College faculty continue to use the campus as a base for research. Recent research focuses on the effects of nitrogen fertilizers on the growth of Douglas-fir.

Increases in use prompted the college to hire the campus's first on-site manager, Walter Dunn, in 1987. Also during 1987, more than 300 people attended programs at the campus. At Elderhostel, senior citizens enjoyed a week of botanizing, wildlife identification, and nature photography. In another program, high school teachers from all over the state learned fish and wildlife ecology.

Wilderness Quest, an Outward Bound-type retreat directed by graduate student James Tangen-Foster, helped under-achieving University of Idaho students to reach their potential. Also during 1987, federal and state agencies used the campus for short courses and conferences, Forest Service fire fighters received food and lodging, and local citizen's groups held meetings.

During 1988, the college will continue to host wildland ecology and Elderhostel and will offer its first year of Enrichment Series courses. These will be one- to two-day courses for the public on such diverse topics as urban forestry, birds of prey and the peregrine recovery program, mushroom identification, lake and stream ecology and management, increasing human effectiveness, landscape watercolor painting, the geology of McCall and central Idaho, and wildland photography. Another new series will present the college's findings on Idaho's future timber supply and on tourism in Idaho.

Walter Dunn

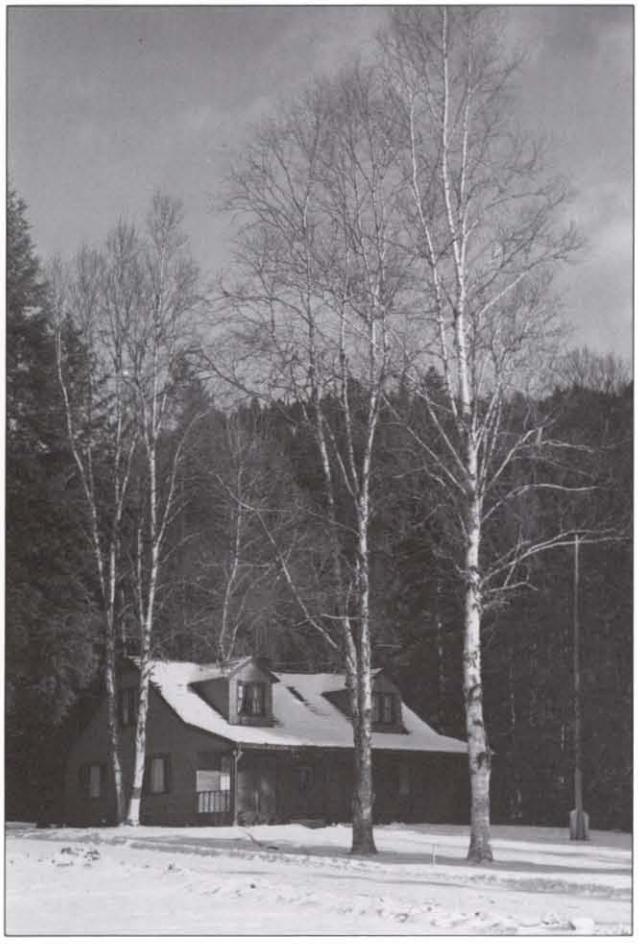
Clark Fork Field Campus

The ten-acre Clark Fork Field Campus is tucked into the Idaho Panhandle National Forests near the town of Clark Fork. Scotchman Peak, tallest in the county, forms a 5,000-foot backdrop for the campus's lawns, flower beds, native trees, year-round creek, and wooden buildings—the oldest built in 1937 by the Civilian Conservation Corps.

The campus was until 1973 a Forest Service ranger station. Leased by the University of Idaho in 1980, the College of Forestry, Wildlife and Range Sciences now manages it as a center for education, research, conferences, retreats, and service to the people and communities of northern Idaho.

Old ponderosa pines shade the lakeside McCall Field Campus—site of the summertime Wildland Ecology class and programs for natural resource professionals and the public.

Beverly Jaquish



Kenneth Kinucan

Built by the CCC, the administration building at the Clark Fork Field Campus houses an office, nature center, and guest rooms.

During 1987, the campus offered its fifth consecutive year of one- to two-day weekend classes for the public. Taught mainly by university faculty, the 1987 Enrichment Series attracted hundreds of participants—aged eight to eighty—who gained new knowledge and skills in fly tying, waterfowl identification, songbird identification, spring and fall mushroom identification, ethnobotany, the prehistory of the Northwest, big game, geology and fossil collecting, and forest insects. All courses were well attended, and most had waiting lists.

Wild Country Botanizing, a week-long Elderhostel led by the college's faculty, attracted 40 people older than 60 from all over the United States.

Drawn by the campus's facilities and by nearby creeks, lakes, meadows, thick forest, and habitat for deer, elk, weasels, waterfowl, and other wildlife, local schools use the campus for outdoor education programs. During 1987, Clark Fork Junior and Senior High School held a two-day outdoor education session attended by 110 students, and several area elementary schools held overnight outdoor education programs.

The campus is growing in popularity among local citizen's groups, such as girl scouts, boy scouts, women's clubs, and chambers of commerce, who use the buildings and grounds for meetings and projects. The campus also hosts retreats for university groups and for agencies such as the Idaho Department of Fish and Game.

Campus buildings include an administration building that contains an office, small nature center, and guests rooms; two dormitories sleeping 40; a classroom seating 50; maintenance buildings; and three small houses, one occupied by full-time Campus Manager Kenneth Kinucan.

In the future, Bonner County schools plan to use the campus for county-wide, week-long outdoor education programs for all sixth graders. The Enrichment Series and Elderhostel will continue to bring the faculty's expertise to the public. Short courses will be offered for academic credit, such as Interpersonal and Communication Skills for Resource Professionals, scheduled for 1988. Other plans include state and nationwide promotions to attract conferences, retreats, and workshops for students and professionals.

Kenneth Kinucan and Focus *staff*

Wood Boiler

In 1987, the University of Idaho installed a 60,000-pound wood-fired boiler to heat the University of Idaho campus. Each winter day, the boiler burns some eight truckloads of wood wastes hauled from North Idaho mills. For members of the Forest Products Department, the boiler has become a full-scale research laboratory for studying the relationships between wood fuel and combustion efficiency.

Because of local availability and low price, wood residue or ''hog fuel'' is an attractive Idaho alternative to heating with gas or oil. But problems and high costs associated with storing and with efficiently handling and burning hog fuel have limited the number of wood-burning facilities.

Inconsistencies in the fuel's moisture content and particle size pose particular problems. Hog fuel may range in size from very fine dust to four-inch-long chunks. Half of its total weight will often be water. Because fuel-handling and preparation equipment constitute a significant investment, systems smaller than those at forest products plants often cannot be economically justified.

Researchers are translating these problems into research opportunities. For example, research into preliminary drying and sorting of hog fuel could result in an industry that

sizes and dries hog fuel for use by smaller facilities such as high schools and hospitals.

University-funded projects begun in 1987 include ones on (1) the effects of fuel moisture and fuel drying on the value of hog fuel, directed by Associate Professor Peter Steinhagen; (2) the impact of fuel characteristics on boiler and combustion efficiency, directed by Associate Professor Alton Campbell; (3) the impact of wood fuel variables on emissions, directed by Associate Professor Thomas Carleson of the College of Engineering; (4) the production of wood biomass from Idaho hybrid poplar, directed by Associate Professor David Wenny of the Forest Resources Department; and (5) the development of a computerized data base and decision model to guide selection of wood fuel alternatives, directed by Professor Leonard Johnson.

Delays in start-up and continuous firing of the boiler during 1987 delayed progress on the projects, but initial procedures and methods were developed. In addition, pre-firing data on Moscow's air quality were collected, and will be used to determine the impact of the boiler on airborne particulates.

Diane Noel

Inclined on a hydraulic lift, a chip truck dumps hog fuel at the university's power plant. Wood fuel stored in the silo at left eventually will burn in the 60,000-pound wood boiler.

Other wood-energy projects underway in the Forest Products Department include a study of options for recovery and processing of logging residues and previously noncommercial timber and an analysis of wood pellet production and use in home and industrial heating. The college's projects in wood energy have involved seven graduate students and three undergraduate students.

Results of wood fuel projects are being shared with industry and agency personnel through publications and oral presentations.

Currently, five formal proposals in areas ranging from the micropropagation of plants to the environmental impacts of biomass removal from forest sites are pending with various state and federal agencies. These and continuing research efforts should allow the state of Idaho to continue on a road toward more self-sufficiency in energy and perhaps even allow the state to become a net energy exporter.

Leonard Johnson

Natural Resources Communication Laboratory

A decade ago the College of Forestry, Wildlife and Range Sciences established what is today one of the most capable and well-known natural resource media laboratories in the nation. Known best for its slide/tape productions, the lab equips present and future natural resource managers with the ability to use a wide range of electronic and photographic media.

The Natural Resources Communication Laboratory began informally, in a cramped 6- by 20-foot room where Wildland Recreation Management Associate Professor Sam Ham taught his environmental interpretation students the skills of audio recording, special effects photography, and multi-media programming, often with his own equipment. With the support of then Department Head James Fazio, Ham gradually added more and better equipment, purchased with the proceeds from slide/tape programs he and his students produced for external organizations.

In 1987, the college officially recognized the lab and hired former wildland recreation management student Robin Hartmann as its first full-time manager.

The lab has three primary roles, teaching, research and technology transfer, and service. First is teaching. Each year, the 30 to 40 students enrolled in Ham's interpretation classes receive practical instruction and hands-on experience

producing slide/tape programs and soundtracks. Some advanced students develop programs under contract to various external agencies. Others develop advanced expertise by working as lab assistants.

In the area of research and technology transfer, the lab has produced more than 40 slide/tape programs on such topics as silviculture, fire management, wildlife management, recreation psychology, and plate tectonics. And in increasing numbers, the college's researchers contract with the lab to produce programs that will disseminate research results and inform constituent groups.

In its service role, the lab assists external organizations and citizen groups and is open to the college's students and faculty who wish to prepare their own visuals and audio recordings.

During just the second half of 1987, the lab completed a slide/tape program reporting the results of a three-year Idaho tourism and outdoor recreation survey to legislators in Boise. It produced an instructional videotape for the National Park Service, directed by Associate Professor Gary Machlis, that will explain a visitor-mapping research procedure to park rangers all over the United States. Another video program, directed by Associate Dean Leon Neuenschwander, was produced for use by college administrators before the state legislature's Joint Finance and Appropriations Committee. The lab also started production of a slide/tape program and companion materials to describe grizzly bear research in the Bitterroot Mountains.

In the summer of 1987, the lab added a new audio mixing console, microphone, recording studio, and additional slide storage facilities. In 1988, Ham and Hartmann will install a computer-assisted slide filing and retrieval system, a computer-generated graphic system, and an enhanced system for copystand photography. Workshops covering practical considerations in slide presentations are planned for faculty and graduate students, and several contracts for slide/tape productions are being negotiated with natural resource management agencies.

The lab's philosophy is that natural resource management is easier and more effective when it is carried out in concert with an informed public. Through student training, technology transfer, and public service, Hartmann and Ham feel the lab will make important contributions to the college's mission of leading natural resource management into the next century.

Sam Ham and Robin Hartmann

Robin Hartmann/Judy Strassman

Manager Robin Hartmann (right) oversees day-to-day operations at the Natural Resources Communication Laboratory, begun 10 years ago by Associate Professor Sam Ham.

Research Units & Cooperatives

Idaho Cooperative Fish and Wildlife Research Unit

In a humid laboratory, researcher Christine Moffitt feeds pellets laced with erythromycin to yearling chinook salmon. A potent antibiotic, erythromycin is the most effective drug against bacterial kidney disease—the number one cause of death in hatchery-reared chinook. But because erythromycin lacks federal Food and Drug Administration approval for use in fish, hatcheries can use it only experimentally. Moffitt's work will provide the information on dose and duration of administration that FDA needs to approve the drug.

North in Alaska's Yukon Delta National Wildlife Refuge, graduate student David Budeau has been spending the long days of the arctic spring studying the pre-nesting feeding ecology of white-fronted geese. The white-front is the only arctic-nesting goose thought to acquire important pre-nesting energy reserves from its arctic diet. During the past 20 years, its numbers have fallen by 75 percent. Although many factors are likely contributors to the decline, Budeau's research will clarify factors influencing reproduction.

These are just two of the 35 projects underway in the Idaho Cooperative Fish and Wildlife Research Unit, housed in the Department of Fish and Wildlife Resources. Funded and supported by the U.S. Fish and Wildlife Service, the Idaho Department of Fish and Game, University of Idaho, and the private, nonprofit Wildlife Management Institute, the unit is one of 37 such cooperatives nationwide.

The unit's five scientists, three of whom are full-time U.S. Fish and Wildlife Service employees, conduct research primarily in Idaho and as far away as Hawaii and Alaska. Its objectives are to conduct research on fish and wildlife populations and habitats; to develop modern methods for managing fish and wildlife; and to educate future researchers and natural resource managers. In the process, the unit has trained two generations of graduate students. In 1987, 23 graduate students worked on unit projects.

Unit researchers have a history of tackling long-term research projects. Former Unit Leader Maurice Hornocker's studies of large cats and other predators have spanned nearly a quarter of a century and attracted worldwide attention.

Former fisheries Unit Leader Donald Chapman used artificial streams simulating natural conditions to determine limiting factors for fish of the Pacific Northwest. These and later studies of wild trout populations by unit staff and students are the basis for many of the special angling regulations that maintain or enhance Idaho's native trout and those of other western states.

Continuing studies on the ecology and behavior of the endangered whooping crane by former unit member Elwood Bizeau and cooperator Roderick Drewien at Gray's Lake, Idaho, are at the forefront of endangered species research.

John Ratti

Bundled against the May cold at Alaska's Yukon Delta National Wildlife Refuge, master's student David Budeau observes white-fronted geese feeding on tubers and new shoots some 100 yards from his tent.

For the past 10 years, Research Associate Rudy Ringe has trapped adult fall chinook salmon at the Snake River's Ice Harbor Dam and collected their eggs for Northwest hatcheries. Numbers of this race had declined from an estimated 70,000 fish in the 1800s to a near extinction level of 637 adults swimming up the Snake River in 1984. In 1987, as a result of hatchery releases, 3,000 adults returned to the Snake River.

Other projects underway in 1987 included one on the habitat requirements of a threatened population of Selkirk Mountain grizzly bears, led by graduate student David Volsen, and another on reducing disease mortality in hatchery-reared and wild salmonids, led by Assistant Leader James Congleton and Adjunct Assistant Professor Christine Moffitt.

At the Bear Lake National Wildlife Refuge in southern Idaho, researchers have been helping the U.S. Fish and Wildlife Service decide whether to allow increased sediments and nutrients to drain into the refuge from a Bear River diversion. Led by Assistant Unit Leader Theodore Bjornn, researchers have studied how a variety of management options related to the diversion may affect the refuge's fish, shorebirds, and waterfowl.

A major new research effort, headed by Unit Leader J. Michael Scott, involves using a computerized system of vegetation maps, species distributions, land ownership maps, and maps of existing management areas to assess the adequacy of existing preserves and management areas for sustaining native mammals, birds, reptiles, and other animals into the 22nd century. Cooperating in this work are the Idaho Department of Water Resources, Idaho Department of Fish and Game, and the Idaho chapter of The Nature Conservancy.

Future research efforts by unit personnel will place increasing emphasis on helping managers to anticipate conflicts between natural resources and development—and thus avoid or minimize them. The unit also will continue to meet the needs of natural resource managers in their day-to-day management of fish and wildlife.

J. Michael Scott

Cooperative Park Studies Unit

In August of 1979, the University of Idaho and the National Park Service agreed to sponsor a Cooperative Park Studies Unit housed in the College of Forestry, Wildlife and Range Sciences. The unit is a product of the realization that scientific research is a useful tool for land managers and often essential for sound natural resource stewardship.

