FOREST RESEARCH LABORATORY

Annual Report 1980

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JOHN GARLAND, Logging Systems
CHARLES SUTHERLAND, Forest Management

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DIRECTOR'S REPORT

Economic conditions this year again provided a striking illustration of how important forests and forest products are to Oregonians—*all* Oregonians. An induced reduction early this year in the markets for lumber, plywood, and particleboard and the subsequent reduction in timber harvests have been promptly reflected not only in unemployment in forest-based communities but also in reduced public services, education, and human resources programs *throughout Oregon*. Thus, all Oregonians will benefit from research that results in stronger markets for Oregon timber species, in more efficient timber-growing, protection, and harvesting practices, in more timber becoming available for future harvests, and in expansions in other forest benefits. And, indeed, such efforts are the business of the Forest Research Laboratory, the forestry research arm of the State of Oregon and Oregon State University.

But many of you reading this report may be able to benefit directly as well as indirectly from Laboratory research. Designed to provide information that will enable more effective management and wiser use of Oregon's forest resources and wood-using industries, the Laboratory's research program is focused on the problems of forest owners, plant managers, foresters, public officials, and forest users. And you may be one of those who are using, managing, or regulating those resources. Therefore, in this section of the report, I should like to suggest how you might more successfully take advantage of our research results, and perhaps influence the emphases of our future research.

As usual, this annual report has four other major sections. Program Highlights for 1980 will indicate the scope of our research by describing the Laboratory's six research program areas and highlighting recent results in each. Activities to ensure that research results are used are highlighted in Extending Research Results. The Publications section will give you the titles, significance, and

availability of the University's forestry research reports of the past year. And the Budget Summary outlines the Laboratory's current sources of research funding and areas of research investments.

Discovering Research Results

Research publications are the scientific community's traditional means of reporting and documenting its work and its results. Accordingly, Laboratory scientists regularly publish their research results in various journals and bulletins. However, many scientific publications are structured around the research project, rather than the user problem which the research is eventually intended to help solve. Thus, not all forestry research publications are immediately or directly useful to forest owners or managers—many are directed to other scientists as an essential intermediate step in developing problem-solving information.

On the other hand, the University's extension and short course programs do synthesize the latest research results that are directly applicable in the solution of specific kinds of forestry problems. These short courses thus provide results in a particularly useful format and also offer the opportunity to discuss research results and applications. You can keep up with statewide and regional short course offerings of Laboratory, School of Forestry, and Extension faculty by reading "Forestry Update," a free quarterly newsletter prepared by forestry extension specialists in Corvallis. Write us and have your name put on the "Update" mailing list.

Locally, other forestry short courses are available in many Oregon communities through county extension offices. Locations of county forestry extension staff and examples of their programs are described on pages 27 through 32 of this report.

Extension and Laboratory scientists sometimes also collaborate in writing publications which synthesize the latest research results that are relevant to some forest use or management problem. Thus, Extension is a valuable partner in the Laboratory's effort to get its research results into use.

Letters, telephone calls, and visits to Laboratory or Extension staff are other ways to discover the latest information that is relevant to some forestry problem or decision you are facing. I suggest you start with your local forestry extension agent or the appropriate extension specialist here at the Laboratory. Or you may wish to call the Laboratory Department most likely to be working on the problem—names are on the first page of this report.

Influencing Future Research

Contact with the Laboratory may enable you to find just the information you need. Or we might refer you to another university or federal research agency where particular research of interest is being conducted. Or we might simply have to report that neither we nor others are pursuing such research at this time and we know of no relevant information. When this occurs, you may wish to question our research priorities by describing the importance of the information you need. Conversations or correspondence with me or with the appropriate Laboratory staff is one way to influence our priorities for future research.

Relaying such information needs and priority opinions to Laboratory program leaders is also an important function of forestry extension agents and specialists. Thus, they too are a very good place to start.

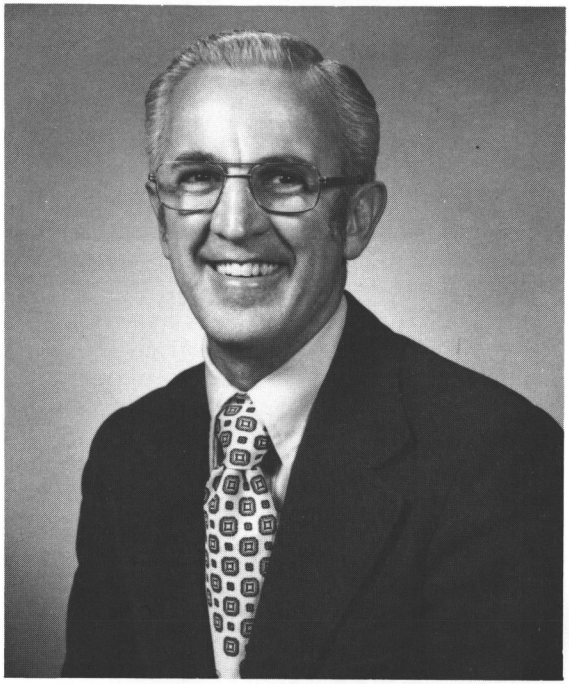
Another is to discuss the nature and importance of the problem, and the information needed, with a member of the Laboratory's Forest Research Advisory Committee (see page 70). Conversations with committee members are particularly appropriate when you feel that some phase of the Laboratory's program deserves greater attention, or that a new area of research activity should be developed.

Participation in Advisory Committee meetings is also possible.

For some, direct participation in Laboratory research is also an effective means of both influencing research direction and learning research results. (The extent of such participation is indicated by the list of research cooperators on the following page.) We do not conduct proprietary research—*all* of our research results are available to *all* potential users. But federal and state agencies and other groups regularly do initiate or accelerate our research in areas of particular interest to them by providing research grants or contracts or by other useful support. In fact, for some research, such as studies of harvesting systems, we may initiate the study only if such cooperation is available—to make sure the research is practical and to assure ourselves that the research is of high value to potential users. "Forestry Update" will keep you informed of studies that are in the planning stage and thus particularly susceptible to your suggestions and participation.

FIR (Forestry Intensified Research) is an ambitious new research and educational effort that is being developed in direct response to the requests and support of public and private forestry agencies, foresters, community agencies and officials, and private citizens in southwestern Oregon. This cooperative program involving research by ourselves and the Pacific Northwest Forest and Range Experiment Station is described on pages 33 and 34.

To meet the most important needs of Oregonians for forestry information, our research program must change continuously. Thus, we and our Advisory Committee are always open to information on emerging forestry problems and new ideas regarding productive areas of research. I invite your active participation.



Carl H. Stoltenberg

Carl H. Stoltenberg
Director

OUR COOPERATORS

Research of the Laboratory is supported by numerous contributions from individuals and organizations. These contributions range from providing land, materials, manpower, and financial support to assisting in planning and technical reviews. We gratefully acknowledge the valuable contributions during 1979-80 of the following individuals and organizations:

Agrashell Incorporated
American Can Company
American Hardboard Association
American Institute of Timber Construction
American Plywood Association
American Wood Preservers' Association
Battelle
Bauer Brothers
Baxter and Company
Benton County Parks Department
Bohemia Incorporated
Boise Cascade Corporation
Bonneville Power Administration
Bordon Chemical Company
British Columbia Forest Service
Brooks-Scanlon Incorporated
California Redwood Association
Canadian Forestry Service
Canadian Wood Council
Caterpiller Tractor Company
CH2M Hill
Champion International Corporation
City of Portland Parks Bureau
Cone Lumber Company
Consolidated Laboratory Services, National Environmental Research
Consumers Power Incorporated
Crown Zellerbach Canada Limited

Crown Zellerbach Corporation
Curry County
Douglas County
DR2 Enterprises
Electric Power Research Institute
Evans Product Company
Fibron Corporation
FMC Corporation
Frank Lumber Company
Fruit Growers Supply
Georgia-Pacific Corporation
Gilpin, Walter
Industrial Forestry Association
Inter-Pacific Resins
International Paper Company
Jackson County
John Deere
Josephine County
Joslyn Manufacturing and Supply Company
Kaiser Gypsum
Koppers Company
Longview Fibre Corporation
Masonite Corporation
MacMillan and Bloedell Limited
McCrae, Kenneth
McFarland and Company
Medford Corporation
Menasha Corporation
Monsanto Corporation
National Forest Products Association
National Tank and Pipe Company
National Wood Tank Institute
Neptune-Microfloc Incorporated
Nordson Incorporated
Northwest Forest Pest Action Council
Northwest Hardwood Association
Oregon State Department of Energy
Oregon State Department of Forestry
Oregon State University
- Agricultural Experiment Station
- Computer Center
- Department of Agricultural Chemistry
- Department of Animal Science
- Department of Botany and Plant Pathology
- Department of Civil Engineering
- Department of Crop Science
- Department of Entomology
- Department of Fisheries and Wildlife
- Department of Microbiology
- Department of Soil Science
- Department of Statistics
- Department of Zoology
- Extension Service
- Sea Grant College Program
- Water Resources Research Institute