The unit is divided into two programs: a sociology program directed by Associate Professor Gary Machlis and a biology program directed by Associate Professor R. Gerald Wright. In parks throughout the Pacific Northwest and in some Rocky Mountain parks, Machlis and Wright participate in and often direct research projects. In many of these projects, graduate students work as full-time research associates. The unit's extension, training, and consultative activities aid national park managers throughout the nation and even across the seas to make sound resource management decisions.

UI Photographic Services

Associate Professors R. Gerald Wright (left) and Gary Machlis lead the Cooperative Park Studies Unit, sponsored by the University of Idaho and National Park Service. Biologist and sociologist, Wright and Machlis conduct research and training programs in the Pacific Northwest and beyond.

The unit promotes an interdisciplinary approach. For example, Machlis and Wright have developed a conceptual model of national parks that includes biological variables, such as number of plant species, and sociological variables, such as number of visitors. Their model is one of the first to combine biology and sociology to understand how parks function. Park managers are now using the model to guide park management.

Recent research projects include Wright's analysis of bird and mammal communities at Craters of the Moon National Monument in southern Idaho. His information will form a baseline from which future environmental change at the monument can be measured. Wright also is developing inexpensive, accurate, and easy-to-use monitoring techniques that can be applied in other parks.

In a series of "visitor mapping" studies at national parks from Virginia's Shenandoah to Colorado's Mesa Verde, data have been gathered on visitor backgrounds, activities, spending, expectations, and evaluations of park programs and facilities. Visitor mapping helps managers learn who their visitors are—senior citizens, foreigners, handicapped—and then to plan for their needs. This technique was developed at the cooperative unit for use throughout the National Park Service system.

A study at Washington state's Olympic National Park is examining ways to artificially reduce the fertility of both male and female mountain goats—an introduced species suspected of severely damaging the park's fragile alpine flora.

Other recent research at the cooperative unit includes

- A study to devise ways to record, store, and retrieve resource data for national parks in the Pacific Northwest. Using microcomputers, researchers are recording more than 30 categories of data for every study ever done in the region's parks.
- A study of threats to national parks worldwide. Following a study of threats to United States parks, researchers studied parks overseas, resulting in the book *The State of the World's Parks*. Recent efforts have focused on the Caribbean and Central and South America, where tropical deforestation seriously threatens parks.

In extension activities, unit researchers have developed chemical-free techniques to restore natural vegetation and control noxious weeds at several historic sites in the Pacific Northwest. Researchers also have conducted training courses in advanced interpretive skills, visitor safety, and advanced planning for National Park Service and other recreation professionals at training centers around the country.

Gary Machlis and R. Gerald Wright

Cooperative University of Idaho Aquaculture Program

When Manhattan's restaurant-goers dine on rainbow trout, the chances are good that the fish are Idaho grown. Idaho's aquaculture industry produces about 85 percent of the commercial trout sold in the United States, resulting in out-of-state sales estimated at more than $70 million each year.

Idaho's fish farms are concentrated in south-central Idaho's Hagerman Valley, where fish growers tap natural springs whose clean, oxygen-rich, 58-degree waters are prime for trout production. Idaho's aquaculture industry also includes two major fish-food manufacturers, several fish-farming equipment manufacturers, and four commercial rainbow trout egg producers.

Although Idaho's fish farms are doing well, advances in fish nutrition, disease control, and other areas will greatly increase their capacities, efficiencies, and profits. Too, parts of the state outside Hagerman Valley are well-endowed with water, and numerous opportunities exist for the industry's geographic expansion. There is also tremendous potential for enlarging markets and developing value-added products such as fish patties.

In the past, Idaho's aquaculture industry developed without the support of a strong university research and extension program. To draw the university into a closer alliance with the commercial fish-growing industry, a series of discussions and meetings between university personnel and the industry began in 1986. Out of them grew the Cooperative University of Idaho Aquaculture Program. Its purpose is to conduct research on priority problems and opportunities identified by the aquaculture industry.

Coordinated by Ernest Ables, head of the Department of Fish and Wildlife Resources, the program is directed by a board of deans from the colleges of Agriculture; Business and Economics; Forestry, Wildlife and Range Sciences; and Letters and Science. An eight-member industry advisory board acts as liaison between the board and the industry.

During the past one and one-half years, 11 campus scientists began work on 12 research projects specifically designed and funded to support aquaculture. They include one that seeks to transform potato processing wastes into fish food and another that will produce a computer system that fish farmers can use to access information on the myriad aspects of fish farming.

Within the College of Forestry, Wildlife and Range Sciences, four aquaculture research projects are underway.

Christopher Hrusa

Associate Professor James Congleton operates on a rainbow trout in a study aimed at combatting infectious hematopoietic necrosis.

During 1987, master's student Nancy Markwardt completed laboratory work on a method to rid growing salmonids of the intestinal bacteria *Aeromonas salmonicida*. A major problem for some fish growers in the Hagerman Valley, the bacteria can be fatal for fish already stressed by fish-farm environments. Markwardt successfully tested an antibacterial bath that eliminates the bacteria in fish that carry the bacteria, but are not yet diseased.

Also in the college, Associate Professor James Congleton is working on a way to combat infectious hematopoietic necrosis—a viral disease that kills and disfigures rainbow trout. Congleton's work focuses on discovering why some fish are more resistant to the virus than others, then finding ways to infuse an entire population with that resistance.

In other projects, Professor George Klontz is developing a computer program to help fish growers reuse water while maintaining healthful water quality. Adjunct Assistant Professor Christine Moffitt is studying natural immunity to infectious hematopoietic necrosis and to bacterial kidney disease.

Nine of the aquaculture projects are funded by a special $150,000 state research appropriation to support economic development. The others are funded by $70,000 from the Western Regional Aquaculture Consortium, one of four regional organizations funded by the U.S. Department of Agriculture to address regional aquaculture research and development. The university is a member of the five-state consortium, and is represented on its board of directors and technical committee.

In 1988, the university will hire a full-time aquaculture specialist who will be based in the Hagerman Valley. Also during 1988, university researchers will continue studies begun in 1987. And as the aquaculture program matures, Coordinator Ables hopes to hire a second aquaculture specialist and an extension specialist who will swiftly bring research results to Idaho's aquaculture industry.

Ernest Ables

Inland Empire Tree Improvement Cooperative

The Inland Empire Tree Improvement Cooperative is on its way to producing conifer seedlings with pedigrees as impeccable as a thoroughbred's. At new breeding orchards, cooperators are carefully selecting trees to mate under controlled conditions. Researchers expect the progeny to be better formed, healthier, and faster growing than trees whose lineage is uncertain. The breeding orchards are the latest phase in the cooperative's work to select and breed improved genetic stock for reforestation in the Inland Empire.

The 19 member organizations who share costs and labor include seven timber companies, four federal and three state agencies, two tribal councils, and three universities. Associate Professor Lauren Fins is the group's director and coordinates its activities from the College of Forestry, Wildlife and Range Sciences.

At the cooperative's core are nearly 100 test plantations, established throughout the Inland Empire, in which six important conifer species are being grown. The tests consist of "families" of seedlings, that is, trees grown from the seeds of carefully selected wild "mother" trees. The different families are compared over time for such traits as survival, height, form, wood quality, and resistance to insects and diseases. Cooperators are already using early results from the tests to establish seed orchards that will produce genetically improved seed for growing regeneration stock.

Because it will be many years before the field tests yield final results, short-term tests also are underway. These short-term tests will be used to evaluate the performance of seedlings grown in mild, nursery or nursery-like environments. Later, their performance will be compared with that of their siblings grown in the field tests. So far, there appears to

Gerald Franc/USDA Forest Service

Western white pine seedlings grown at the USDA Forest Service's Coeur d'Alene Nursery were used to establish seed orchards for producing rust-resistant white pine seeds.

be a moderate correlation between the performance of nursery-tested and field-tested seedlings—good enough to identify and drop from the program the poorest families based solely on their nursery performance.

Two ponderosa pine breeding orchards are in the process of being established, at Plains and Missoula, Montana. During 1987, researchers evaluated and selected trees for the first controlled matings, planned for 1988. Progeny from these crosses will be used to establish seed orchards for production of highly improved seed for reforestation and to establish additional test plantations of advanced generation families.

During 1986 and 1987, Director Fins and Data Analyst Marc Rust found ways to save time and money by using electronic data recorders instead of paper field sheets to collect field data. The recorders save the cooperative $6,000 to $7,000 per year, eliminate numerous data errors, and substantially reduce the time between data collection and data analysis.

Also in 1987, Rust developed a computer program that helps cooperators to map their seed orchards. This program already has helped managers at the two cooperative ponderosa pine seed orchards to "see" how their orchards will look following special thinnings.

Fins's graduate student Du Wei has begun to study ways to modify a computer model to include growth and yield simulations for genetically improved forest trees. This work will continue for the next three years and is being conducted in cooperation with researchers at the USDA Forest Service Southeastern Forest Experiment Station.

Fins anticipates that in the future the cooperative will increasingly emphasize seed orchard establishment and management, advanced generation breeding, techniques for controlled mating, clonal propagation, and growth and yield information from existing tests.

Lauren Fins and Focus *staff*

Intermountain Forest Tree Nutrition Cooperative

The Intermountain Forest Tree Nutrition Cooperative (IFTNC) wants to know what makes trees grow, and how to make them grow better.

Formed in 1981 from a coalition of 11 cooperating organizations representing private industry, federal and state agencies, and institutions in Idaho, western Montana, eastern Oregon, and eastern Washington, the IFTNC developed four principal goals: (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.

Although easily stated, the IFTNC's goals are complex. To realize them requires developing an understanding of the nutritional requirements of forest trees, which, in turn, involves understanding the ecosystems in which they grow. "We want to be able to predict how specific sites will respond to specific fertilization treatments. For that, we need a lot of information," said James Vander Ploeg, the cooperative's research associate.

IFTNC researchers gather exhaustive information from a wide variety of forest sites. They chart aspect, slope, elevation, types and conditions of understory vegetation, soil moisture, and soil chemical constituents. They correlate soil chemical properties with nutrients found in the tree foliage, and plot the soil chemicals/nutrients relationships as they occur among different sites.

Because comparatively little data exist on forest fertilization, the IFTNC has established over 100 field trial sites to study the effect of nitrogen on tree growth. Each

Cynthia Mital

Doctoral student James Mital climbs a fertilized Douglas-fir to collect foliage samples for nutrient analysis.

trial site consists of six to eight study plots, for a total of 632 plots. Most are undergoing various fertilization treatments, but one or more plots at each site are left untreated as controls. Before the trials begin, researchers measure the heights and diameters of all trees in their plots. They also sample soil at the site and tree foliage. Once the trials are underway, the trees are periodically and carefully remeasured to determine their responses to fertilization. Foliage is sampled one year after fertilization and periodically from then on.

"We have fairly well-developed regimes for Douglas-fir, and are currently working on ponderosa pine, western larch, and grand fir," said James Moore, director of IFTNC and professor of forest resources.

Moore said that determining what types of sites don't respond well to fertilizer treatments is as important as finding which do. "If you unknowingly fertilize nonresponsive sites, you're wasting money, probably a lot of money. The information IFTNC is developing allows us to create predictive models that can help us target sites that will respond."

He added that the implications of the cooperative's work extend beyond tree fertilization. "The understanding of why sites respond has provided some potentially useful information for other forest management practices—for different harvesting practices and silvicultural treatments that may affect the long-term productivity of a site."

As a by-product of its information gathering, the cooperative is providing its members with basic growth and yield information for their tree stands. Vander Ploeg's stem analysis of 1,200 Douglas-fir trees led to the development of new site index and height growth equations for western Montana and central Washington. Graduate student Pedro Real is developing individual tree taper and volume equations for managed second-growth Douglas-fir stands in the Intermountain Northwest. And graduate student Donald Patterson, with funding from the Inland Northwest Growth and Yield Cooperative, has been collecting growth and yield data in IFTNC control plots for testing two commonly used growth and yield simulation models, the Stand Prognosis Model and the Stand Projection System.

These projects and others conducted through the IFTNC will yield valuable information for forest land management decisions.

James Moore and Focus *staff*

Inland Empire Vegetation Management Working Group

When shrubs in a newly regenerated stand threaten to overtop tree seedlings and steal sunlight, nutrients, and water, the forester has to make decisions that may profoundly affect the future of the stand. Tools—mechanical, chemical, and cultural—for controlling the competing vegetation are available. But which to use? And if the choice is, for example, chemical—a herbicide—which herbicide? How applied? When applied? The same sorts of questions apply to any of the vegetation management techniques.

Now, getting the right answers is much easier for foresters in the Idaho, Washington, Montana, and southern Alberta and British Columbia region. In 1987, the Inland Empire Vegetation Management Working Group was formed to provide them with quick access to literature and field experience in vegetation management, also known as forest weed control.

George Lightner/USDA Forest Service

A vegetation management tool, the "forest cultivator" loosens the soil and rips out competing vegetation prior to reforestation on the Clearwater National Forest.

Created as an affiliate of the Inland Empire Reforestation Council, the working group is housed in the College of Forestry, Wildlife and Range Sciences.

Said David Adams, the working group's executive secretary and professor of forest resources, "Primarily we're creating a computer data base through which we can provide field foresters with the most current information, published and unpublished, on forest vegetation management."

The working group has three major objectives: (1) to develop a referral network that will allow identification of vegetation management experts in particular areas of interest; (2) to provide an information "clearinghouse" for members with regard to vegetation management research and operational experience in the region; and (3) to develop a regional vegetation management data base that can be used to develop operational management guidelines, provide supporting data for acquiring state registration of chemicals, and direct future research.

Through computer searches of library holdings on vegetation management subjects, the working group will gather published material on such topics as herbicides, grazing, prescribed fire, and mechanical strategies.

"But a lot of significant information is unpublished," said Adams. "It's out there, incorporated in field practices." To get this "field" information into the data base, the working group relies on its current 52 members representing research institutions, state and federal agencies, and private businesses and industries.

"We've developed a reporting form and distributed it to our members," said Adams. "They let us know what they and their organizations are doing in the way of vegetation management, and we incorporate that into our data base."

He added that the group intends to keep the referral system simple so that foresters can input and access vegetation management information easily.

Membership in the working group is open to all state and federal agencies, private businesses and industries, and academic institutions in the Inland Empire region. For the purposes of membership, the region includes, but is not limited to, Idaho, eastern Washington, eastern Oregon, western Montana, and southern Alberta and British Columbia. Currently, there is no charge for membership.

For more information on the Inland Empire Vegetation Management Working Group, write to Dr. David L. Adams, Department of Forest Resources, College of Forestry, Wildlife and Range Sciences, University of Idaho, Moscow 83843.

David Adams and Focus *staff*

Intermountain Research Station at Moscow

The Forestry Sciences Laboratory at Moscow is one of nine laboratories in four states that constitute the U.S. Forest Service Intermountain Research Station. The laboratory's 21 scientists are affiliate faculty members of the College of Forestry, Wildlife and Range Sciences. As such, they serve as graduate-level research advisors and sit on graduate students' research committees. By cooperating with the college's faculty members on research projects, they lend the college added depth and expertise. Also, the laboratory's facilities are available to faculty and graduate students for cooperative research.

Two experimental forests are managed by staff of the Moscow Forestry Sciences Laboratory: the Deception Creek Experimental Forest, located east of Coeur d'Alene, and the Priest River Experimental Forest near Priest Lake. These experimental forests are used primarily for field research, but also are the sites of tours and meetings sponsored by the Forest Service and university researchers.