Oregon State Wildlife Commission
Pacific Northwest Regional Commission
Pacific Power and Light Company
Plywood Research Foundation
Portland General Electric Company
Potlatch Corporation
Publishers Paper Company
Robert Dollar Company
Roseburg Lumber Company
Runckel, William J.
Shelter Products
Simpson Timber Company
Southern Pacific Land Company
Southern Pacific Transportation Company
St. Regis Paper Company
Starker Forests
Stump, Jack

Sun Studs Incorporated

Technical Committee of the Acoustical and Board Products Association

Temple Industries Incorporated

Timber Products Inspection Incorporated

Timber Services Company

Trusjoist Corporation

University of British Columbia

University of Oregon

University of Texas

University of Washington

U.S. Department of Agriculture
- Forest Service
  - Equipment Development Center
  - Forest Products Laboratory
  - Intermountain Forest and Range Experiment Station
  - North Central Forest Experiment Station
  - Northeastern Forest Experiment Station
  - Pacific Northwest Forest and Range Experiment Station
    - Forestry Sciences Laboratory
  - Rocky Mountain Forest and Range Experiment Station
- McIntire-Stennis Fund
- Science and Education Administration, Cooperative Research

U.S. Department of Energy
- Energy Research and Development Administration
- Oak Ridge National Laboratory (Contractor, Union Carbide, Nuclear Division)

U.S. Department of Interior
- Bureau of Land Management
- Bureau of Sport Fisheries and Wildlife
- National Park Service

U.S. Environmental Protection Agency

U.S. National Science Foundation
- International Biological Program

U.S. Navy Civil Engineering Laboratory

Washington State Department of Natural Resources

West Coast Lumber Inspection Bureau

Western Kraft Company

Western Wood Mouldings and Millwork Association

Western Wood Preservers' Institute

Western Wood Products Association

Weyerhaeuser Company

Washington Irrigation and Development Company

Williamette Industries Incorporated

PROGRAM HIGHLIGHTS

Work at the Forest Research Laboratory (FRL) is divided into six program areas. The following sections highlight representative research in each of these areas over the past 18 months. No effort has been made to summarize all of the work in progress. Rather, each section presents significant results from a few of the many studies under way or recently completed in that program.

Forest Regeneration

At the FRL, work on regeneration is devoted to improving the planting stock for Oregon's forests and to insuring its establishment and growth. Specifically, this research focuses on the genetic improvement of our major conifers, proper nursery and planting practices for these species, and the control of vegetation that competes with plantations of young trees. Over the past 18 months, significant progress has been made in each of these areas.

Research on genetic improvement is directed principally to Douglas-fir, Oregon's main crop tree. One major emphasis is determining how provenance (area of seed origin) affects the performance of seedlings outplanted in distant locations. FRL researcher W. K. Ferrell has discovered, for example, that Douglas-firs from coastal provenances are less drought resistant than those from inland sources and that even seedlings from north and south slopes in the same area can differ in this trait. Knowledge of such differences will be crucial in matching seeds with the proper sites for future plantings.

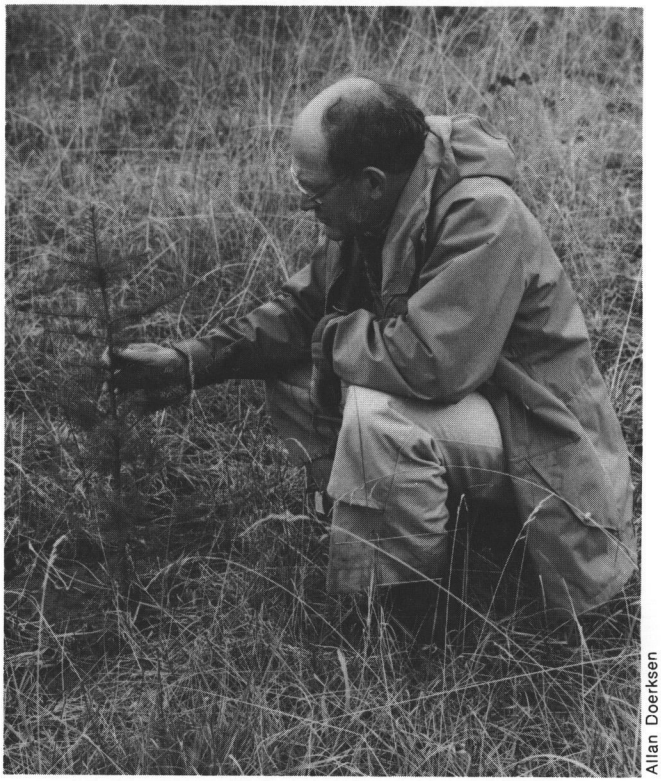
Drought resistance in Douglas-fir seedlings may be intimately connected with the opening and closing of the stomates (breathing pores) on the needles. J. D. Johnson, a graduate student working with Ferrell, recently found that when the air humidity drops, Douglas-fir stomates close rapidly. Ferrell believes that investigation of the mechanism

controlling rapid closure of stomates may provide the key to breeding drought-resistant trees.

Tree improvement programs, like all breeding programs, depend on crossing selected parents in order to obtain progeny with desirable characteristics. For trees, this crossing involves the collection and transfer of pollen to targeted parents. In Douglas-fir, however, good flowering years often occur in 3- to 5-year cycles, necessitating pollen storage until conditions are right for artificial pollination. Geneticist K. K. Ching has demonstrated that Douglas-fir pollen can be safely stored up to 5 years if properly freeze-dried. One key to successful freeze-drying, he says, is to start with pollen at a moisture content low enough to prevent the formation of ice crystals, which can puncture the walls of pollen cells.

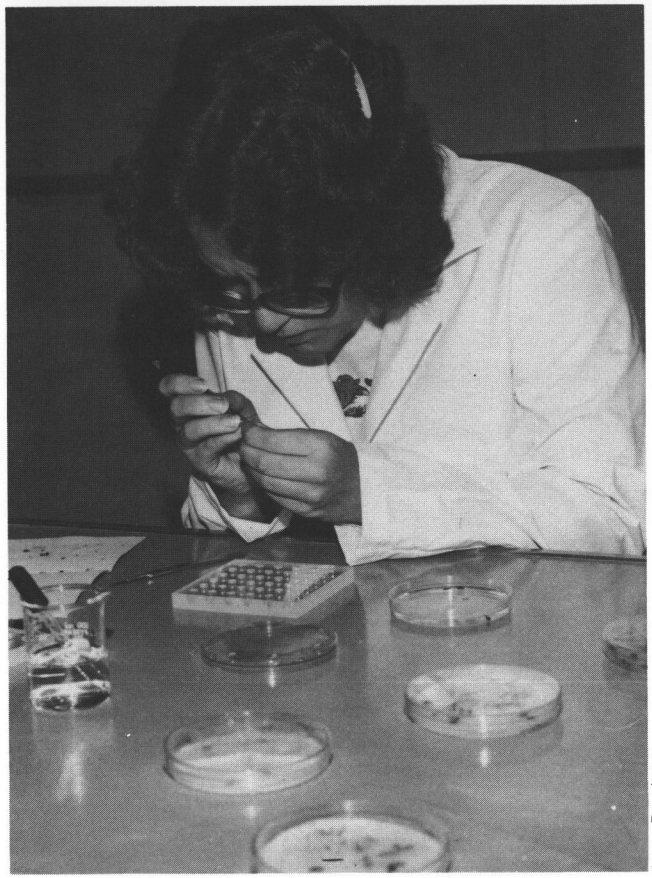
In tree breeding programs, large quantities of genetically improved seeds are produced in seed orchards populated by clones (groups of genetically identical plants) of selected trees. In such orchards, it is important to assess how effectively each clone contributes to the orchard's seed production. By analyzing the enzymes in seeds and in the clones within an orchard, researcher W. T. Adams can pinpoint which parents crossed to produce the seeds. This technique also has application in certifying the parentage of seed lots to be used in tree planting programs. Adams can also estimate the amount of self-pollination within (and of pollination from trees outside) an orchard. Such information is useful in designing and managing seed orchards to avoid these undesirable occurrences.

It is also important to assess a clone's pollen production relative to that of other clones. Adams has learned that clonal differences in numbers of pollen grains per pollen cone are overshadowed by the large clonal differences in number of pollen cones per tree. Clonal differences even extend to the weight of individual pollen grains, a finding that



Allan Doerksen

FRL researcher W. K. Ferrell examines a drought-resistant Douglas-fir seedling on a dry site.

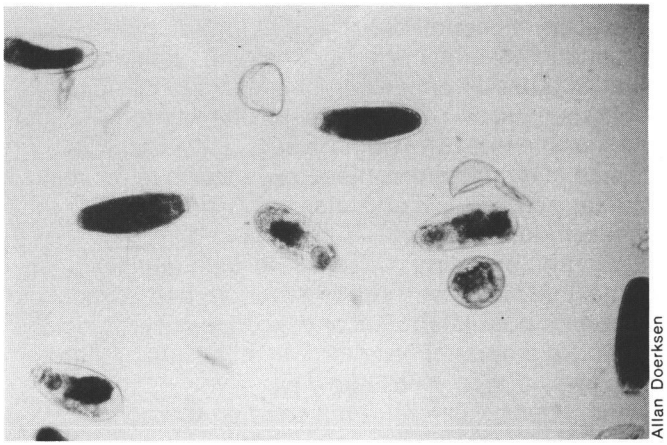


Allan Doerksen

Preparing seed tissue for enzyme analysis. Each petri dish contains seeds from a different clone in a seed orchard.

will be important in formulating pollen mixes, which previously were obtained by mixing equal weights of pollen from each desired source.

If improved planting stock is essential to Oregon's reforestation program, so are the tree nurseries that provide millions of seedlings for outplanting on thousands of acres each year.



Allan Doerksen

Germinating Douglas-fir pollen. FRL research has shown that the weight of individual pollen grains is genetically controlled.

Nursery practices are continually being assessed at FRL and recommendations made for their improvement. For example, D. P. Lavender and M. L. Duryea recently evaluated the practice of "wrenching" Douglas-fir seedlings—drawing a blade under the nursery bed to reduce root surface and, in some cases, enhance field survival by improving the ratio of shoot and root tissue. They discovered that wrenching is not necessary with this species if seedlings are properly irrigated in the nursery. This finding is expected to save nurserymen considerable expense without any sacrifice in the production of hardy seedlings.

So important are Oregon's tree nurseries to her welfare that former State Forester J. E. Schroeder and Laboratory Director C. H. Stoltenberg set up a Task Force on Nursery Soil Management in 1979. Its assignment was to examine problems associated with management of Oregon's tree nurseries and nursery soils and to determine whether action was required by either the FRL or Oregon State Department of Forestry. The Task Force's major recommendations, just released, were that the FRL establish a center for coordinating research and disseminating information on all aspects of nursery management and for analyzing soils and seedlings for nurserymen throughout the State. Such a center would draw upon the expertise not only of FRL researchers and extension specialists but also of other Departments (mainly Soils, Entomology, Botany, and Plant Pathology) at Oregon State and other Universities. Charging the nurseries for soil and plant analyses would avoid budgetary problems for FRL, while the coordination of available services would greatly improve the usefulness of the data obtained, according to the Task Force. Initially, the center would ensure that current knowledge on nursery management is being applied across the State. Later, it would initiate additional research.

Proper matching of tree species and sites is critical to Oregon's reforestation efforts, especially when harsh sites are involved. FRL researcher Michael Newton is evaluating the proper species and age of conifers to use in regenerating sites in five habitat types associated with the Cascades and Coast Range. After 3 years of study, he reports that 3-0 Englemann spruce is outperforming grand and noble firs, Douglas-fir, and ponderosa pines in subalpine areas (4,000 feet or more in elevation). In the foothills (up to 1,500 feet) characterized by dry summers, Sitka spruce is performing better than grand or noble firs and comparably to ponderosa pine. In the Coast Range, it is outperforming all three species. Newton reports that small

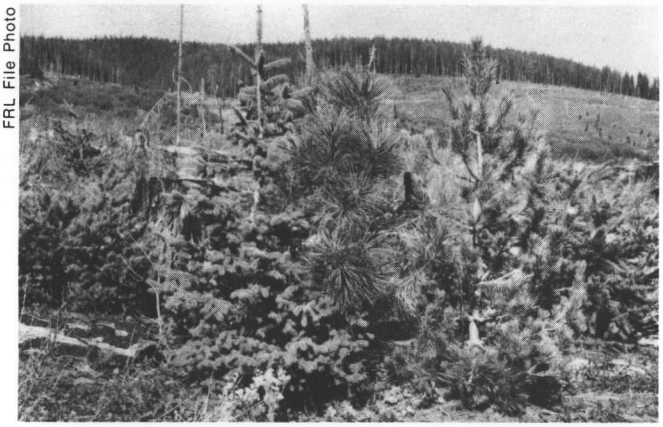
FRL File Photo

"Wrenching" Douglas-fir seedlings by pulling a tractor-drawn blade under the nursery bed is unnecessary if the seedlings are irrigated properly.

FRL File Photo

Tree nurseries are vital to Oregon's reforestation effort.

FRL File Photo



Comparative planting of 10-year-old Englemann spruce, ponderosa pine, Douglas-fir, western hemlock, and western white pine at 4,000 feet in the Cascades.

FRL File Photo

In southwestern Oregon, brushfield species such as broadleaf evergreens and hardwoods must be controlled if desirable species such as Douglas-fir and ponderosa pine are to survive and thrive.

containerized stock and 3-foot wildlings of Douglas-fir and western hemlock are doing equally well in the 5- to 10-mile-wide belt blanketed by summer fog along the Pacific coast. Further inland where drier summers reduce juvenile growth, larger stock of both species outperforms containerized or small, bare-root seedlings. On extremely dry sites at high elevations, small seedlings appear better able to tolerate transplanting than do large trees.

But the most careful matching of seedlings with sites will be wasted if newly planted seedlings are crowded out by competing vegetation. This problem is particularly acute in the brushfields of southwestern Oregon, where broadleaf evergreens and hardwoods often choke Douglas-firs and ponderosa pines. Because of the widespread need for brush control, a cooperative dedicated to solving this problem was formed in January 1980. Known as CRAFTS (Coordinated Research on Alternative Forest Treatments and Systems), the new organization will have as its focal point the FRL, with cooperative support provided by 12 other organizations including the Bureau of Land Management, the Oregon State Department of Forestry, and several forest products companies. Its efforts will be centered on comparing treatments for controlling unwanted vegetation, assessing their environmental impacts, and providing the basic biological information needed to develop new control treatments.

Several CRAFTS projects are already under way, ranging from determining the exposure of forest personnel to the herbicide 2,4-D to refining the recommendations for using the new herbicides glyphosate, fosamine ammonium, and triclopyr.

Under the CRAFTS aegis, Newton is evaluating 16 aerial sprays in the southwest Oregon brushfields. Early results suggest that triclopyr or 2,4-D applied in early August at the rate of 3.3 kilograms per hectare selectively controls a broad spectrum of evergreen brush species with minimal damage to conifers. Further results of the program will be announced in future Annual Reports.

Forest Ecology, Culture, and Productivity

Work at the FRL on ecology, culture, and productivity is concerned with factors affecting site fertility and tree nutrition and with tailoring thinning and harvesting practices to fit Oregon's varied forests. Specifically, this research is devoted to understanding the mechanisms by which nutrients are cycled through forest stands and to devising harvesting systems that do not impair site productivity.