The Moscow laboratory has five research units: (1) silviculture and genetics, (2) root diseases and soil biology, (3) growth and yield analysis, (4) engineering technology, and (5) soil and water management.

Notable research accomplishments include development of varieties of western white pine resistant to white pine blister rust. In addition, definition of seed collection zones for ponderosa pine, lodgepole pine, western white pine, Douglas-fir, and western larch in the northern and central Rocky Mountains has led to seedlings being planted in the

same zone as their seed source, resulting in better-adapted seedlings.

Silvicultural research on site preparation has shown that trees grow best in soils containing adequate amounts of organic matter. As a result of this research, many traditional forest management practices are being modified to protect soil organic matter.

The laboratory's forest pathologists are studying the genetics, physiology, and ecology of *Armillaria* root rot. Work to date has shown that *Armillaria* damage is closely associated with habitat, and that there is variation in *Armillaria* susceptibility among species and probably within species. Other soil studies are demonstrating important links between soil productivity and soil microbes.

Development of the Prognosis Model to predict stand development and individual tree growth has been a highlight of mensuration research. The model is being progressively improved, and submodels that take into account regeneration, spruce budworm, and root rots are being developed. Comparisons of model forecasts to long-term records of forest growth show that the model applies to both managed and natural stands. During 1987, graduate students from the college contributed to this effort.

Again with the assistance of a graduate student, the engineering technology project is developing a computer model to estimate sediment produced from forest roads and harvested areas.

The hydrology group is monitoring streamflow and sediment loads that result from timber harvest and road building. The objective is to improve the Forest Sediment Yield Prediction Model, which is used in forest planning. New studies conducted downstream from roads and harvest sites are determining the impact of streamflow and sediments on the aquatic habitat.

Diane Noel

At the Forestry Sciences Laboratory, doctoral candidate Deborah Dumroese measures levels of potassium in Douglas-fir and western white pine seedlings grown in mounds of organic matter.

Since establishment of the Forestry Sciences Laboratory in 1963, Forest Service scientists have enjoyed an excellent cooperative relationship with college faculty and students. Building on past research successes, they hope to help solve complex resource management questions in the future.

Raymond Hoff, USDA Forest Service

Cooperative Extension

Range Extension

More than half of Idaho's land area is rangeland. As well as producing forage for Idaho's livestock industry, it provides wildlife habitat, minerals, water, and opportunities for recreation. These and other uses are managed by the land's many owners—the federal government, principally the Bureau of Land Management (BLM) and USDA Forest Service, the state of Idaho, citizens, and private firms—whose holdings frequently interlock like patches in a quilt. The diverse policies and priorities of these landowners as well as of the ranchers, hunters, miners, anglers, and others who use the range inevitably lead to conflicts over rangeland management and use.

The Range Extension Program, a branch of the Cooperative Extension System, has as one of its primary goals to resolve conflicts among range owners and users through cooperative, coordinated management of Idaho's rangeland. Another major goal is to provide professional and technical assistance to individuals, local associations, and state and federal land management agencies.

Kenneth Sanders, professor of range resources, is Idaho's range extension specialist, a position created in 1980 at the request of Idaho's ranchers. Sanders and Range Economist Neil Rimbey, an associate professor, are based in southern Idaho. Range Resources Professor Lee Sharp completes Idaho's range extension team.

Lee Sharp

Near Challis, Idaho, ranchers, natural resource agency officials, and extension personnel ride together to resolve conflicts.

Both Sanders and Sharp have served as chairman of the Challis Experimental Stewardship Program's steering group. The program was established in 1979 to foster cooperation among land management agencies, ranchers, and other range users in the Challis, Idaho, area.

Among the program's successes are coordinated management plans, in which separately owned but similarly used lands are combined for the purposes of management. When land management agencies wrote plans independently, a rancher might be scheduled to leave one agency's land before being allowed on another's. The coordinated plans incorporate the objectives of all users and lead to improved range resources.

Another leader in cooperative, coordinated management, the more than 20-year-old Idaho Rangeland Committee consists of the heads of the various agencies and organizations dealing with Idaho rangelands. Sharp and Rimbey both serve on the committee, and Sanders is its current executive secretary. One of the committee's goals is to help ranchers and land managers develop coordinated plans that are founded on the principles of range ecology as well as on users' needs. "Usually," said Sanders, "once they get out on the range and start talking, they can come up with solutions to their differences."

Sanders also leads workshops in which ranchers and agency personnel switch roles, then write coordinated management plans for hypothetical rangelands. This exercise can lead local groups of ranchers and agency personnel toward developing plans for their own areas.

With the help of range resources faculty, the range extension team also has put on workshops, short courses, and field tours covering such topics as computer training, integrated watershed management, sagebrush-grassland ecology and management, prescribed burning, grazing systems, plant identification, forest plantation grazing, and wildland rehabilitation. During 1987, a three-day riparian area conference drew about 80 ranchers and public agency personnel for streamside study of riparian area ecology and management.

The range extension team also has helped to develop procedures for monitoring range condition and has trained ranchers, agency personnel, and county extension agents in their use. Training aids include a monitoring guide for ranchers, two videotapes, and numerous news articles. As with conflict resolution, the ultimate goal is a quality environment and healthy economy.

Kenneth Sanders

Forestry Extension

Every year, Ronald Mahoney receives some 2,000 phone calls and letters from Idahoans who ask everything from help for sick shade trees to advice for selling woodlot logs, growing Christmas trees, or managing woodlands for wildlife. The state's extension forester, Mahoney uses the products of research and a far-reaching network of resource professionals to help Idaho's individuals and communities get the most from their woods.

Extension forestry is part of the United States's Cooperative Extension System—a partnership among federal, state, and county levels of government and the private sector. Its focus is Idaho's privately owned forest lands, and includes forest management, community forestry, conservation planting, and environmental education for Idaho's youth.

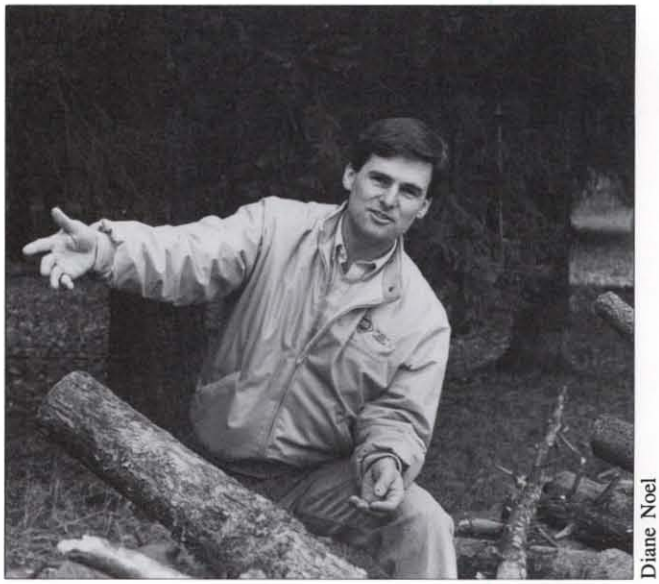
Assistant Extension Professor Mahoney operates from the College of Forestry, Wildlife and Range Sciences. An area extension forester, Donald White, serves in the state's four northern counties.

One of extension's top priorities—reiterated in its 1988-1991 plan—is to help Idaho's more than 26,000 nonindustrial private forest landowners to manage their woodlands. The 11,000 owners who each own more than 10 acres control a total 1.6 million acres of potentially productive timberland. With these landowners in mind, extension forestry plans educational programs to improve the abilities of farmers, ranchers, and other landowners to develop and sustain profitable timber management enterprises.

A series of publications, workshops, demonstrations, and field tours are planned for the coming years, with the first workshop scheduled for September 1988. Workshops will cover such topics as applying chemical pesticides, building roads, and turning forest management into a tax advantage. Nontimber-oriented landowners will be shown how profitable timber harvest can enhance other land uses.

These programs continue a tradition of assistance to landowners. Every year, Mahoney organizes field demonstrations of new forest practices and helps to conduct continuing education classes for resource professionals. During 1987, a workshop on animal damage in Pacific Northwest forests drew more than 300 professionals who learned to recognize and control animal damage.

In the realm of community forestry, Mahoney's graduate student Craig Foss is helping local governments, city park boards, chambers of commerce, and others to establish and preserve trees in their communities' parks, playgrounds, yards, and other arbors. Part of Foss's job is to help diagnose tree diseases. During 1987, he and Mahoney responded to some 75 requests for disease diagnosis—often with the help of Professor of Forest Resources Arthur Partridge, other faculty, and the college's diagnostic laboratory. Foss also has developed and conducted workshops that help tree-care professionals, homeowners, and city officials to better diagnose and treat insect and disease problems.



Diane Noel

Extension Forester Ronald Mahoney explains to landowners how proper handling of logging debris can prevent bark beetle attacks.

In addition to disseminating the benefits of research, the extension foresters conduct research. During 1987, Mahoney helped to complete an analysis of trees that were raised as seedlings in the University of Idaho Forest Research Nursery then planted on private lands all over Idaho. His analysis will enable the research nursery to better inform Idahoans on species selection and seedling care.

The education of Idaho's youth—primarily through cooperative extension's 4-H program—is another task of forestry extension. Each year, forestry extension helps to host two natural resource youth camps in Idaho where about 200 campers aged 13 to 16 learn about forests, water, soils, and other natural resources. The camps recently began to enroll teachers who learn new ways to bring natural resource subjects into their own classrooms.

The forestry extension office has produced hundreds of booklets, bulletins, and news releases that inform on topics ranging from firewood selection to woodlot thinning. A recent 4-H publication for youngsters, *Developing a Nature Trail*, was written by extension secretary Mary Vander Ploeg. Whether the audience be today's landowners or tomorrow's, forestry extension is dedicated to helping Idahoans toward the practical management of their private and community woodlands.

Ronald Mahoney and Focus *staff*

Communications

Continuing Education & Outreach

An owner of a small, isolated Idaho motel learned how to better manage her taxes, financing, marketing, and time. The lumber dryer operator at an Idaho mill learned new skills that will improve product quality—and company profits. A Forest Service silviculturist learned how cattle and young conifers can coexist. Fisheries biologists gained microcomputer skills. And nature lovers older than 60 learned nature photography, wildlife identification, and natural history. All were among the more than 2,400 people attending the college's 1987 continuing education and outreach programs.

Workshops, short courses, conferences, videos, and tours sponsored by the college help practicing natural resource professionals keep up to date with developments in natural resource thinking and practice. Outreach programs bring an understanding of natural resources and their management to members of the general public and enhance their involvement in natural resource decisions. Faculty for both continuing education and outreach programs include University of Idaho personnel and outside specialists.

During 1987, the college's continuing education and outreach program grew larger and stronger. Course offerings increased to 73, a 35 percent increase over the lineup in 1986.

Gerry Snyder

USDA Forest Service fisheries and wildlife biologists attended the Leadership and Communications Workshop.

One focus of the college's continuing education program is mid-career training. "Executive Leadership of Political and Social Forces in Natural Resources" and "Non-Supervisory Leadership" drew mid-level managers from as far away as Washington, D.C. These and many other continuing education courses were offered for academic credit.

Other highly successful continuing education classes included the symposium "Land Classifications Based on Vegetation: Applications for Resource Management," which attracted more than 250 foresters, range managers, wildlife biologists, and other natural resource professionals from the western United States and Canada. In its fourth year, the Inland Empire Forest Engineering Conference drew some 200 logging contractors, logging supervisors, and forest engineers for seminars on subjects from microcomputers to long-line cable systems.

Outreach activities engaged people aged less than eight to more than eighty. For the fourth year, outdoor Idaho was the setting and the subject of courses offered to senior citizens during Elderhostels at the university's Clark Fork and McCall Field Campuses. The Clark Fork Enrichment Series continued its offerings of one- to two-day weekend courses for the public on topics ranging from fall mushroom hunting to fossil collecting. And through Project WILD and Project Learning Tree environmental education workshops, primary and secondary schoolteachers learned how to make trees and wildlife an everyday part of the school curriculum.

Also during 1987, Range Resources Professor Lee A. Sharp received the first annual Outstanding Continuing Education and Service Award for his long-time commitment to serving southern Idaho's cattle ranchers and the range profession.

Assistant Professor Penelope Morgan joined the staff as continuing education coordinator, and Walter Dunn was hired as assistant coordinator and program manager for the McCall Field Campus. They joined existing staff members Associate Dean James Fazio, Clark Fork Field Campus Manager Kenneth Kinucan, Office Coordinator Carol Spain, as well as the dozens of faculty members who plan and execute programs for professionals and the public.

Penelope Morgan

Publications Office

In 1987, the Idaho Forest, Wildlife and Range Experiment Station Publications Office produced nearly 200 station publications, journals, flyers, posters, brochures, newsletters, news articles, news briefs, and its annual report, *Focus*.

The Publications Office also distributed, quite literally to "the four corners of the world," over 1,300 station publications and reprints of faculty journal articles.

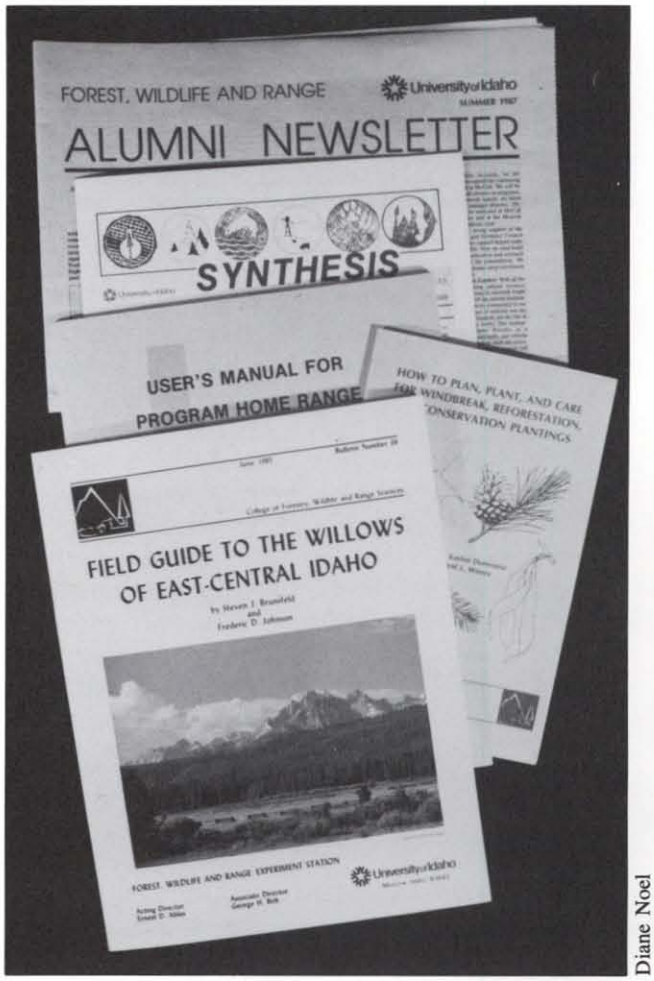
It was—at least for the past decade—a fairly typical year. Almost since its inception in 1909, the College of Forestry, Wildlife and Range Sciences has tried to place its work before its peers and the public. In the early years, however, a very small faculty and little emphasis on research made for only occasional and sporadic publication.

In 1924, the college systematized its approach to getting the word out, at least temporarily, and established the Forestry Bulletin Series—short, general information sheets that addressed state, national, and international forestry concerns, but that included very little research.

In 1939, an act of the Idaho Legislature established the Idaho Forest, Wildlife and Range Experiment Station as the research arm of the college, one legislated function of which was to disseminate information. But there was still relatively little information to disseminate.