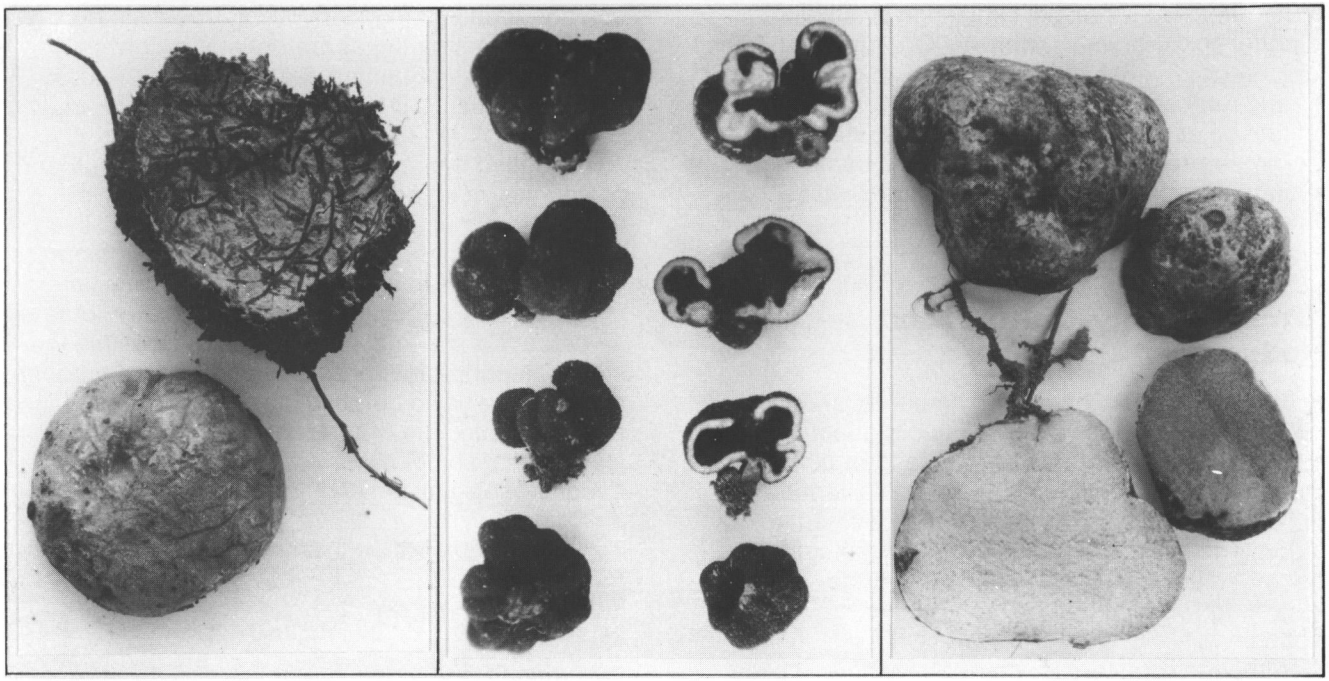
Although foresters for many years have measured the above-ground portions of trees in nutrition studies, they are now concentrating on the below-ground portions as well. In studying the role of fine roots in Douglas-fir stands, researchers R. K. Hermann, Daniel Santantonio, and E. M. DePree have discovered that fine roots—the most nutrient-rich portion of the tree's below-ground structure—die and are replaced three to five times faster than foliage. The extensiveness of these structures and their rapid turnover ensure that, as fine roots decay, an abundant supply of nutrients is returned to the soil and organic matter is added.

In forest stands, nutrient uptake is enhanced by soil fungi that form symbiotic structures with tree roots. These structures, known as mycorrhizae (literally, *fungus-roots),* provide a protective mantle around the roots and increase their absorptive area.

In a cooperative project involving scientists from the Forest Research Laboratory of the University and the Forestry Sciences Laboratory of the U.S. Forest Service, R. D. Fogel, Kermit Cromack, Jr., G. A. Hunt, A. W. Todd, and J. M. Trappe are investigating the role of mycorrhizae in the nutrition of Douglas-fir stands. These researchers have learned that, because mycorrhizae are short-lived, they account for half the annual turnover in biomass (matter composed of living organisms) within a stand. As they decay, these symbionts contribute 42 percent of the total nitrogen released within the stand, an important consideration because nitrogen is one of the basic building blocks of plant (and animal) tissue. The FRL research team has also learned that some mycorrhizae are able to decompose cellulose and lignin in forest litter and

FRL File Photo

Fine roots of Douglas-fir are a major source of the nutrients and carbon needed to support soil organisms.



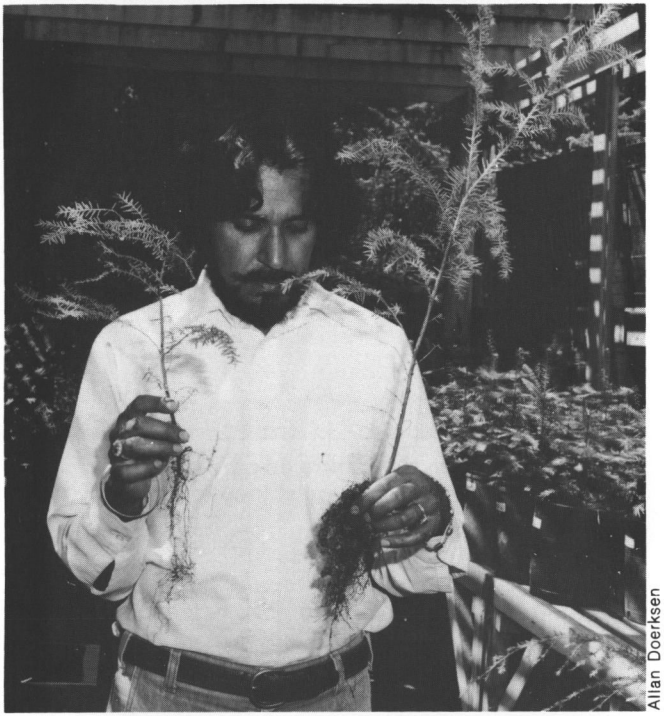
U.S. Forest Service

In addition to forming symbionts that enhance nutrient uptake, mycorrhizal fungi also produce edible fruiting bodies called truffles. Pictured are truffles of fungi associated with Douglas-fir: *Elaphomyces granulatus* (left), *Genea harknessii* (center), *Rhizopogon hawkeri* (right).

humus. They speculate that someday fungi capable of producing such mycorrhizae may be introduced in partnership with planted trees on harsh, nutrient-poor sites.

Despite their role in nutrient uptake, mycorrhizae do not function well in association with all fertilizers. This was the recent finding of researchers D. P. Lavender and R. S. Gill, who have been seeking the reason why western hemlock responds poorly to certain fertilizers in some field trials. They have discovered that both urea and calcium nitrate adversely affect western hemlock's ability to absorb phosphorus, whereas ammonium phosphate does not. The reason? The first two fertilizers, unlike ammonium phosphate, sometimes kill mycorrhizae on hemlock roots. This finding will be valuable in future plantings on nutrient-deficient sites.

Maintaining site productivity necessarily involves the prevention of soil erosion during logging. This is especially important in thinning young stands on steep terrain or fragile soils, where existing technology for handling old-growth logs is unsuitable. Development of environmentally acceptable methods for such operations is the assignment of several scientists specializing in forest engineering. One of these researchers, L. D. Kellogg, recently demonstrated that tree-length logs can be yarded (collected at a central point)



Allan Doerksen

FRL researcher Rangit Gill compares spindly western hemlock seedling with nonmycorrhizal roots (left) and vigorous hemlock with heavily mycorrhizal roots (right). The seedling on the left was fertilized with urea; the one on the right was not fertilized.

downhill without seriously damaging the stand or soil. To accomplish this feat, he used a small cable yarder and a multispan skyline (which partially suspends logs in the air during transport). The new technique will allow stands originally logged by downhill hi-lead cable systems (with logs dragged on the ground) to be thinned without constructing additional roads.

Kellogg also showed that the cost of yarding small trees (10 to 14 inches in diameter) can be reduced 25 to 40 percent. The key is prebunching—felling trees along lines at an angle with the skyline and pulling them to the skyline corridor with an inexpensive machine—and then swinging the logs to the landing with a conventional cable yarder. This method not only reduces costs but also increases productivity by allowing a full load of logs to be brought to the landing each time.

Can older, depreciated yarders be used with skylines to thin very small timber (6- to 8-inch diameters) economically on steep slopes? Six timber companies participating with the FRL in the Smallwood Harvesting Research Cooperative asked Kellogg to find out. After intensive study, he not only concluded that such an operation can be profitable but that adaptation of new felling and landing techniques to the handling of small timber can result in still more savings.

FRL File Photo

A Norwegian "Alp Cat" carriage on a multispan skyline allows logs to be yarded downhill.

Integrated Protection of Forests and Watersheds

Work at the FRL on integrated protection of forests and watersheds centers on devising management techniques to safeguard Oregon's renewable resources. Such efforts range from preventing insect and disease attacks on forest stands to maintaining water quality during timber harvest and road construction.

One of the most serious insect pests in the Pacific Northwest is the mountain pine beetle. Each year, this insect destroys millions of dollars' worth of standing timber by introducing a blue-stain fungus that prevents the uptake of water and nutrients in trees. Researchers R. H. Waring and G. B. Pitman are seeking silvicultural techniques that prevent beetle attacks without the need for costly and controversial insecticides. Their experiments on 120-year-old stands of lodgepole pine indicate that removing less vigorous trees immediately increases the resistance of remaining trees against attack. In thinned plots, even the use of chemical attractants failed to cause beetle attack, whereas such attractants in unthinned plots caused trees to be attacked and killed.

How, then, can foresters select the less vigorous trees with low resistance to beetle attack? Waring and Pitman have devised a method of detection based on a tree's carbohydrate reserve. This reserve can be gauged by coring the tree to determine the width of its most recent, complete sapwood ring. Small amounts of current sapwood indicate low amounts of carbohydrates and low vigor and resistance, whereas large amounts indicate high resistance. Testing of this method will be completed this fall. If successful, not only will it increase timber revenues by pinpointing trees that should be cut before their harvest value is destroyed, but it will also allow the more vigorous trees to survive and grow until they reach full marketability.

FRL File Photo

Coring a tree to determine its carbohydrate reserve. Low reserves indicate low resistance to attack by the mountain pine beetle.

If Oregon's forests must be protected against natural pests, they must also be safeguarded against management practices that jeopardize soil and water. FRL researcher R. L. Beschta has been assessing the impact of harvesting and other activities on sediment concentration in nearby streams. Such changes are difficult to determine because the concentration of suspended sediment can vary as much as 1,000 percent during a single rainstorm even in an otherwise undisturbed area. Despite this wide variation, Beschta has shown that sediment concentrations are predictable if sampling is intensive. Thus, deviations from natural fluctuations in suspended particles can be identified and their magnitude determined. Such a capability is essential in enforcing Oregon's Forest Practices Act and the resulting guidelines known as Best Management Practices, both of which emphasize the protection of soil and water.

FRL File Photo

Safeguarding water quality of forest streams depends on our ability to determine the effects of harvesting and other activities on sediment concentrations.

Evaluating Forest Uses, Practices and Policies

At the FRL, forest uses and practices are evaluated so that resource planners and private timber owners will have the information needed for making sounder management and policy decisions. Such evaluations have been useful for setting levels of development and usage on recreational areas, analyzing how governmental actions affect timber supply, and even for determining how various forms of land ownership affect forest management when estate taxes are paid at time of death.

Because recreational preferences differ, resource planners need to know the costs of managing facilities that offer various kinds of experiences. Only with such knowledge can they allocate available money and people to provide the services recreationists want. To help planners make such allocations, FRL researchers K. C. Gibbs and W. S. van Hees recently analyzed the costs associated with 111 campgrounds operated by the U.S. Forest Service in Washington and Oregon. Each campground was categorized according to its degree of development or improvement; total annual costs ranged from $800 for the most rustic to $65,000 for the most highly developed. From their data, Gibbs and van Hees derived equations for predicting campground costs on the basis of size and use. Recreation planners in both the public and private sectors can now use these equations to project the costs of existing and proposed facilities.

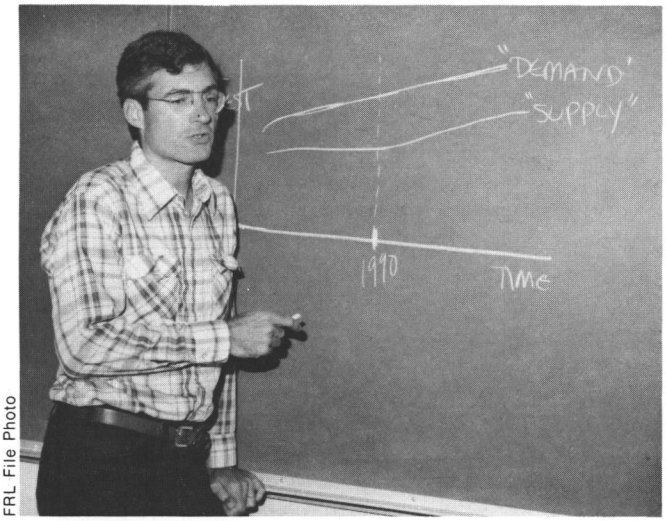
The number of people on a recreational area can affect how well we enjoy being there, especially on a wilderness or white-water river where much of the attraction lies in a personal confrontation with nature. One such area is southwest Oregon's Rogue River, parts of which are becoming overcrowded as the sport of river floating grows increasingly popular. Managers regulating recreation on the National Wild River section of the Rogue for the U.S. Forest Service and Bureau of Land Management recently asked researcher B. B. Shelby to help them establish appropriate levels of usage. Shelby complied by polling the recreationists themselves. The consensus was that a group of recreationists on the Rogue should encounter no more than five other groups per day, that such encounters should occur at no more than two out of five scenic areas along the river, and that no more than one night in five should be spent in contact with another group. Recreation managers for the two government agencies will use these responses along with other data to set launching quotas that allow maximum usage commensurate with maximum enjoyment.

FRL File Photo

For effective management, recreation planners must be able to predict the costs of existing and proposed campgrounds.

Like land managers on localized areas, those who set regional and national policies need to know the consequences of their decisions. How fast will stumpage prices rise in western Oregon over the next decade if log exports are limited? Or how

might assistance programs aimed at Southern forest landowners influence Western lumber markets? FRL economist D. M. Adams has designed a computer model to help answer such questions. Known as the Timber Assessment Market Model, it predicts how industrial and governmental actions will affect the supply and demand and, ultimately, the prices of wood products. It can evaluate trends in timber harvesting across the entire United States



FRL File Photo

FRL economist D. M. Adams explains the relationships between supply and demand for wood products. His Timber Assessment Market Model predicts how governmental and industrial actions affect these relationships.

and Canada or, conversely, make projections about stumpage prices within a single state or half-state. The U.S. Forest Service was confident enough of the model to use its price projections in this year's report to Congress as required by the Resources Planning Act. For its next such Congressional report in 1985, the Forest Service will use Adams' model to assess its national timber supply and project the consequences of alternative management policies. Adams stresses, however, that his model will benefit not only governmental agencies but anyone interested in long-term economic planning about forest resources.

Work on another model developed at FRL—one that simulates forest management and harvest scheduling to predict future harvests and their effects on forest inventories—is now completed and available in published form. Known as the Timber Resource Economic Estimation System (TREES), the model was developed by researchers K. N. Johnson, H. L. Scheurman, and J. H. Beuter and documented for publication by P. L. Tedder, J. S. Schmidt, and J. C. Gourley. Its characteristics and capabilities are outlined in four volumes: a user's manual, a mathematical analysis and policy guide, an example problem guide, and a computer analyst's guide. Futher information on these volumes appears in the list of publications at the end of this report.

Economist Tedder is also formulating feasible harvest schedules for areas administered by the U.S. Forest Service and Bureau of Land Management in western Oregon. He is also tracing the impact of these schedules on the region's long-term sustainable harvest. Tedder hopes to determine how combining the inventories of both agencies for harvest scheduling could affect harvest revenue sharing to counties in the region. Thus, his findings will be important to Oregon's citizens and to her legislators on the local, state, and federal levels.

FRL research is also aiding in the decision-making process of private, nonindustrial forest landowners, whose holdings comprise one-fourth of Oregon's forest resources. Such lands may be heavily taxed at their owners' deaths, often necessitating premature cutting of timber or forced sales, to the detriment of productive long-term management of these important resources. Researcher C. F. Sutherland, Jr. is looking for

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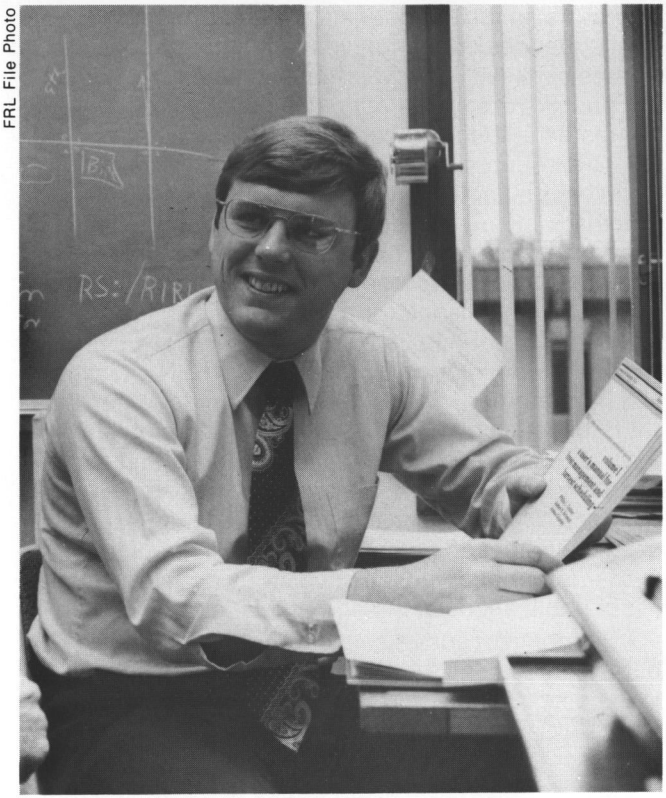