It wasn't until over 25 years later, in 1965—by which time faculty research had increased markedly, both in amount and in sophistication—that the college entered its "modern era" of publications production and dissemination. To encourage faculty publication, the college established the Forest, Wildlife and Range Experiment Station Publication Series, which included a variety of publications—refereed and nonrefereed, short and substantial—designed to accommodate all types of research data from preliminary results to major reports.

Since then, the college has published and distributed over 180 publications (not including news articles, newsletters, recruitment flyers and posters, and other special interest publications), ranging from the esoteric for experts (*Taxonomy of the* Artemisia tridentata *Complex in Idaho*) to self-help diagnostic manuals for the public (*What's Wrong with My Shade Tree*) to distinguished lectures by public figures such as the late Senator Frank Church and then Secretary of the Interior Cecil Andrus. Publications Office personnel have also edited and produced publications on contract for outside agencies such as the Food and Agriculture Organization of the United Nations, the U.S. Agency for International Development, the USDA Forest Service, and others.



Diane Noel

Currently available from the Publications Office are some 100 research publications as well as newsletters and brochures.

Today the FWR Experiment Station Publications Office employs, and keeps busy, two full-time editor/writers, a graphics artist, and a typesetter operator, who, as this is being written, are working on a directory of Idaho primary wood processors, two forest tree nursery regime bulletins, a bulletin on research conducted at Craters of the Moon National Monument, the biannual *Forest, Wildlife and Range Alumni Newsletter,* a wood economics manual for the southern Sahel, a graduate student recruitment brochure, a variety of news releases, journal articles to be edited for faculty members, and *Focus*. The office also produces *Synthesis,* a twice-yearly, 8- to 12-page newsletter for natural resource professionals in industry and public agencies.

For a listing of current publications of the Idaho Forest, Wildlife and Range Experiment Station Publications Office and of some 75 reprints of faculty articles, write to the editor, College of Forestry, Wildlife and Range Sciences, University of Idaho, Moscow 83843.

George Savage

Research Highlights

In-Water Dredge Disposal: Boon for Salmon & Steelhead?

A slight haze hung over the water's surface. The water was calm, the air crisp, and a moonlit sky provided some diffuse light. A lantern's glow, visible from across the reservoir, illuminated the amorphous forms of two men leaning over the bow of a small boat. They clutched a mesh net holding a northern squawfish, several 1 1/2-foot suckers, and a 4-foot white sturgeon.

This was not part of an illegal fishing operation, but part of an aquatic assessment in the Snake River's Lower Granite Reservoir being done by Fisheries Resources Professor David Bennett, Research Associate Larry Dunsmoor, and master's candidate James Chandler. The research team is helping the Army Corps of Engineers learn whether it can dispose of dredged sediments within the reservoir and at the same time improve conditions for young chinook salmon and steelhead trout.

U.S. Army Corps of Engineers

Sediment from the Snake River may be used to enhance habitat for young salmon and steelhead in Lower Granite Reservoir.

Bennett's previous work suggests that some additional shallow waters within the reservoir may benefit these economically valuable migratory fish. But because salmon and steelhead runs in the Columbia River Basin are just a quarter of what they were 100 years ago—and measures are being taken to bring them back—managers want to be sure that in-reservoir dredge disposal will cause them no harm.

Lower Granite Reservoir is the upper-most reservoir on the lower Snake River. As a result, it receives massive quantities of predominantly sand-sized sediment from sources upstream. Sediment deposited in the upstream portions of the reservoir is raising the water level on the levees at Lewiston, Idaho. Flooding could result.

Several alternatives to lessen the flooding potential are being examined by the Corps of Engineers. One is to dredge and dispose of approximately 800,000 cubic yards of sediment. Because onshore options for disposal are limited, the Corps is examining the potential for disposal within the reservoir.

Bennett's previous research, also funded by the Corps, showed that before young salmon and steelhead migrate to the Pacific Ocean, they move into the shallow waters along the reservoir's shoreline, presumably to rest and feed. Formerly, managers believed that the reservoirs provided little benefit to the migrating fish. Because of the apparent importance of the reservoir's shallow water habitat, the Corps has suggested using the dredged sediment to fill in deeper areas, making them similar to the habitat currently used by the young fish.

One concern about the proposal is that the filled areas may attract potential salmon and steelhead predators such as northern squawfish and smallmouth bass. Another is that the "improved" habitat may increase presently limiting squawfish habitat, and hence increase squawfish numbers. In both cases, the result could be fewer salmon and steelhead.

During January 1988, the Corps will begin, experimentally, to fill portions of the reservoir with dredged sediment. Bennett's team will measure predator abundance, use of the filled area by juvenile salmon and steelhead, and production of bottom dwelling invertebrates that nourish the young fish. The researchers also will measure chemical and physical properties of the filled area such as water velocity and dissolved oxygen. Assessment work will be conducted around the clock and throughout the year in order to fully understand the habits of the reservoir's fish.

The Corp's experimental filling and the salmon and steelhead research will continue for three to four years. Then, the Corps will use Bennett's information to help decide whether to continue in-water dredge disposal.

To Bennett's knowledge, fish habitat improvement on the scale proposed by the Corps has never been attempted in fresh water. But if habitat enhancement works in Lower Granite Reservoir, a new potential for improving salmon and steelhead returns to Idaho exists.

David Bennett

Tracking Transplanted Caribou

In the winter of 1987, wildlife biologists from the United States and Canada captured 24 caribou in British Columbia. By helicopter and by truck they moved them south, fitted them with radio collars, then released them in northern Idaho's Selkirk Mountains just west of Bonners Ferry. There, the transplanted caribou joined the remnants of a herd that had dwindled to 25 animals, so few that the U.S. Fish and Wildlife Service declared the population endangered.

The objective of the transplant is to establish a population within the United States that will sustain itself at higher levels. The federal caribou recovery plan sets a goal of 100 animals.

Research underway by wildlife resources graduate student Christopher Warren, Idaho Fish and Game Department Research Biologist Gregg Servheen, and Wildlife Resources Professor James Peek will determine annual habitat use and movement patterns of the transplanted caribou and compare them with the patterns of the resident population, identified previously by the Idaho Fish and Game Department.

Using radio telemetry to locate the caribou, Warren climbs over steep and rocky high-elevation terrain to map and describe their habitat. He records such habitat elements as overstory composition and density and abundance of the caribou's wintertime staple—the light-green to black tree-hanging lichen similar to the Spanish moss of southern swamps.

The introduced animals came from two populations—one living near Revelstoke and one near Williams Lake, British Columbia. In winter, the group captured near Revelstoke historically moves as do the resident Selkirk Mountain caribou, into densely forested areas in early winter, then, as snows harden, up to sparsely forested ridge tops to feed on arboreal lichens. In contrast, the animals captured near Williams Lake habitually move onto the windswept ridge tops early in winter. As snows deepen, they move down into denser forests to feed on arboreal lichens.

Common practice when selecting wildlife stocks for transplanting is to use animals from similar habitats. In this case, however, caribou occupying habitats similar to the

Gregg Servheen/Idaho Department of Fish and Game

Three female caribou, members of the resident Selkirk herd, gather on a British Columbia highway. The radio collar on the female at left has been showing researchers her location since 1983.

Selkirk Mountain caribou's are not abundant, so the additional source of caribou from Williams Lake was necessary.

Information on the ability of the Williams Lake caribou to adapt to conditions in the Selkirks will be extremely useful, not only in increasing numbers of Idaho caribou, but in efforts to augment other endangered populations of antlered wildlife.

During 1987, the twelve Williams Lake caribou split up. One disappeared just after release, two died over the summer, two joined the resident population, one was alone across the border in British Columbia, and six remained in a group in Idaho. Of the 12 Revelstoke animals, four joined the resident herd, four joined a resident population in British Columbia, and four remained in the United States. One group of five caribou in the United States contained animals from both transplant groups.

Distances moved by the newcomers were greater than those moved by the resident population. This was expected, because exploratory behavior is typical of transplanted animals. Also, the transplant may have augmented the native herd, which will be watched to see if calf production and survival increase.

Additional caribou will be transplanted from the same areas in British Columbia during the winter of 1988, and their movements will be monitored along with the existing animals'. Management of the caribou and its habitat in Idaho involve the Idaho Department of Fish and Game, USDA Forest Service, U.S. Fish and Wildlife Service, and the University of Idaho.

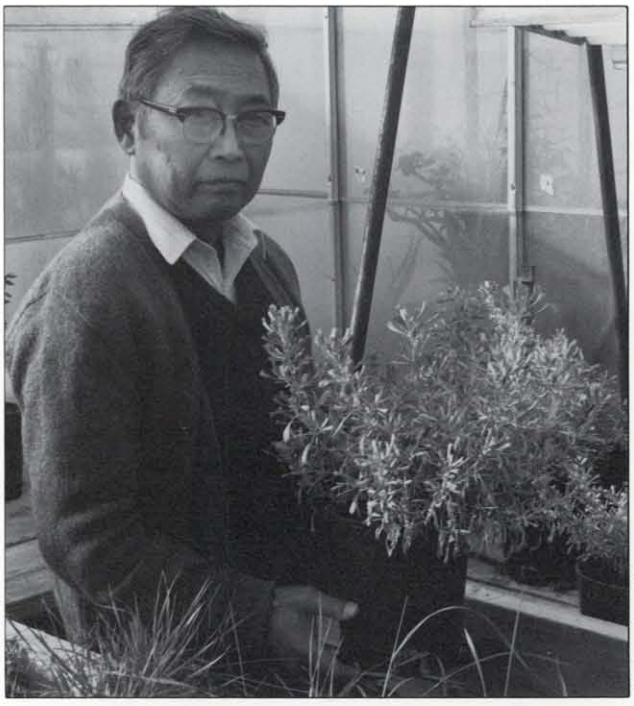
Christopher Warren and James Peek

Breeding Shrubs for Grassland Restoration

Over much of the West's sagebrush grasslands, productive and palatable shrubs for livestock, big game, and other wildlife are rapidly losing ground to annual grasses. Chief among them is cheatgrass. This Mediterranean exotic burns readily, feeding wildfires that consume both desirable shrubs and their seed.

Rabbitbrush, on the other hand, is a fire-resistant shrub, of little value to livestock or wildlife, that readily resprouts after fire. Once widespread, the cost of removing it will be prohibitive.

Range Resources Professor Minoru Hironaka and Associate Professor Stephen Bunting are starting research



Christopher Hrusa

Professor Minoru Hironaka displays a strain of big sagebrush that may play a role in restoring the West's sagebrush grasslands.

to develop sprouting, palatable shrubs for restoring the West's sagebrush grasslands. The shrubs are to be palatable to livestock, big game, and other wildlife. They must be able to resprout after fire. They also must be able to thrive in the grasslands' harsh growing climate of low precipitation and high summer temperatures and withstand competition from annual grasses, especially cheatgrass. They also should retain the aesthetics of natural vegetation.

Hironaka and Bunting's work will focus on sagebrush, bitterbrush, and four-wing saltbush. These species occur naturally in the northern Great Basin, but populations of sagebrush and bitterbrush possessing all of the qualities desired for range restoration have not been observed. The status of four-wing saltbush is unclear.

The researchers' strategy is to cross genotypes and closely related species that possess complementary desirable attributes, but, because of geographic distance and other breeding barriers, cannot or do not hybridize in the wild. Bitterbrush, for example, is a highly preferred shrub for livestock and big game animals. It is palatable and nutritious, and its seed is readily used by rodents and birds. Natural populations of antelope bitterbrush that are capable of enduring hot and dry environments are, however, unable to reestablish after fire. Desert bitterbrush is a strong sprouter, but lacks winter hardiness.

It is hoped that some progenies resulting from the hybridization of antelope bitterbrush and desert bitterbrush will possess traits that are superior to those of either par-

ent. Hybridization experiments with different genotypes of antelope bitterbrush are also to be conducted.

Sagebrush was the dominant shrub before the ranges were converted to cheatgrass. Sage grouse require sagebrush, but it generally is of low palatability to livestock and of limited food value for big game. There are two sagebrush populations, however, that have been identified as highly nutritious and palatable to deer and livestock. The palatable sagebrush populations and a closely related sagebrush species that has sprouting ability are to be the focus of sagebrush hybridization experiments.

Controlled and open pollination experiments will be conducted and resulting progenies will be evaluated. Progenies possessing the desired combined qualities will be retained and propagated. It is envisioned that tissue culture as well as growth from seed will be involved in the propagation of transplants.

Preliminary work on the initiative has been started and funding is being sought.

Minoru Hironaka

Idaho Leisure Travel and Recreation Study

The true gems of the Gem State may well be its mountains, lakes, rivers, trout, big game, and other natural attractions—at least in the eyes of its pleasure travelers. Preliminary results of the three-year Idaho Leisure Travel and Recreation Study suggest that Idaho's natural resources are at the heart of Idaho's image and appeal as a tourist destination. It also suggests the outdoors is essential for many of the activities that most engage Idaho's leisure travelers, pursuits such as sightseeing, hiking, hunting, skiing, camping, fishing, and other water activities.

The study is one of the most comprehensive analyses of travelers ever conducted in the United States. Led by Assistant Professor Charles Harris in the Department of Wildland Recreation Management, it has three major goals: (1) to assemble, for the first time, comprehensive, accurate, and representative data about Idaho's tourists and outdoor recreationists; (2) to collect information useful to state and regional tourism promoters and to public and private recreation managers—information such as how and why tourists select Idaho destinations; and (3) to identify the economic impacts of Idaho's travel and tourism industry and to clarify the role of the state's recreation resources in Idaho's economy.

During the study's year-long collection phase, two interview teams queried 16,413 groups of travelers at two airports and at 36 randomly selected roadside interview sites scattered throughout the state. Of these groups, more than a third were traveling at least partly for pleasure. By the end of 1987, information collected from more than 20,000 interview forms, questionnaires, mail questionnaires, and two-day expense diaries and activity diaries had been coded, entered on computer files, and analyzed for preliminary reporting.

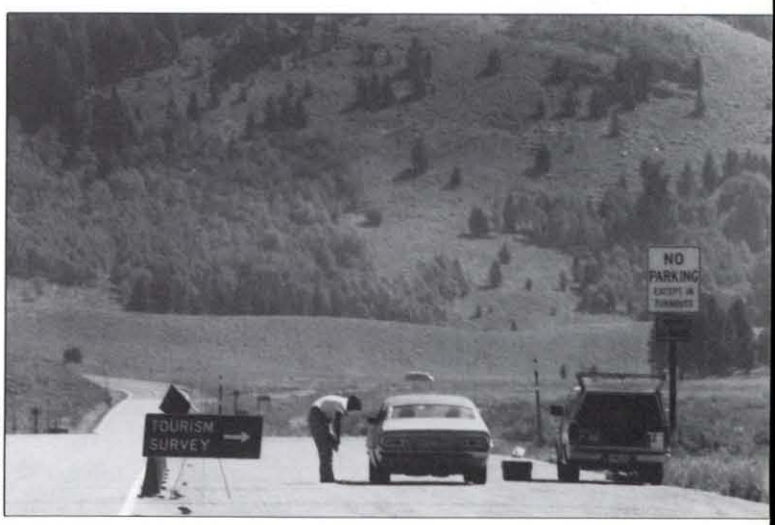
Early results already are suggesting ways to improve Idaho's tourism industry. For example, they show that three times as many leisure travelers seek Idaho's rural towns and natural attractions as head for its 10 largest cities. This suggests a need to connect towns and other rural areas to transportation centers.

The study also found that when leisure travelers spend the night in Idaho—as 80 percent of them do—they are as likely to camp as sleep indoors. A surprising 28 percent of campers use sites along the road or in the backcountry, while 43 percent check into public campgrounds in national forests, state parks, and other public sites. Public campgrounds dominate the Idaho market, a finding that suggests commercial campgrounds may not be realizing their market potential.

Retirees make up 24 percent of Idaho's leisure travelers. Although these travelers have discretionary time and money, researchers found that most drive straight through Idaho on their way to somewhere else. Reversing this pattern ought to be a key strategy for tourism promoters.

Other major implications drawn from the early analysis are that tourism needs to be developed during the current

Stuart Leidner interviews one of the 16,413 groups of travelers queried in the Idaho Leisure Travel and Recreation Study.



Roberta Rene'

off-seasons, fall and winter, and that better information services are needed to augment the way most people learn about Idaho—by word-of-mouth.

In the study's final year and a half, researchers will look in detail at leisure travel in each of Idaho's six tourism regions, analyze how people make travel decisions, and develop a model of the impacts of resource-based tourism on Idaho's economy. This information will be shared with state tourism and recreation planners, public land managers, private industry, and the state's regional tourism committees.

This study's baseline data and the research that generated it are important elements in the Department of Wildland Recreation Management's initiative to establish a tourism and recreation training, research, and development institute at the University of Idaho. Basic objectives of the institute would be to provide an on-line computerized statewide data base, carry out a research program to develop information requested by the state's tourism and recreation sector, serve as a repository and clearinghouse for recreation and tourism statistics, coordinate with industry associations and government agencies in delivering education and training programs to tourism professionals, and, most importantly, serve as a networking center to facilitate communication among the diverse groups involved in Idaho's tourism industry.

Researchers besides Harris are Wildland Recreation Management Department Head William McLaughlin, Associate Professors Sam Ham and Edwin Krumpe, graduate students Sharon Timko and Joanne Tynon, and undergraduates Roberta Rene, Edward Sellers, Stuart Leidner, and Mark McConnel.

Charles Harris and Focus *staff*

Artificial Intelligence in Resource Management

The big pine in your backyard has faded needles. Suspecting an insect problem, you seek a diagnosis and cure from your state's forestry extension worker, perhaps the state entomologist at the Idaho Department of Lands. He's on vacation? No matter. His knowledge and rules of thumb for diagnosing seasonal insect damage are housed on a tabletop—in a computer-driven expert system. A technician will take your phone call, and use the expert system to diagnose the problem and suggest a cure. Once the call is complete, the expert system will write you a personal follow-up letter.

UI Photographic Services

Professor Molly Stock conceived and edits the quarterly journal AI Applications in Natural Resource Management.

A prototype for such an expert system exists at the Idaho Department of Lands. It determines whether faded trees are the result of pine engraver bark beetles and if so, what can be done. It then composes a follow-up letter—one of the entomologist's most time-consuming yet important tasks. Developed by then forest resources master's student Sandra Gast, this expert system is just one of several with applications to natural resource management being developed at the College of Forestry, Wildlife and Range Sciences.

Gast's work is highlighted in the Winter 1988 issue of *AI Applications in Natural Resource Management,* a new quarterly journal conceived, developed, and edited by Forest Resources Professor Molly Stock. Stock, a recent graduate of Boeing's Artificial Intelligence Program, said that AI is "a technology that aims to make computers perform activities which, if done by a human, would appear intelligent."

In short, a computer program based on artificial intelligence would seem to reason and respond in much the same way a human would, and would interact with the user not in codes, but in plain English. In an expert system, some portion of a human expert's knowledge and rules-of-thumb for making decisions are distilled into a computer program easily accessible to the non-AI trained user.

Not so easy, however, is creating an expert system. The human expert, called a "domain expert," works closely with an AI specialist called a "knowledge engineer," who encodes and structures a necessarily limited portion of the expert's knowledge into a computer program.

There are many practical reasons for attempting to capture expert behavior in a computer program, said Stock. "Most experts are scarce and in high demand." she said. "Their knowledge is valuable and rare. Experts are also perishable. They get sick, have bad days, retire, and take other jobs. Thus, expert systems can provide a more permanent, accessible, and consistent source of expertise."

Doctoral candidate James Saveland is working with a seasoned USDA Forest Service fire officer to develop an expert system that will predict the long-term spread of fires burning in wilderness areas. Given such information as cover type, aspect, slope, fuels, and weather, Saveland's system will help fire managers decide whether to suppress a wilderness fire or let it burn.

In a people-oriented application, doctoral candidate Michael Whiteman has developed a prototype expert system to help natural resource managers resolve conflicts among natural resource agencies and outside interest groups. Whiteman's expert is a Forest Service district ranger known for his acumen in settling disputes. Given such information as the identities of the disputing parties, their history of interactions, their motivations to settle, and the amounts of money at stake, Whiteman's system recommends means to conflict resolution. Approaches the system considers include arbitration, mediation, even litigation.

Research Associate Marc Rust has developed a prototype expert system that rates potential white pine planting sites for blister rust hazard. Rust's system is designed to help managers decide where to plant rust-resistant stock, where to plant unimproved stock, and where to plant another species.

In a study that draws from psychology as well as silviculture and computer science, master's student Larry Amell is analyzing the process of developing a silvicultural prescription. Amell is focusing on the silviculturists' needs and desires, breaking their jobs into component subtasks and learning which can best be handled by expert systems, which by more traditional computer programs, and which by the silviculturists themselves.

In cooperation with the USDA Forest Service, Molly Stock is developing an expert system to estimate the probability that a prescribed fire will escape. She and James Saveland also are working with the Forest Service to study uncertainty and bias in experts' decision making, specifically, decisions about the management of wilderness fires.

Even though AI and expert systems techniques are beginning to be applied to many areas of natural resource management, few avenues exist for sharing information. Journals that do address the subject are "by computer scientists for computer scientists and indecipherable to anyone else, and none of them is geared to specific areas," said Stock.

That's a problem she hopes *AI Applications in Natural Resource Management* will solve—at least for natural resource professionals. Articles during 1987 included overviews of AI and expert systems, AI applications to weather forecasting, forest fire control, forest pest management, geographic information systems, even growing grapes. Said Stock, "We're trying to bridge the gap between an advanced technology and the actual user by presenting concepts and applications in straightforward, intelligible English."

Molly Stock and Focus *staff*

Idaho Timber Supply Study: Report to the Governor

In February 1987 the USDA Forest Service released *A Report on Idaho's Timber Supply.* The report evaluated the impact on Idaho's timber supplies of proposed 10- to 15-year plans for guiding the management of Idaho's national forests. Because the issues and policies discussed in that report are likely to influence Idaho's total economy as well as selected regional economies, the report was of critical interest to Idaho's lawmakers.

In July 1987, Governor Cecil Andrus asked the college to evaluate the issues and findings presented in the report and, in addition, to evaluate the timber supply recommendations contained in Idaho's proposed national forest plans. The college responded with a *Report to the Governor on the Idaho Timber Supply Study and Forest Plan Effects on Timber Supply.* The college's report summarized 58 national forest planning documents and commented broadly on timber supply and forest planning issues as they influence Idaho and its natural resources. It was prepared by Dean John Hendee, Associate Dean Leon Neuenschwander, and by faculty members Charles Hatch, Charles McKetta, and Henry Robison.

Among the report's conclusions:

- Owners of Idaho forest land other than the federal government have generally been ignored in the forest planning process, yet they have the potential to influence levels of timber harvest in Idaho.
- Timber harvest in Idaho is affected by the demand for timber nationally, yet neither the Forest Service's timber

supply study nor the forest plans consider the economic demand for Idaho's timber.

- Neither the timber supply study nor the forest plans adequately identify timber-dependent communities, the role of communities in the state's economy, or how communities are affected by resource decisions. Future planning and analysis should include community-level modeling focused on natural resource dependency and the effects of proposed management alternatives on total community income.
- Trade-offs in relationships such as those between road density and wildlife abundance, harvest levels and water quality, and harvest levels and community well-being are imperfectly known. This uncertainty probably results in reduced commodity outputs, because managers would tend to include a margin of safety in their decisions until further research and experience more clearly identify the trade-offs.
- The proposed forest plans allocate an additional 1.26 million acres to the wilderness system. If these acres are added, timber supplies will likely be reduced because future harvests depend on the amount of land open to timber harvest. In selected locations, however, reducing the proposed wilderness acreage may not increase timber supplies significantly because other multiple-use constraints already apply.
- There is more accord in the forest planning process than is generally recognized. Most controversies appear to focus on the philosophy of a management policy or on a relatively small and local issue.

The college's 39-page report discusses each of these findings. It also includes nine tables that are the first to standardize and summarize land base and forest resource output statistics found in the forest plan documents for each of Idaho's 10 national forests.

Charles Hatch

K.D. Swan/USDA Forest Service

LOGHEAT: Software for Softening Wood

At plywood and veneer mills, logs are bathed in hot water or steam before being cut. Warming softens the wood, making it supple enough to bend over the lathe knife without cracking.

Optimum log temperatures for cutting veneer are known. But because temperatures within logs cannot be economically measured, mill operators must estimate when their logs are warm enough to cut. Logs taken from the bath too soon can produce low-quality plywood—which brings a lower price. The lost revenue to mills frequently adds to thousands of dollars per month.

In the Department of Forest Products, Associate Professor Peter Steinhagen and Assistant Professor Harry Lee have developed a computer program for the IBM-PC to help mills get prime veneers and full price from every log they heat. LOGHEAT predicts the time it will take for frozen logs to thaw and for unfrozen logs to reach cutting temperatures. It also predicts the amount of energy needed to heat logs.

LOGHEAT has applications beyond plywood and veneer plants. Particleboard, waferboard, and other mills that need to thaw logs before processing will benefit, too.

LOGHEAT is copyrighted. Program disks, user's manuals, and technical assistance are available through the Idaho Research Foundation at the University of Idaho. Re-

Christopher Hrusa

Associate Professor Peter Steinhagen demonstrates LOGHEAT, computer software for mills that warm logs before cutting.

quests for LOGHEAT have been received from all over the United States and from Sweden. Already, LOGHEAT is being used by a particleboard manufacturer in Minnesota who frequently must handle frozen logs. LOGHEAT has increased that mill's production.

To qualify for LOGHEAT, log length must be greater than four times log diameter, and the diameter must measure 25 inches or less. Given log diameter, log length, initial log temperature, and bath temperature, LOGHEAT calculates temperatures for 1/2-inch radial increments measured from the log surface. LOGHEAT also can determine the effect of log diameter on temperature profile and energy consumption and the effect of bath temperature on heating time.

Thirty hardwood species and 25 softwood species are listed in the program's menu. Program users can address unlisted wood species simply by entering the species's specific gravity and moisture content.

Steinhagen is now extending his work into a more general heat transfer model that can be applied to heating and drying hog fuel for power plants and wood chips for pulp and paper mills. Two graduate students are working with Steinhagen in this attempt.

Peter Steinhagen

Appendix

Experiment Station Scientists

Department of Fish and Wildlife Resources

Ables, Ernest D.
Professor and Department Head
Coordinator, Cooperative University of Idaho Aquaculture Program
Ecological animal behavior

Bennett, David H.
Professor
Warmwater fisheries ecology, fisheries management and population dynamics

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

Bjornn, Theodore C.
Professor
Assistant Leader, Idaho Cooperative Fish and Wildlife Research Unit
Management and ecology of wild and hatchery salmonids

Congleton, James L.
Associate Professor
Assistant Leader, Idaho Cooperative Fish and Wildlife Research Unit
Fish immunology, stress physiology

Dunsmoor, Larry K.
Research Associate
Reservoir fisheries

Falter, C. Michael
Professor
Ecology and management of lakes, streams, and reservoirs; aquatic pollution ecology

Garton, Edward O.
Professor
Dynamics and management of bird and mammal populations, population estimation, modeling and simulation of population processes

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

Hungerford, Kenneth E.
Professor Emeritus
Wildlife management

Klontz, George W.
Professor
Aquatic animal medicine

MacPhee, Craig
Professor Emeritus
Fish behavior, ecology, toxicology

Moffitt, Christine M.
Adjunct Assistant Professor
Biology and management of aquatic resources, particularly anadromous fish

Nelson, Lewis, Jr.
Professor
Environmental education, continuing education, communications/public relations

Peek, James M.
Professor
Big game ecology and management

Ratti, John T.
Adjunct Associate Professor
Research Scientist
Avian ecology, research design and techniques, management and biology of waterfowl and upland game birds

Reese, Kerry P.
Assistant Professor
Waterfowl and wetland ecology, upland game bird ecology and management, nongame wildlife, avian habitat relationships

Ringe, Rudy
Research Associate
Anadromous fish ecology and management

Scott, J. Michael
Professor
Leader, Idaho Cooperative Fish and Wildlife Research Unit
Animal ecology, conservation biology, estimating animal numbers

Wright, R. Gerald
Associate Professor
Project Leader (Biology), Cooperative Park Studies Unit
Wildlife management in national parks and protected areas, ungulate ecology and habitat use, modeling of ecological problems, natural resource data management and geographic information systems

Yeo, Jeffrey J.
Research Associate
Big game habitat relationships

Department of Forest Products

Bottger, Richard F.
Adjunct Associate Professor
Director of Administrative Services
Assistant Director, Idaho Forest, Wildlife and Range Experiment Station
Business management, accounting systems

Campbell, Alton G.
Associate Professor
Pulp and paper mill processes, wood chemistry, wood adhesives, wood-fired boilers, wood-cement composites

Gorman, Thomas M.
Assistant Professor
Wood construction and design

Govett, Robert L.
Associate Professor
Forest products marketing, forest products management, forest products manufacturing, production feasibility analyses

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

Johnson, Leonard R.
Professor
Systems and cost analysis of timber harvesting operations, recovery and processing of small timber and forest residue

Lee, Harry W.
Assistant Professor
Harvesting systems, road design, soil-water relationships

Moslemi, Ali A.
Professor and Department Head
Wood particle composites, wood technology

Steinhagen, H. Peter
Associate Professor
Drying of lumber and wood particulates, heat transfer in frozen and nonfrozen wood

Department of Forest Resources

Adams, David L.
Professor
Executive Secretary, Inland Empire Vegetation Management Working Group
Silviculture, growth and yield

Belt, George H.
Professor
Forest hydrology and watershed management, social forestry and agroforestry

Brunsfeld, Steven J.
Research Associate and Instructor
Curator, Forestry, Wildlife and Range Sciences Research Herbarium
Vegetation ecology, autecology, systematics, molecular biology of woody plants

Burlison, Vernon H.
Extension Forester Emeritus
Extension Professor Emeritus

Canfield, Elmer R.
Associate Professor Emeritus
Forest pathology

Dennis, Brian
Associate Professor
Statistical ecology, biometrics, mathematical modeling

Deters, Merrill E.
Professor Emeritus
Silviculture

Dumroese, R. Kasten
Research Associate
Nursery management

Fins, Lauren
Associate Professor
Executive Director, Inland Empire Tree Improvement Cooperative
Genetic improvement of forest trees, effects of forest management on genetic resources

Force, Jo Ellen
Associate Professor
Forest planning and policy, particularly the role of people and other social science aspects; training and international development

Hatch, Charles R.
Professor and Department Head
Forest mensuration and statistics

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

Hendee, John C.
Professor
Dean, College of Forestry, Wildlife and Range Sciences
Director, Idaho Forest, Wildlife and Range Experiment Station
Human behavior aspects of renewable resource management; conflict resolution; social impact analysis; wilderness, recreation, wildlife, and forest policy and management; use of natural environments for personal growth, therapy, and education; university and public administration

Johnson, Frederic D.
Professor
Autecology, synecology and phytogeography—emphasis on northern Rockies and upon forest lands and woody plants, dendrology—temperate and tropical

Kessler, Charles L.
Research Associate
Watershed management, forest soils

Loewenstein, Howard
Professor Emeritus
Forest soils and tree nutrition

Lotan, James E.
Adjunct Professor
Research Scientist
Silviculture and fire management