FRL author P. L. Tedder displays the first of four recently published volumes documenting the TREES model.

alternative ways to fund estate taxes so that their effect on forest management will be lessened. He has found that there are three strategies of ownership—sole-proprietorships, partnerships, and corporations—and that each has a different effect on the amount of taxes paid and the transfer of property from one generation to the next. Under certain forms of sole-proprietorship, for example, property may be taxed 1½ times in the process of passing it on. Such taxes can be reduced, however, by the "gifting" of property to a spouse or to children, although this procedure limits control of the property by the original owner. Under partnerships, on the other hand, the value of the property can be transferred without the owner losing control of the property itself. During the coming year, Sutherland will explore other ramifications of using partnerships and corporations to transfer forest property.

Efficiencies in Wood and Energy Use

Research at the FRL on efficient use of wood and energy centers on finding energy-saving, effective ways to manufacture wood products and extend their serviceability. Such efforts are designed to stretch Oregon's wood and energy supplies by ensuring that raw materials and finished products are fully utilized. Work in this area includes such projects as increasing the recovery of veneer from logs, enhancing the bonding ability of veneer surfaces, and preserving pilings and poles from decay.

The quantity of veneer peeled from veneer bolts (debarked logs) can be increased up to 25 percent if the bolts are preheated. But what is the best method of heating bolts, and would such an operation be profitable? While surveying the plywood industry in the West, FRL researchers Helmuth Resch and R. J. Parker investigated the three most common heating methods—steaming bolts, deluging them with hot water, and submerging them in hot water. The survey revealed advantages and disadvantages for each method: steaming is least expensive, but the discharge into nearby streams may not be permitted in some states; deluging with recirculating hot water avoids this problem but fails to heat uniformly if bolts are of varying diameters; submerging heats the surfaces of all sizes of bolts uniformly but requires the greatest initial investment and safety precautions. Profitability, concluded the

FRL File Photo

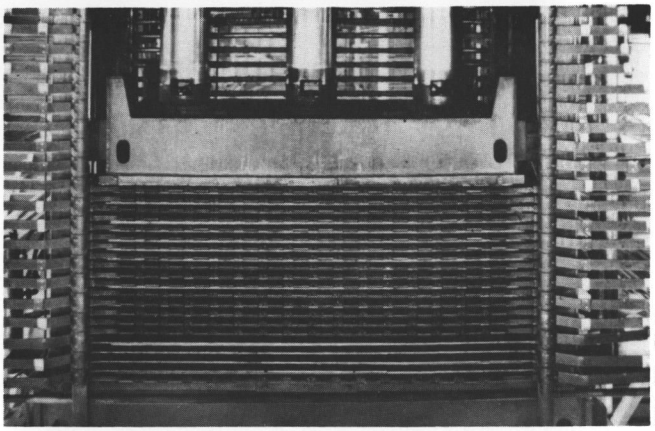
Preheating increases the quantity and quality of veneer that can be peeled from veneer bolts.

two researchers, depends on the amount and value of additional veneer recovered and on operating costs. These costs will remain within acceptable limits if existing boilers are retained and fired with wood residues from the parent plant.

To conduct their survey, Resch and Parker developed a device containing an infrared sensor and microcomputer for monitoring the temperature of veneer bolts as they are peeled. Mill operators need to know both this temperature and the amount that bolts have cooled during transfer from the heating chamber to the lathe. Thus, the monitoring device can provide a new process control tool for the plywood industry.

In the manufacture of plywood, the moisture content of the veneer affects the bonding ability of the various plies during gluing. Unfortunately, to attain uniform moisture contents, many mills tend to dry veneers, especially Douglas-fir, too much and then encounter gluing problems. Mill operators generally believe that very dry veneers fail to bond because they cannot absorb water from the glue. To test this theory, FRL researcher J. D. Wellons attempted to bond a series of Douglas-fir veneers at various moisture contents. He discovered that, contrary to prevailing opinion, extremely dry veneers fail to bond well because they absorb too much, rather than too little, water from the glue. His solution? Decrease the time between gluing and hot-pressing (applying heat and pressure) so that the veneers absorb less water from the glue. Wellons stresses, however, that this solution is proposed for mill operators unwilling to modify their drying operations and that the best solution is not to dry Douglas-fir veneers to extremely low moisture contents.

Among the large consumers of wood products are shipping and utility firms, who annually install and replace millions of dollars' worth of marine pilings and power poles. Preserving such wood from



FRL File Photo

Extremely dry veneers of Douglas-fir should be hot-pressed soon after gluing to prevent their absorbing too much water from the glue.

decay would save these firms both time and money. FRL researcher R. D. Graham, with cooperation of OSU oceanographer J. J. Gonor, has discovered that caps of creosote coal-tar cement embedded with fiberglass cloth protect pilings from the invasion of decay fungi. This technique has proved so successful that next year it will become a recommendation in the national standards of the American Wood-Preservers' Association. Earlier research by Graham and OSU plant pathologist M. E. Corden has also resulted in the development of a way to prevent internal decay of power and other poles while they are in service. Holes are drilled in the poles, filled with the liquid fungicides chloropicrin or Vapam, and plugged. The fungicide then turns into a gas that fumigates the wood for about 6 feet on either side of the hole. The Bonneville Power Administration estimates that it has treated about 15,000 power poles by this technique, extended their life by 10 to 15 years, and thereby saved itself an annual investment of $2,250,000. Research on preservation of poles is continuing.

FRL File Photo

Assuring Product and Structure Performance

At the FRL, research is conducted to ensure that wood products and structures perform well during service. Wood products must be safe for human use. And if they are to be used efficiently, they must be combined with other components into well-designed structures. Performance research thus ranges from tests for detecting potentially harmful emissions from wood adhesives to improved designs for structural systems such as wood-stud walls. Emphasis is placed on structures incorporating Oregon's timber species.

Both industrialists and consumer groups are increasingly concerned because the fumes from urea-formaldehyde adhesives in particleboard may be dangerous to human health. Particleboard is widely used in constructing new houses, especially mobile homes. In the future, building codes may restrict the use of products containing formaldehyde. To aid particleboard manufacturers in detecting and quantifying this chemical in emissions from their products, researcher J. D. Wellons recently examined all the known methods of testing for formaldehyde, especially those applicable to wood adhesives. He found that colorimetric and titrimetric methods are easy to perform and highly sensitive. Manufacturers of wood products will find these methods both effective and efficient in future quality-control tests.

In designing the floors, walls, and other structural systems in a wood-frame building, engineers and architects must know the strength of the various components, both separately and in combination. FRL researchers Anton Polensek and G. H. Atherton

Drilling holes before applying fumigants to control decay in a marina piling. If the piling is then capped with coal-tar cement, its life can be doubled.

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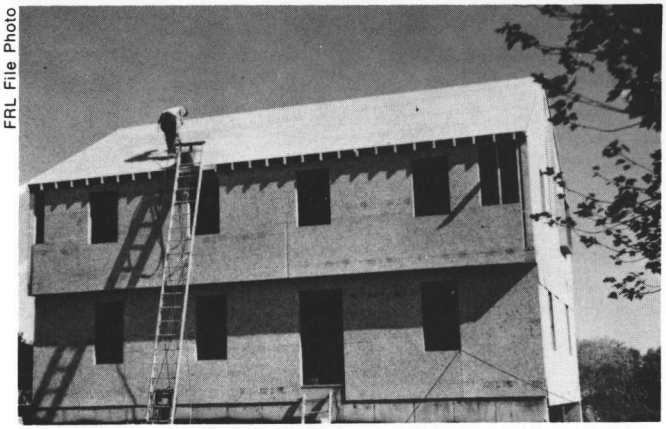

Particleboard can make an excellent wall sheathing for houses, but manufacturers must insure that particleboard products do not emit formaldehyde fumes.

have discovered that current design procedures ignore the strength and stiffness imparted to wall systems by nails. In fact, they have demonstrated that a wood-stud wall exposed to a sufficiently strong wind would deflect almost 20 percent more if half the nails joining the studs and wall coverings were removed. In cooperation with the U.S. Forest Service and lumber manufacturers, the two researchers are using this information to develop improved procedures for designing wood-stud walls. Because the strength of nails can now be accounted for in designs, lower grades of lumber can frequently be substituted. Once the new procedures are accepted by building code officials, they will thus result in safer, less costly housing for Oregonians and, indeed, for all Americans.