Machlis, Gary E.
Associate Professor
Project Leader (Sociology), Cooperative Park Studies Unit
Sociology of natural resources

Mahoney, Ronald
Assistant Extension Professor
Extension Forester, Cooperative Extension Service
Silviculture and management of non-industrial private forests, natural resources education for youth

McKetta, Charles W.
Associate Professor
Economist, Idaho Forest, Wildlife and Range Experiment Station
Timber investments, forest policy, international forestry, fire and fuel management economics, harvest scheduling, forest taxation, timber supply

Medema, E. Lee
Associate Professor
Currently on leave with U.S. Agency for International Development in Thailand
Forest economics (investment analysis, stumpage markets, policy, impact assessments)

Mika, Peter G.
Research Associate
Biometrics, forest nutrition

Moore, James A.
Professor
Director, Intermountain Forest Tree Nutrition Cooperative
Various aspects of forest growth and yield modeling, mineral nutrition of forest trees, the influence of nutritional status on primary forest productivity

Morgan, Penelope
Assistant Professor
Coordinator of Continuing Education and Outreach
Fire ecology and management, silviculture and forest ecology, ecological modeling, continuing education for natural resource management professionals and public education to enhance lifelong learning

Neuenschwander, Leon F.
Professor
Associate Dean for Research and International Programs
Associate Director, Idaho Forest, Wildlife and Range Experiment Station
Associate Member, Department of Range Resources
Forest and range ecology, fire management, prescribed burning, site preparation for conifer release

Osborne, Harold L.
Extension Assistant Professor
Manager, University of Idaho Experimental Forest
Silviculture, log scaling and timber cruising, forest resource inventories

Partridge, Arthur D.
Professor
Insect/disease interactions, nursery problems, urban tree problems

Pym, Geneva E.
Research Technician
Quantitative testing

Robison, M. Henry
Visiting Assistant Professor
Regional economic modeling and forest management

Rust, Marc
Data Analyst
Inland Empire Tree Improvement Cooperative

Schenk, John A.
Professor Emeritus
Forest entomology (insect bionomics, silviculture, and biological control)

Seale, Robert H.
Professor Emeritus
Forest economics

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

Stiff, Charles T.
Assistant Professor
Forest growth and yield, inventory, modeling and simulation

Stock, Molly W.
Professor
Artificial intelligence/expert systems applications in natural resource management, human-computer interactions, biosystematics and population genetics of forest insects

Stoszek, Karl J.
Professor
Forest protection, silviculture

Ulliman, Joseph J.
Professor
Small format aerial photography and interpretation

Vander Ploeg, James L.
Research Associate
Growth-yield, forest nutrition

Wenny, David L.
Associate Professor
Manager, University of Idaho Forest Research Nursery
Forest nursery technology and production, seedling physiology and quality, forest regeneration

Department of Range Resources

Bryant, David A.
Professor and Department Head, through June 1987
Coordinated management planning, range nutrition

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

Ehrenreich, John H.
Professor
Range ecology, international forestry

Hironaka, Minoru
Professor
Range ecology

Johnson, Kendall L.
Professor and Department Head, as of August 1, 1988
Range extension and ecology

Kingery, James L.
Assistant Professor
Forest grazing policy, range economics, rangeland rehabilitation

Robberecht, Ronald
Assistant Professor
Physiological ecology, stress physiology, range ecology

Sanders, Kenneth D.
Professor
Range Extension Specialist
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

Department of Wildland Recreation Management

Allen, Stewart D.
Visiting Assistant Professor
Environmental psychology, river recreation, research design and methodology

Fazio, James R.
Professor
Associate Dean for Academics and Continuing Education
Resource communication, environmental interpretation, history

Ham, Sam H.
Associate Professor
Natural resource communication, environmental education and interpretation, natural resource tourism, reserve management in Latin America (lesser-developed countries)

Harris, Charles C.
Assistant Professor
Recreation resources management and planning; recreation and amenity economics; natural resource tourism—impacts and market analysis; recreationist/tourist behavior and consumer psychology

Hendee, John C.
Professor
Dean, College of Forestry, Wildlife and Range Sciences
Director, Idaho Forest, Wildlife and Range Experiment Station
Human behavior aspects of renewable resource management; conflict resolution; social impact analysis; wilderness, recreation, wildlife, and forest policy and management; use of natural environments for personal growth, therapy, and education; university and public administration

Krumpe, Edwin E.
Associate Professor
Director, Wilderness Research Center
Wilderness management, monitoring indicators of recreation impacts, dispersed recreation, human decision making

McLaughlin, William J.
Associate Professor and Department Head
Natural resource planning, international park and natural preserve management and planning

Research Projects and Investigations

This listing shows the range of work in progress through the College of Forestry, Wildlife and Range Sciences during 1987. If additional information is needed, write to the principal investigators or to the Associate Director, Idaho Forest, Wildlife and Range Experiment Station, University of Idaho, Moscow, Idaho 83843.

Department of Fish and Wildlife Resources

Behavioral interactions between bighorn sheep, mule deer, and elk. E.D. Ables, H.A. Akenson

Impacts of winter recreation on elk in Yellowstone National Park. E.D. Ables, E.F. Cassirer

Coyote social systems. E.D. Ables, R.L. Crabtree

Role of vocalizations in coyote society. E.D. Ables, K.F. Fulmer

Application and testing of an index of biotic integrity to assess the impact of land use activities on receiving streams. D.H. Bennett

Dredging of Kidd Island Bay, Coeur d'Alene, Idaho. D.H. Bennett

Dynamics and ecology of salmonid fishes as affected by project operations of Post Falls Dam on the Spokane River, Idaho. D.H. Bennett

Fish and benthic community abundance at proposed in-water disposal sites in Little Goose and Lower Granite reservoirs. D.H. Bennett

Gas supersaturation at Clark Canyon Dam, Montana. D.H. Bennett

Predator-prey abundance of fishes in shallow-water habitats in Lower Granite Reservoir, Washington. D.H. Bennett

Effluent evaluation and toxicity reduction from the proposed Ponderay newsprint mill. D.H. Bennett, C.M. Falter, A.G. Campbell

Re-establishment of whooping cranes in the western United States. E.G. Bizeau, R.C. Drewien

Offsite benefits from improved land use practices—Tucannon River and other Columbia Basin streams. T.C. Bjornn

Response of chinook salmon fry to steelhead and brook trout predators and cover. T.C. Bjornn

Evaluation of habitat for salmonids in the Boise River. T.C. Bjornn, G.M. Asbridge

Fish response to solar input, riparian vegetation, and instream cover in second-growth forest streams of Southeast Alaska. T.C. Bjornn, M. Brusven, R. Kieth, N. Hetrick

Survival of chinook salmon as related to stress at dams and smolt quality. T.C. Bjornn, J.L. Congleton

Development of sampling techniques and life history information for yellow perch in Cascade Reservoir. T.C. Bjornn, R.G. Griswold

Production of kamloops rainbow and bull trout in Pend Oreille Lake tributaries. T.C. Bjornn, B.G. Hoelscher

Potential production of cutthroat trout in Priest Lake tributaries. T.C. Bjornn, D. Irving, P. Cowley

Development and testing of models to estimate supplementation requirements for salmon and steelhead stocks. T.C. Bjornn, J. McIntyre, A.F. Byrne

Carrying capacity of streams as related to physical and biological factors. T.C. Bjornn, W.R. Meehan, C.R. Steward

Effects of small hydroelectric developments on aquatic invertebrates and fish. T.C. Bjornn, W. Minshall, K. Bovee, S.Rubin

Evaluation of the proposed use of Bear Lake National Wildlife Refuge as a sediment and nutrient trap for inflows to Bear Lake. T.C. Bjornn, C.M. Moffitt, K.P. Reese, C.M. Falter, J.H. Milligan, R.W. Tressler, R.E. Myers, C.J. Cleveland

Evaluation of methods for controlling bacterial kidney disease in chinook salmon. T.C. Bjornn, C.M. Moffitt, J.A. Schreck

Viability of progeny from hatchery steelhead and their effects on native stocks. T.C. Bjornn, R. Reisenbichler, G.M. Chandler

Fall chinook trapping at Ice Harbor Dam. T.C. Bjornn, R.R. Ringe.

Sedimentation and embryo survival in natural redd of chinook salmon and steelhead in relation to sediment transport. T.C. Bjornn, C.R. Steward, C.M. Chandler

An examination of the role of natural fire on the shrub-grasslands of the Snake River Plain in Craters of the Moon National Monument. S.C. Bunting, R.G. Wright, M. Barrington

Comparison of three flume designs for bypass of chinook salmon and steelhead trout smolts at Lower Granite Dam, 1987. J.L. Congleton

Effects of cortisol on immune responsiveness in rainbow trout. J.L. Congleton

Algae toxicity in Black Lake, Kootenai County, Idaho. C.M. Falter

Attached algae production in in-shore areas of Pend Oreille Lake, north Idaho. C.M. Falter

Benthos development in the Yakima River, Washington. C.M. Falter

Development of a nutrient loading and lake management model for Cocolalla Lake, north Idaho. C.M. Falter

Powerboat nutrient loading to Twin Lakes, Idaho. C.M. Falter

St. Joe River late summer-fall limnology. C.M. Falter

Watershed sediment and nutrient export from the forested Twin Lakes watershed, Idaho. C.M. Falter

Aerial census methods for elk populations. E.O. Garton

Population ecology of trumpeter swan and whooping crane populations. E.O. Garton

Studies of avian predators of the western spruce budworm. E.O. Garton

Aerial census methods for mule deer populations. E.O. Garton, B. Akerman

Status and habitat requirements of boreal owls in northern Rocky Mountains. E.O. Garton, G.D. Hayward, P.H. Hayward

Lynx habitat selection in Troms County, Norway. E.O. Garton, O. Johansen

Research Projects and Investigations

Habitat requirements of fisher in the Nez Perce National Forest. E.O. Garton, J.L. Jones

Black bear population dynamics in Yosemite National Park. E.O. Garton, J.A. Keay

Functional feeding response of coyotes to changing prey abundance in the northern Great Plains. E.O. Garton, B.T. Kelly

Expert systems applications in wildlife management. E.O. Garton, F.A. Leban

Survival and habitat use of bull elk of the Lochsa elk herd. E.O. Garton, J.W. Unsworth

Dynamics of sympatric populations of mountain lions, bobcats, and coyotes in the Frank Church-River of No Return Wilderness. M.G. Hornocker, G.M. Koehler

Ecology of the bobcat in the Frank Church-River of No Return Wilderness. M.G. Hornocker, G.M. Koehler

Ecology of the mountain lion in southwestern New Mexico. M.G. Hornocker, K. Logan, L. Sweanor

Ecology of the mountain lion in Yellowstone Ecosystem. M.G. Hornocker, K. Murphy

Ecology and behavior of the mountain lion in the Frank Church-River of No Return Wilderness. M.G. Hornocker, H. Quigley

Evaluation of candidate antibacterials for systemic bacterial fish diseases. G.W. Klontz

Evaluation of ornamental fish diets. G.W. Klontz

Fish production capacities of multiple-use water systems. G.W. Klontz

Nature and fate of the *Yersinia ruckeri* carrier state in trout. G.W. Klontz, N.M. Markwardt

Determination of dosage and duration of oral administration of erythromycin thiocyanate to treat bacterial kidney disease in chinook salmon. C.M. Moffitt

Natural immunity to infectious hematopoietic necrosis and bacterial kidney disease in salmon and trout. C.M. Moffitt, J.L. Congleton

Mule deer habitat use relative to rangeland succession in Washington. J.M. Peek, D.B. Griffith

Winter habitats and forage use patterns of moose on the Copper River Delta, Alaska. J.M. Peek, J.G. MacCracken

Winter habitat selection and habitat partitioning within a moose population. J.M. Peek, D.G. Miquelle

White-tailed deer habitat use patterns, Priest Lake, Idaho. J.M. Peek, G.R. Pauley

Evaluation of habitat selection patterns in native cervidae:elk. J.M. Peek, D.J. Vales

Habitat use patterns of translocated caribou in the Selkirk Mountains, Idaho. J.M. Peek, C.D. Warren

Habitat use patterns of Sitka black-tailed deer in logged and unlogged forests, southeast Alaska. J.M. Peek, J.J. Yeo, J.D. Mankowski

Energy dynamics, foraging ecology, and behavior of pre-nesting white-fronted geese on the Yukon-Kuskokwim Delta, Alaska. J.T. Ratti, D.A. Budeau

Behavior and ecology of tundra swans, Arctic National Wildlife Refuge. J.T. Ratti, M.J. Monda

Ten-year analysis of gray partridge population fluctuations and associated environmental factors. J.T. Ratti, K.P. Reese

Habitat use, movements, and survival of mallard broods in southwestern Manitoba: Consideration of untested hypotheses. J.T. Ratti, J.J. Rotella

Statewide mail survey of citizen's attitudes toward the Idaho Nongame Wildlife and Endangered Species Program. K.P. Reese, C.C. Harris

Columbian sharp-tailed grouse in southeastern Idaho: Seasonal movements, habitat use, and productivity. K.P. Reese, D.R. Meints

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

Analysis of edge habitats and their relationship to productivity of passerine birds. K.P. Reese, J.T. Ratti

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

Spring movements and nesting ecology of sage grouse in southeastern Idaho. K.P. Reese, W.L. Wakkinen

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

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

Hawaiian forest bird populations 1977-1987: Managing for the future. J.M. Scott, E.O. Garton, J. Jeffrey

Adequacy of reserve areas to maintain biological diversity in Idaho into the 22nd century. J.M. Scott, C.R. Groves, S. Caicco

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

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

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

Observer variability in estimates of bird numbers. F.L. Ramsey, J.M. Scott

The development of comprehensive microcomputer databases for resource data in the national parks of the Pacific Northwest. R.G. Wright

Development of methods to interpret air quality data to park visitors at Craters of the Moon. R.G. Wright, M. Bean

An analysis of techniques for restoring native grasslands and controlling noxious weeds at national historic sites in the Pacific Northwest. R.G. Wright, S.C. Bunting

An analysis of population control techniques for mountain goats in Olympic National Park. R.G. Wright, R. Hoffman

The development of comprehensive baseline inventory and monitoring techniques for biological resources at Craters of the Moon. R.G. Wright, R. Hoffman

An analysis of blue monkey damage and control options in forested plantations in Tanzania. R.G. Wright, S. Maganga

Research Projects and Investigations

Department of Forest Products

Effluent evaluation and toxicity reduction from the proposed Ponderay newsprint mill. D.H. Bennett, C.M. Falter, A.G. Campbell

Chemical analysis and comparison of lodgepole pine samples. A.G. Campbell

Effect of supercritical extraction on wood structure using SEM. A.G. Campbell

The impact of wood fuel on the operation, efficiency, and emissions of the UI wood-fired boiler. A.G. Campbell

Boron as a factor in the control of lignin biosynthesis. A.G. Campbell, L. Roberts

Harvesting, processing, and marketing of wood products—Idaho: Agricultural extension. R.L. Govett

Marketing of Idaho Christmas trees. R.L. Govett

Western whitewoods as a source material for shakes and shingles—grand fir and western white pine. R.L. Govett

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

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

Mechanization of timber harvesting in the Intermountain Region. L.R. Johnson

Modeling of cost and availability of wood fuel for University of Idaho boiler. L.R. Johnson

Recovery of forest residues: Harvest and collection systems. L.R. Johnson

Survey of forest residues in Idaho. L.R. Johnson

Production and site impacts of mechanized feller-buncher. L.R. Johnson, H.W. Lee

Residue recovery, transport, densification, and storage economics. L.R. Johnson, H.W. Lee

Northern Idaho nonindustrial private forest landowner survey. H.W. Lee, J.E. Force

Analytical, economical, and financial evaluation of wood burning bioenergy systems for Idaho. H.W. Lee, H.P. Steinhagen, A.G. Campbell

Effect of fly ash on wood-cement composites. A.A. Moslemi

Interaction of wood components with portland cement. A.A. Moslemi

SoForm fibers with inorganic binders. A.A. Moslemi

Development of a computerized, two-dimensional heat transfer model with phase change for logs (LOGHEAT2). H.P. Steinhagen

Conditioning times for frozen and unfrozen veneer blocks. H.P. Steinhagen, A. Khattabi

University of Idaho hog fuel drying. H.P. Steinhagen, G. Li, P. Thomson

Heat conditioning of veneer blocks. H.P. Steinhagen, H.C. Sim

Department of Forest Resources

Animal damage to western redcedar regeneration in northern Idaho. D.L. Adams

Seed wafers: A forest regeneration alternative. D.L. Adams

A comparison of natural and artificial regeneration on six habitat groupings. D.L. Adams, R.R. Becker

Effects of hexazinone application on survival and growth of ponderosa pine seedlings. D.L. Adams, S.L. Jeheber-Matthews

Root performance of container-grown seedlings. D.L. Adams, P.F. Kolb

Analysis of the seed tree harvest regeneration method: Regeneration and residual stand growth. D.L. Adams, H.L. Osborne

Influence of thinnings on the growth and development of planted ponderosa pine. D.L. Adams, H.L. Osborne

Vegetation management and herbicide use for forest weed control. R. Boyd, H.L. Osborne

Analysis of coastal and disjunct populations of *Cornus nuttallii*. S.J. Brunsfeld

Ecology, distribution, and utilization of Idaho woody plants. S.J. Brunsfeld

Systematics and evolution in *Salix* sect. *Longifoliae*. S.J. Brunsfeld

Implementation of grasshopper stage-development models for integrated pest management. B. Dennis

An evaluation of operational stratification procedures for western white pine. (1) How these procedures affect and are affected by the papery membrane. R.K. Dumroese, D.L. Wenny

An evaluation of the efficacy of granular Banrot® to control *Fusarium* root disease in Douglas-fir seedlings grown in styroblock containers. R.K. Dumroese, D.L. Wenny, R.L. James

Douglas-fir seed treatments: Effects on germination and seedborne organism levels. R.K. Dumroese, D.L. Wenny, R.L. James

Survival of *Fusarium* root disease on Douglas-fir seedlings after outplanting. R.K. Dumroese, D.L. Wenny, R.L. James

Pathogenicity of selected *Fusarium* isolates from Douglas-fir seed and seedlings. R.K. Dumroese, D.L. Wenny, R.L. James, C.J. Gilligan

Epidemiology of *Fusarium* on containerized Douglas-fir seedlings. (1) Seed and seedling infection, symptom production, and disease progression. R.K. Dumroese, D.L. Wenny, R.L. James, J.F. Myers, C.J. Gilligan

Comparison of a growth and yield model for predicting performance of improved and unimproved trees. L. Fins, W. Du

Comparison of juvenile height growth rankings of Douglas-fir over time in a nursery test. L. Fins, M. Rust, B. Wilson

Shoot growth in western larch. L. Fins, J-W. Zhang

An evaluation of the user's role in wood energy for residential heating in Idaho. J.E. Force

Forest landowner survey. J.E. Force, H.W. Lee

Research Projects and Investigations

The relationship of site characteristics and fuelwood collecting following timber harvest. J.E. Force, L. Neuenschwander, S. Bernatas

Developing a theoretical model for personal growth and development through wilderness experiences. J.C. Hendee, M. Brown, J.W. Tangen-Foster

Management implications of wilderness legislation. J.C. Hendee, J.A. Browning

Introduction to Pan-tropical trees. F.D. Johnson

Wild trees of Idaho. F.D. Johnson

Ecology, distribution, and utilization of Idaho woody plants. F.D. Johnson, S.J. Brunsfeld

Escaped and naturalized woody plants of Idaho. F.D. Johnson, S.J. Brunsfeld

Phytogeography of Idaho disjunct and endemic plants. F.D. Johnson, C.C. Lorain

Vegetation dynamics of Crater Lake National Park. F.D. Johnson, R. Mastroguissepe

Growth model for *Cedrus atlantica* in Morocco. F.D. Johnson, S. Messat

Succession in the *Abies lasiocarpa/Xerophyllum tenax* habitat type in central Idaho. F.D. Johnson, M.J. Simpson

Relationship between site productivity and vegetation in the upland pine forests of central Honduras. F.D. Johnson, C.T. Stiff, O. Hernandez

Threats to national parks: The development of monitoring techniques and conceptual models for examining threats to parks. G.E. Machlis

Visitor services study: An examination of visitor use patterns in 10 national parks. G.E. Machlis

Community stability and timber-dependent communities. G.E. Machlis, J.E. Force

Land use and threats to parks in the neotropics. G.E. Machlis, R.P. Neumann

Economic implications of proposed Idaho log export restrictions. C.W. McKetta

Development of export supply functions for selected Chilean forest products. C.W. McKetta, K. Blatner

Thinning response of pole-sized lodgepole pine. R. Mahoney, H.L. Osborne

Nursery stock evaluation on private land. R. Mahoney, D.L. Wenny

Administration of social forestry programs in Southeast Asia. E.L. Medema

Nutrient status of forest communities. J.A. Moore, P. Mika, J.L. Vander Ploeg

Treatment response data development. J.A. Moore, B. Shafii

Data base development for model testing. J.A. Moore, C.T. Stiff

Douglas-fir site index prediction equations. J.A. Moore, L-J. Zhang

Ecology and management of ponderosa pine in the western United States. P. Morgan

Individual shrub response to burning in a combustion chamber. P. Morgan

Whitebark pine fire ecology and management. P. Morgan, S.C. Bunting

Probabilistic models of shrub cover. P. Morgan, R.K. Steinhorst

Bracken ecology and management problems on the Selway Ranger District. L.F. Neuenschwander, L.B. Evers

Development of operational prescriptions for prescribed fire and mechanical site preparation. L.F. Neuenschwander, H.L. Osborne

Microsite variability and safe site influences on western larch establishment. L.F. Neuenschwander, B.P. Oswald

Effect of site preparation techniques on juvenile conifer growth. L.F. Neuenschwander, K.T. Wellner, H.L. Osborne

Horselogging applied to the group selection harvest regeneration method: A production and feasibility assessment. H.L. Osborne

Management of mixed conifer stands for fuelwood production. H.L. Osborne

Diagnostic keys and computer programming of nursery diseases, tree problems, and hazard trees risk assessment. A.D. Partridge

Interactions of root-disease causing fungi and bark beetles in conifers. A.D. Partridge, C.L. Bertagnole

Scanning electron microscopy of seed-borne diseases of conifers. A.D. Partridge, C.L. Bertagnole, R.K. Dumroese

A natural resource-focused model of the Idaho economy. M.H. Robison

An evaluation and comparison of two distance-independent forest projection models in the Inland Northwest—Part 2. C.T. Stiff

Effects of fugitive cement kiln dust on forest productivity. C.T. Stiff

Alternative terms for stand density and relative competitive status in individual tree diameter increment models. C.T. Stiff, J.E. Horn, J.A. Moore

Diameter increment models for forest species in Maine. C.T. Stiff, W. Mott

Compatible total volume and stem taper equations for *Pinus oocarpa* in central Honduras. C.T. Stiff, N. Perez, F.D. Johnson

Soil-site equations for *Pinus oocarpa* stands in central Honduras. C.T. Stiff, C. Valdez, F.D. Johnson

Evaluation of height growth measurement techniques. C.T. Stiff, J.L. Vander Ploeg, J.A. Moore, C.R. Hatch

Task allocation in silvicultural prescriptions. M.W. Stock, L.L. Amell

Estimating the risk of escape of prescribed burns. M.W. Stock, D.A. Cleaves, J. Williams

An expert system for identifying damage caused by the pine engraver. M.W. Stock, S.J. Gast

Genetic diversity and environmental stress in *Ips pini*. M.W. Stock, S.J. Gast

Predicting the spread of wilderness fires. M.W. Stock, J.M. Saveland, M. DeZell

Biosystematics of California *Ips* species. J. Cane, D. Wood, M.W. Stock

Dynamics of forest ecosystems under stress: Natural and management-induced factors and acidic depositions. K.J. Stoszek

Site nutrients and Sitka spruce-barkbeetle relationships in Southeast Alaska. K.J. Stoszek

Uneven-aged silvicultural methods applied to ponderosa pine/Douglas-fir and grand fir/western redcedar types in northern Idaho. K.J. Stoszek, H.L. Osborne

Evaluating alternative target structures for an uneven-aged ponderosa pine stand using the Stand Prognosis Model. T.S. Hensold, K.J. Stoszek, C.T. Stiff

Obtaining aerial photography with emphasis on small format. J.J. Ulliman

Fast forest biomass production from Idaho hybrid poplar. D.L. Wenny

Lotus 1-2-3® templates for the container nursery industry. D.L. Wenny

Potential applications for rare earth elements in forest nursery operations. D.L. Wenny

A growing regime for containerized Douglas-fir. D.L. Wenny, R.K. Dumroese

A growing regime for containerized pines. D.L. Wenny, R.K. Dumroese

A growing regime for containerized spruces. D.L. Wenny, R.K. Dumroese

A growing regime for containerized western redcedar. D.L. Wenny, R.K. Dumroese

An attempt to improve survival and growth of seedlings in southern Idaho using polymer gels. D.L. Wenny, R.K. Dumroese

Clonal propagation of western larch (*Larix occidentalis* Nutt.). D.L. Wenny, J.L. Edson, L. Fins, C.M. Stiff

Delayed sowing and accelerated growth regimes: Their influence on morphological development and outplant performance in Douglas-fir and ponderosa pine. D.L. Wenny, J.D. Head

Using foliar fertilizers on container-grown conifers. D.L. Wenny, M.E. Montville

Micropropagation of hybrid poplar. D.L. Wenny, C.M. Stiff

Micropropagation of western white pine using needle fascicles. D.L. Wenny, C.M. Stiff

Assessing physiological factors and their effects on western white pine and Douglas-fir seedlings as a result of bud initiation stress in a containerized nursery. D.L. Wenny, J.R. Tonn

Using polymer gels for improved soil water retention in potted white birch production. D.L. Wenny, R.R. Tripepi, R.K. Dumroese

Development of ponderosa pine root systems in containers: A comparison between non-treated and chemically root-pruned seedlings. D.L. Wenny, Z-G. Wang

Department of Range Resources

Antelope bitterbrush wildfire rehabilitation. S.C. Bunting

Effects of wood harvesting and fire on soil fertility in western juniper. S.C. Bunting

Sagebrush-grassland burning guidelines. S.C. Bunting

Whitebark pine fire ecology and management. S.C. Bunting, P. Morgan

Effects of length and timing of grazing on postburn productivity. S.C. Bunting, R. Robberecht

An examination of the role of natural fire on the shrub grasslands of the Snake River Plain in Craters of the Moon National Monument. S.C. Bunting, R.G. Wright, M. Barrington

Analysis of agroforestry practices worldwide and of related possibilities for economic development. J.H. Ehrenreich

Development of palatable, resprouting shrubs for the cheatgrass type of the Great Basin. M. Hironaka, S.C. Bunting

Evaluation of the grazed-class method for estimating forage utilization on transitory rangelands in northern Idaho. J.L. Kingery, C. Boyd

Interrelationships of animal use on tree establishment, survival, and growth. J.L. Kingery, R.T. Graham

Analysis of cattle, deer, and elk diets on cutover areas in northern Idaho. J.L. Kingery, K.C. Roscoe

Ecophysiology and mechanisms of plant interference for an adventive species in disturbed rangelands. R. Robberecht

Plant and soil water relations of *Festuca idahoensis* and *Agropyron spicatum* in response to fire. R. Robberecht

The adaptive significance of highly glaucous leaves in regard to leaf energy balance and ecology of grasses. R. Robberecht

The response of *Bouteloua scorpioides* to water stress at two phenological stages. R. Robberecht, J.B.M. Alcocer-Ruthling

Intra- and inter-specific competition between two bunchgrass species in the postfire regeneration stage of grassland communities. R. Robberecht, G.E. Defossé

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Continuing Education and Outreach

Faculty in the College of Forestry, Wildlife and Range Sciences conduct continuing education programs for natural resource professionals and outreach programs for the public on campus, at the Clark Fork and McCall Field Campuses, and throughout Idaho and the West. The college offered the following continuing education and outreach programs during the past one and one-half years. Programs scheduled for 1988 also are listed.

More information is available from the continuing education and outreach staff, headed by Associate Dean James Fazio and including Coordinator Penelope Morgan and Assistant Coordinator Walter Dunn. Write the College of Forestry, Wildlife, and Range Sciences, Moscow, Idaho, 83843 or call (208) 885-6441.

Continuing Education

1986

July 27-August 2	Fish and Wildlife Ecology Workshop—McCall
August 5-8	Classification and Management of Riparian Areas—Idaho Falls
September 13-November 1	University of Idaho Honduras Forestry Field Training Course—Moscow
October 8-December 19	Big Game Management Workshop—Kamiah
October 13-17	Dry Kiln Workshop—Moscow
October 13-November 17	Continuing Education in Forest Ecology and Silviculture (CEFES XIV)—Moscow
November 10-December 9	Land-Use Planning in Natural Resource Management—India
December 1	Idaho Outfitters and Guides—Limits of Acceptable Change—Approach to Carrying Capacity in Wilderness Management—Moscow
December 5	Coordinated Resource Planning Workshop—Mackay

1987

January 5-9	Microcomputer Applications for Wildlife and Fisheries Biologists—Moscow
January 20-22	Managing Grazing Lands for Recreation and Profit, Pacific Northwest Range Management Short Course—Pendleton, OR
January 26-30	Statistical Methods and Data Analysis for Wildlife and Fisheries Biologists—Moscow
February 3-6	Idaho Tourism Training Institute—Moscow
February 12	Nursery Soils Management Workshop—Sandpoint
February 12	The Challenge of Tree Improvement—Inland Empire Tree Improvement Cooperative—Post Falls
February 12-13	Inland Empire Forest Engineering Conference—Moscow
March 10-11	Range Computer Workshop—Boise
March 23-25	Animal Damage Management in Pacific Northwest Forests—Spokane, WA
April 8	Wilderness Resources Distinguished Lectureship—Moscow
April 20-25	Executive Leadership of Political and Social Forces in Natural Resources—Moscow
April 27-May 1	Aerial Photo Interpretation/Aerial Photography Workshop—Moscow
May 12-13	Expert Systems in Natural Resource Management: An Introduction—Moscow
May 26-June 6	Non-supervisory Leadership and Communication Skills Workshop—Moscow
June 15-19	Analyzing Earth Resources from Air and Space Imagery—Moscow
June 15-July 24	Land Use Planning in Natural Resource Management—Moscow
June 22-26	Riparian Area Ecology and Management Workshop—Idaho Falls
July 6-12	Fish and Wildlife Ecology Workshop—McCall
July 11-13	Wildfire: The Role of Fire in the Ecology of the Greater Yellowstone—Teton Science School
July 12-15	Wildlife Issues Workshop—McCall
August 17-19	National Experimental Stewardship Program—Boise
September 29-October 2	Ponderosa Pine: The Species and its Management—Spokane, WA
October 2	Ponderosa Pine Management Field Tour—Spokane, WA
October 12-16	Dry Kiln Workshop—Moscow
October 14-17	Workshop on Bobcat Research and Management in the Western United States—Moscow
October 20-21	Intermountain West Container Seedling Growers Meeting—Moscow
November 17-19	Land Classifications Based on Vegetation: Applications for Resource Management—Moscow
November 30-December 11	Forest Regeneration and Site Preparation, Advanced Education in Western Silviculture, Module I—Moscow