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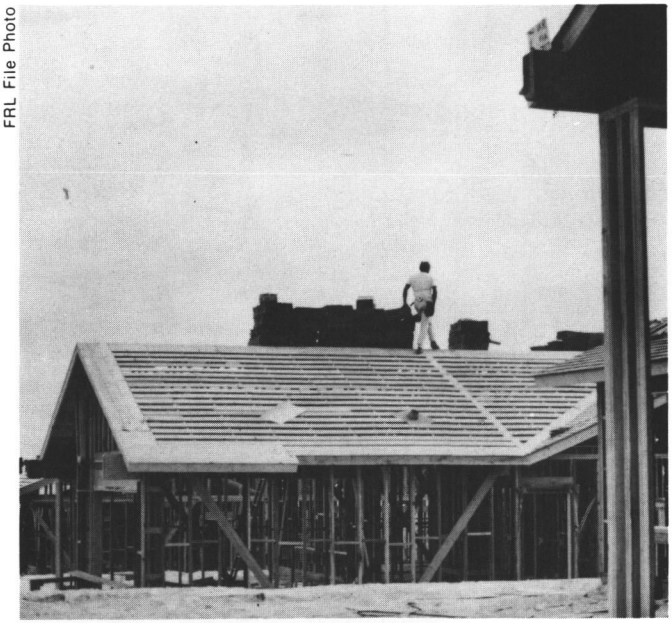


Improved procedures developed at FRL for designing wood-stud walls will result in safer, less costly houses.

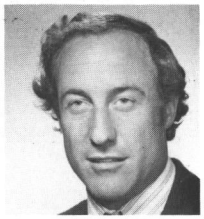
EXTENDING RESEARCH RESULTS

The goal of Extension forestry in Oregon is to provide educational programs that help woodland owners, loggers, foresters, policymakers, and those in the forest products industry make better decisions about the management and use of forest resources. These programs are designed to foster improvements in woodland production, timber harvesting, wood processing, forest and watershed protection, and public awareness of forestry.

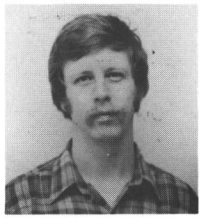
Eight extension specialists headquartered at Oregon State University concentrate on various problem areas in forestry. Several of these campus-based staff are new. Chemical impact specialist F. N. Dost of the Department of Agricultural Chemistry is now devoting most of his time to forestry issues. He will soon release a question-and-answer pamphlet on the herbicide 2,4-D. Christmas tree production is being handled by W. M. Proebsting of the Department of Horticulture. At the FRL, W. H. Emmingham is the new silvicultural specialist; N. E. Elwood is working in forest management and economics; P. W. Adams is in protection of forested watersheds, emphasizing soil erosion and compaction control and water quality; and D. R. DeYoe is conducting field trials and demonstrations on tree improvement as part of the reforestation effort.

In addition to OSU specialists, Oregon's Cooperative Extension program has 11 forestry extension agents stationed in various counties to inform small woodland owners and forestry practitioners about the benefits and techniques of intensive management. Several of these forestry agents are new, too. P. E. Oester is now responsible for Coos and Curry Counties, M. E. Mitchell for Grant and Morrow Counties, and C. G. Landgren for both Columbia County in Oregon and Cowlitz County in Washington. In 1979, these 11 county agents conducted introductory field tours and short courses on forestry for some 500 landowners who