1988

January 4-8	Microcomputer Applications in Wildlife and Fisheries Biology—Moscow
January 6-8	Applications and Use of Personal Computers for the Forest Industry—Coeur d'Alene
January 19-20	Integrated Watershed Management—Boise
January 25-29	Statistical Methods and Data Analysis for Wildlife and Fisheries Biologists—Moscow
January 26-March 1	Natural History of the Nez Perce Reservation: A Short Course for Tribal Wildlife Technicians—Moscow

January 27-28	Riparian Management Workshop—Moscow
February 1-12	Leadership and Communications Workshop—Moscow
February 2	UI Research Nursery Advisory Committee Meeting—Clark Fork
February 3	Nursery Herbicide Workshop—Clark Fork
February 11	Inland Empire Tree Improvement Cooperative Annual Meeting and Workshop—Tree Improvement: The Next Steps—Post Falls
March 2-3	Inland Empire Forest Engineering Conference—Moscow
March 14-18	Aerial Photography/Remote Sensing Workshop—Moscow
March 15-17	Fire Behavior—Moscow
March 21-25	Advanced Natural Resources Communication—Moscow
April 15-17	Interpersonal and Communication Skills for Resource Professionals—Clark Fork
April 18-22	Executive Leadership of Political and Social Forces in Natural Resources—Moscow
June 13-July 22	Land Use Planning for Community Forestry and Natural Resource Development—Moscow
June 14-15	Seed and seedling problem diagnosis—Moscow
June 23-24	Southern Idaho Christmas Tree Growers Short Course—Boise
July 20-22	Densified Wood Fuel: Manufacturing, Marketing, and Use—Moscow
September 11-16	Selection Silviculture Systems (International)—Clark Fork
September 23-24	Integrated Natural Resource Management on Non-industrial Private Forests—Post Falls
October 3-28	CEFES: Continuing Education in Forest Ecology and Silviculture—Moscow
October	Dry Kiln Workshop—Moscow
October 24-26	International Conference on Fiber and Particleboards with Inorganic Binders—Moscow
November 7-18	Forest Regeneration and Site Preparation—Moscow

1989

January 2-6	Microcomputer Applications in Wildlife and Fisheries Biology—Moscow
January 23-27	Statistical Methods and Data Analysis for Wildlife and Fisheries Biologists—Moscow
Spring	Idaho Travel and Tourism Institute—Moscow
March	Inland Empire Forest Engineering Conference—Moscow
April	Executive Leadership of Political and Social Forces in Natural Resources—Moscow
July 10-16	Fish and Wildlife Ecology Course—Moscow

Outreach

1986

July 19	Landscape (Watercolor) Painting—Clark Fork
July 20-26	McCall Elderhostel: Wild Nature of Idaho—McCall
July 27-August 2	Clark Fork Elderhostel: Wild Country Botanizing—Clark Fork
September 20	Mushroom Identification—Clark Fork
Ongoing	Project Learning Tree workshops
Ongoing	Project WILD workshops

1987

January 17-18	Cross-country Skiing and Basic Backcountry Skills—Clark Fork
February 21	Pre-history of the Northwest—Clark Fork
March 21	Beginning Fly Tying and Casting—Clark Fork
April 4	Waterfowl Identification and Management—Clark Fork
April 8	Wilderness Resources Distinguished Lectureship—Moscow
April 18	Lakes and Streams of the Northwest—Clark Fork
May 30-31	For (Bird) Lovers Only—Clark Fork
June 1-5	Idaho Outdoors: A Writing Workshop—McCall
June 6	Spring Mushrooms for Beginners—Clark Fork
June 8-13	Central Idaho 4-H Natural Resources Workshop—Ketchum
June 13	The Nature of Forests—McCall
June 14-20	Inland Empire 4-H Natural Resources Youth Camp—Harrison
June 27	Ethnobotany—Clark Fork
July 12-18	Clark Fork Elderhostel: Wild Country Botanizing—Clark Fork
July 19-25	McCall Elderhostel: Wild Nature of Idaho—McCall
August 15	Big Game Afield—Clark Fork
August 19-23	Wilderness Quest—McCall
September 26	Fall Mushrooms (Intermediate and Advanced)—Clark Fork
October 3	Community Forestry Day—Moscow
October 17 & 18	Fossil Collecting and Geologic Tour of the Lake Pend Oreille Area—Clark Fork
November 7	No Insect is Really a Pest!—Clark Fork
Ongoing	Project Learning Tree workshops
Ongoing	Project WILD workshops

1988

January 16-17	Animal Tracks in the Snow—Clark Fork
February 27	Beginning Fly Tying and Casting—Clark Fork
March 26-27	Waterbirds—Clark Fork
April 9	Introduction to Falconry—Clark Fork
May 7	Lakes and Streams of the Northwest—Clark Fork
May 15	Spring Mushrooms—Clark Fork
May 28	Urban Forestry—McCall
June 13	Wellness Testing—McCall
June 14-16	Eagles and Hawks of the Greater Yellowstone—Teton Science School
June 25-28	Field Botany: Flora of the Tetons—Teton Science School
June 26	Ethnobotany—Clark Fork
June 27-30	Perception: Keeping a Field Journal—Teton Science School
July 6-8	Fire Ecology of the Greater Yellowstone—Teton Science School
July 10-16	Elderhostel: Wild Country Botanizing—Clark Fork
July 17-23	Elderhostel: Wild Nature of Idaho—McCall
July 18-22	Understanding Animal Behavior—Teton Science School
July 25-28	Pattern in Nature—Teton Science School
July 30	Early History of North Idaho—Clark Fork
July 30	Lakes and Streams of Central Idaho: Ecology and Management Challenges—McCall
August 8-12	Nature Illustration—Teton Science School
August 8-9	Increasing Human Effectiveness—McCall
To Be Announced	Alpine Ecology—Teton Science School
To Be Announced	Natural History of Yellowstone Grizzlies—Teton Science School
To Be Announced	River Channels—Teton Science School
August 28	Wildlife Photography—Clark Fork
September 10	Native Ornamental Trees—Clark Fork
September 25	Fall Mushrooms—Clark Fork
October 1	Forests of the Northern Rockies—Clark Fork
October 15 & 16	Fossil Collection and Geologic Tour of the Lake Pend Oreille Area—Clark Fork
November 5	Herbs and Herb Crafts—Clark Fork

Agency and Funding Support

Abbott Labs
Agency for International Development
AID Bureau for Science and Technology
Agriculture Research Service
Alaska Fish and Game Department
American Forest Institute
Bennett Lumber Company
Boise Cascade Corporation
Boise National Forest
Bonneville Power Administration
Champion Timberlands
Clearwater County
Clearwater National Forest
Clearwater - Potlatch Timber Protective Association, Inc.
Cocolalla Lake Association
Colorado State University
Colville Confederated Tribes
Consortium for International Development
Cooperative State Research Service
Crown Zellerbach
Curt Berklund
Diamond International Corporation
Energy/Development International
Environmental Protection Agency
Flathead National Forest
Glacier National Park
Government of Honduras
Idaho Department of Commerce
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 Research Foundation, Inc.
Idaho Travel Council
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
Mississippi State University
Montana Fish and Wildlife
National Aeronautics and Space Administration
National Marine Fisheries Service
National Oceanic and Atmospheric Administration
National Wildlife Federation
North Idaho Forestry Association
Oregon State University
Pacific Northwest Power Company
Pack River Lumber Company
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 Alaska
University of California
University of Idaho Experimental Forest
University of Idaho Forest Nursery
University of Minnesota
University of Montana
University of Washington
Viking Systems International
Washington State Department of Natural Resources
Washington State University
Washington Water Power Company
Western Forestry and Conservation Association
Weyerhaeuser Company
Wildlife Management Institute
Winrock International Institute

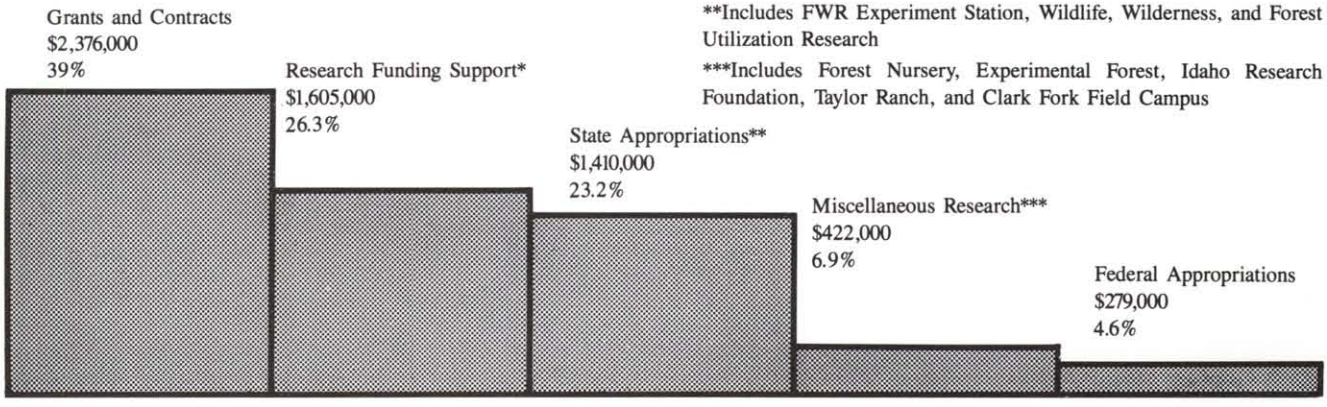
Fiscal Year 1987 Financial Picture

Research expenditures, shown by funding source, totaled $6,092,000 for the fiscal year 1986-87.

*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



Productivity: 1985-1987

	Departments					
	Fish & Wildlife Resources	**Forest Products**	**Forest Resources**	**Range Resources**	**Wildland Recreation Management**	**Total**
1985						
Books	0	0	2	0	1	3
Chapters in Books	0	0	2	0	3	5
Refereed Publications	15	4	11	8	5	43
Other Publications	7	9	33	7	14	70
Scientific Presentations	4	6	38	14	14	76
Faculty Awards	2	2	3	2	3	12
1986						
Books	2	0	2	1	1	6
Chapters in Books	9	0	2	1	0	12
Refereed Publications	11	13	30	13	2	69
Other Publications	2	10	40	5	16	73
Scientific Presentations	9	7	48	14	25	103
Faculty Awards	0	0	6	3	2	11
1987						
Research FTEs[1]	2.5	1.9	6.4	1.5	0.7	13
Books	0	0	2	0	1	3
Chapters in Books	0	0	2	2	2	6
Refereed Publications	34	9	30	7	4	84
Other Publications	6	9	38	11	3	67
Scientific Presentations	68	22	91	23	9	213
Faculty Awards	4	2	9	3	1	19

[1] FTE = full-time equivalent

The College of Forestry, Wildlife and Range Sciences, established in 1909, is one of the oldest natural resource schools in the United States. Last year the college was evaluated by a federal review team and judged to be among the top programs in the nation.

The University of Idaho is the state's land grant institution. The Idaho Legislature established the Idaho Forest, Wildlife and Range Experiment Station in 1939 to conduct research on the state's renewable natural resources. The experiment station has 13 full-time equivalents (FTEs) in research, plus support personnel, in the departments of Fish and Wildlife Resources, Forest Products, Forest Resources, Range Resources, and Wildland Recreation Management. About one-third of the faculty's time is spent on research.

During the 1986 fiscal year, income from outside grants and contracts totalled $1.7 million. During fiscal 1987, the total increased to $2.9 million. In the first half of fiscal 1988, $1.4 million from outside sources helped to support 51 faculty and 174 graduate students on 162 research projects. For every dollar appropriated by the state for experiment station research, faculty grants and contracts brought in $2.30.

The college is currently evaluating the mid-term accomplishments of Q4E—the college's five-year plan. The experiment station's gains in research productivity from 1985 to 1987 are impressive, and occurred even though the college had two fewer faculty.

Gains: 1985-1987

	1985 vs. 1987 Percent Change	**3-year Total**
Graduate Student Enrollment	+15%	
Outside Grants & Contracts	+71%	$6 million
Refereed Publications	+95%	196
Other Publications	-4%	206
Chapters in Books	+20%	15
Books	+0%	12
Scientific Presentations	+180%	382

From the Director

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, according to a 1987 federal review team.

During 1987, as *Focus* attests, the departments in the College made important progress on their "quests," which they outlined in 1985 as part of our five-year strategic plan—Quest For Excellence (Q4E). The individual "quests" are broad topics of focus identified by faculty in each department based on College and departmental capabilities for excelling in the topic areas, anticipated future needs in their natural resource fields, and the feasibility of success considering such things as support and funding. *Focus* includes many articles reporting progress and accomplishments in these areas of emphasis.

In January 1988, the College Executive Council of the Dean—five department heads, two associate deans, and the director of administration—plus two faculty who had recently served on the council, went on retreat for a mid-term review of progress on our Q4E plan. The evaluation, two and one-half years into our five-year plan, included an assessment of accomplishments, of what seemed to account for that progress, of what challenges remain, and of what kind of redirection is needed.

We were especially pleased with some tangible measures: a near doubling of refereed publications, a 70 percent increase in outside grants and contracts, and recognition and awards for achievement going to about 20 percent of our faculty during each of the past two years. In addition, we were pleased by external advisors' perceptions of an increase in visibility and credibility accorded the College. The Q4E final mid-term review and assessment will be completed with the help of faculty and external advisors during the spring meeting of the College Guidance Council in April.

A vital influence on direction and goal setting in our Quest For Excellence has been advice from our several external groups, including the FWR Guidance Council, a 45-person group of state, regional, and national leaders representing all natural resource interests; a Forest Nursery Advisory Committee of 20 representatives from Idaho's seedling industry and reforestation interests; executive committees of the Inland Empire Tree Improvement Cooperative and the Intermountain Forest Tree Nutrition Cooperative; and external reviewers of the Cooperative Park Studies Unit and the Idaho Cooperative Fish and Wildlife Research Unit. Furthermore, the research productivity associated with $285,000 of McIntire-Stennis (federal) funds is reported annually in comparison with the 61 other natural resource schools and colleges, and periodic reviews are conducted by the Cooperative State Research Service of USDA—the most recent review in February 1987. Our 3,600 college alumni are represented by an FWR Alumni Association with a board of trustees that meets at the College twice annually and provides advice, primarily directed at teaching and student affairs. The advice from these external groups helps make all our programs more timely and relevant, and they are a major asset of the College.

During 1987 we also gave major emphasis to completing plans for management of facilities that help support our research programs, including the Clark Fork and McCall Field Campuses, the Experimental Forest, the Forest Research Nursery, the Taylor Ranch Field Station of the Wilderness Research Center, and the Lee A. Sharp Experimental Area, all described in this issue of *Focus*. These facilities add strength and diversity to our College programs and provide a much-needed link to our regional publics and natural resource industries in the state.

The College takes pride in a balanced, data-based, and reasoned approach to renewable resource issues. We believe the College can provide important leadership in the natural resource affairs of Idaho and the region, as analysts—but not as advocates. During the past year, College experts have been called upon for information to assist with the improvement of land management for all of the renewable natural resource specialties, their respective industries, and related economic enterprises. Two highlights were our *Report to the Governor on the Idaho Timber Supply Study and Forest Plan Effects on Timber Supply* and currently, the Idaho Leisure Travel and Recreation Study.

We are emphatic in our quest for balance and in our belief that Idaho and the Northwest need to make the most of all of our natural resources in combination, and not emphasize one use at the expense of others.

I hope you have enjoyed this year's *Focus*. If you have any questions or comments please feel free to write or call. We appreciate your input on how our programs and information can better serve you.

John C. Hendee

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