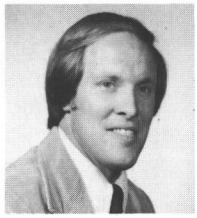
County Forestry Extension Agents



COLUMBIA,
COWLITZ
C. G. Landgren

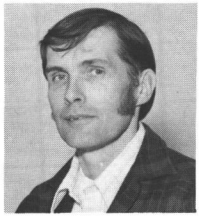


COOS, CURRY
P. T. Oester

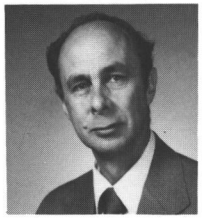


DOUGLAS
R. S. Logan

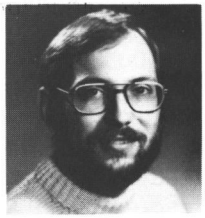
GRANT, MORROW
M. E. Mitchell



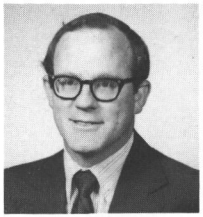
JACKSON,
JOSEPHINE
A. Campbell, III



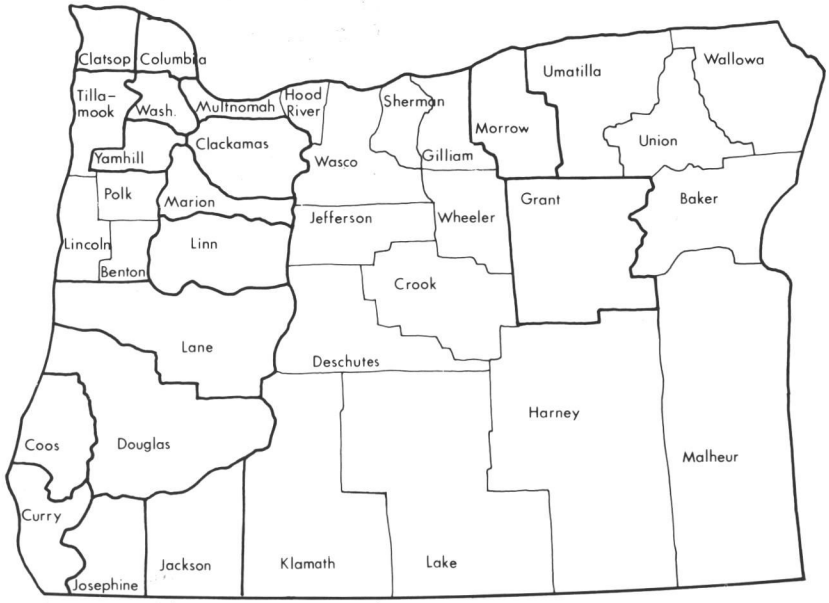
LANE
E. S. Woodard



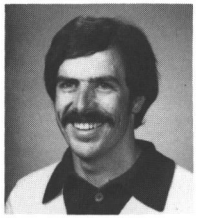
CLATSOP
M. C. Bondi



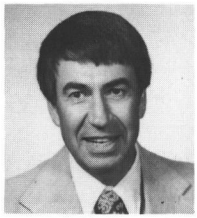
CLACKAMAS
D. F. Green



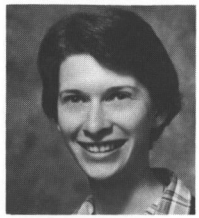
Oregon Counties



LINN
R. A. Fletcher



MARION
K. N. Brown



WASHINGTON,
YAMHILL
M. J. Shearer

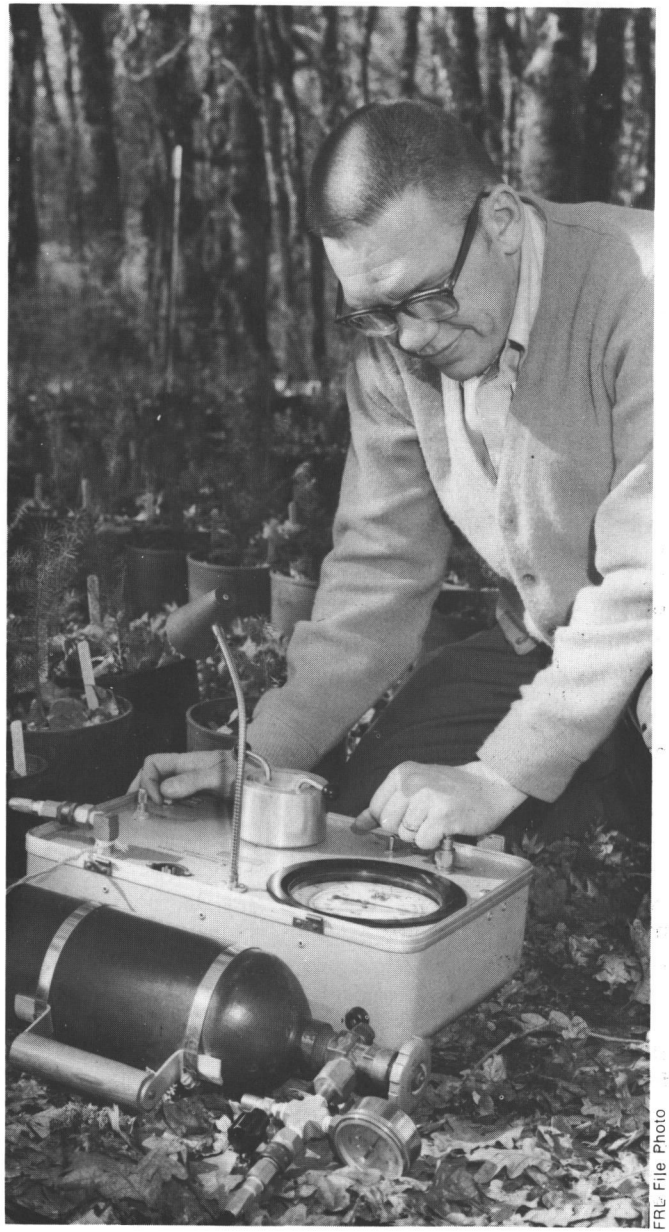
were not then managing their woodlands. In addition, they reached over 5,000 landowners with newsletters about forest management.

Establishing Programs at OSU

Extension specialists at OSU transmit research findings on specific subjects to county agents and forestry practitioners. B. D. Cleary's work as a reforestation specialist has focused on planting procedures. During the past 18 months, he and graduate student T. G. Daniels prepared training sessions on this subject for small woodland owners. They emphasized the proper time for lifting and outplanting nursery seedlings and the need for adequate soil moisture and site preparation. The sessions were actually conducted by county agents in Clackamas, Lane, Douglas, Jackson, and Josephine Counties. Average attendance was 25 to 30 people.

To learn more about reforestation in other parts of the world, Cleary participated in an international reforestation workshop in New Zealand and then studied reforestation projects in Australia. Since returning, he has conducted workshops to introduce successful new techniques from these countries for growing and handling seedlings lifted from the nursery.

New techniques in timber harvesting are relayed to loggers and woodland owners by extension specialist J. J. Garland. Over the past 18 months, he has demonstrated a new yarder, the Austrian trailer-mounted Koller K-300, throughout western and central Oregon. The purpose of his



FRL File Photo

Reforestation extension specialist B. D. Cleary demonstrates a pressure bomb. This device, which measures the internal moisture stress of a plant, can be used to ensure that seedlings are exposed to proper moisture conditions.

demonstrations was to display techniques for yarding (collecting felled timber at a central point) with simple, relatively inexpensive equipment incorporating skylines with intermediate supports. Such equipment is adapted to harvesting, thinning, and salvage work on steep slopes. Garland found that many loggers and most woodland owners were unaware of the existence of small equipment suitable for Oregon's mountainous terrain. County agents cooperated in arranging a series of eight demonstrations. Western Equipment Co. supplied the new yarder, and the Koller Co. and Forest Engineering, Inc. provided the crew. About 900 loggers, foresters, and others attended.

Extension specialist T. D. Brown alerts mill owners and operators to new techniques for manufacturing lumber and other forest products more efficiently. Because stumpage prices have risen drastically over the past 10 years, sawmill operators must obtain the highest grades and quantities of lumber possible from each log. To aid in this effort, Brown has recently devised a series of checklists on quality control for each machine center and operator in the bucking (sawing felled trees into shorter bolts) and sawmilling process. Use of the checklists allows managers and superintendents to monitor the operating efficiency of each machine center and stage in lumber manufacture. Thus far, Brown has distributed about 800 sets of checklists to sawmills in the Pacific Northwest. In addition, last year 70 sawmill managers and operators attended a short course offered by Brown on lumber quality and process control.

Brown has also developed a method for determining sawing variation and target thickness for lumber. Thus, sawmill managers can now use a desk-top calculator to determine how well a machine is sawing and to establish target thickness for lumber that will meet the desired grade with as little waste as possible.

FRL File Photo

Extension specialist J. J. Garland explains downhill yarding on steep slopes to loggers and woodland owners in western Oregon.

Implementing Programs in the Counties

Forestry extension agents tailor their programs to the needs of the counties in which they serve. Douglas County's agent is R. S. Logan. Last year he emphasized field demonstrations on reforestation. Because woodland owners are confronted by differing conditions in various portions of Douglas County, Logan set up demonstrations in six areas. In each demonstration, chemical, mechanical, and manual methods for reforestation were compared. Included were treatments for fertilization and for converting from native hardwoods to commercial species. Logan linked classroom instruction with the demonstrations.

Logan also worked last year to arouse public awareness of the need for energy conservation and alternative energy sources. With a colleague, he organized an Energy Fair that was attended by 4,000 people. This approach was so successful that it has been adopted in other areas and was written up as a model in a national journal for extension workers.

Forestry extension agent for Lane County is E. S. Woodard. In 1979, he delivered 90 hours of instruction to 150 people on such subjects as management planning, stand improvement and regeneration, inventorying, harvesting, and forestry regulations. His newsletters reached 1,500 Lane County landowners, many of whom have begun to manage their woodlands as a result. Woodard also

FRL File Photo

Extension agent R. S. Logan discusses reforestation with woodland owners at the Yoncalla Demonstration Area in Douglas County.

conducted sessions on conservation education for public-school teachers and helped International Paper Corporation to promote local 4-H forestry programs ultimately attended by some 60 youngsters aged 8 to 18.

D. F. Green is the forestry extension agent for Clackamas County. This past year he conducted 10 woodland tours covering a range of forest practices for several hundred landowners. For example, to help solve the problem of premature cutting, Green designed a tour focusing on how to obtain maximum volume and value at harvest. Response of the 70 participating landowners was enthusiastic.

Supplying the demand for information is a crucial activity for Green. During the first nine months of 1980, some 5,300 men and women sought his advice by telephoning or visiting him in his Oregon City office. About half the questions posed related to managing woodlands; many others concerned wood as an energy source and the production of Christmas trees. In an effort to anticipate and answer some of the questions of tomorrow's conservationists, Green will soon release an outdoor study guide for use in the public schools.

Extension Publications

In addition to supplying agents and specialists, Oregon State University's Extension Service also publishes two newsletters devoted to forestry. "Forestry Update" contains news of recent forestry techniques and publications and is distributed to over 3,000 woodland owners in the State. The "FIR Report," part of the Forestry Intensified Research program outlined elsewhere in this report, advises its readers of recent technological advances and upcoming educational events of interest to those concerned with forest management in southwest Oregon. Both publications represent efforts by Oregon's forestry community to find and to share practical solutions to important problems in forest management.

FIR — ACTION FOR SOUTHWEST OREGON

Late in 1977, 27 representatives of forest management agencies, forest industry, county governments, forest research institutions, and related interests from southwest Oregon met in Medford to summarize commonly perceived problems in local forest management and the related need for applicable forestry research.

Briefly, these were the conclusions: Although the average value of timber harvests in Douglas, Josephine, and Jackson Counties exceeds $235 million per year and provides the economic base for these counties, knowledge about varying site conditions in these areas is inadequate for effective forest management. Unresolved local problems exist in reforestation, brush control, shelterwood cutting, soil protection, and productivity evaluation. Unique in climate, ecology, and vegetative types, forests in these three southwest Oregon counties are also unique in important forest management problems and opportunities. Thus, research information must be tested for and adapted to these local conditions, and current research funding does not permit adequate attention to these needs.

Subsequent meetings resulted in the development of FIR (Forestry Intensified Research), an integrated program to provide the knowledge base that will permit consistent regeneration and intensive productive management of the forests of southwest Oregon. Responsibility for the 10-year, $30-million program is to be shared by the Pacific Northwest Forest and Range Experiment Station of the U.S. Forest Service and the Forest Research Laboratory of Oregon State University.

FIR has four closely related elements: adaptation of existing research to local needs; fundamental research focused on the region's most pressing problems; an extension program to promote information sharing between researchers and forest managers and among forest managers; and local tests of new integrative practices synthesized from the results of logging, soils, regeneration, and other

research, to be followed by large-scale operational tests and demonstrations of the most successful of these practices.

The adaptive research and information-sharing phases of the program were implemented in the fall of 1978 with an annual budget of $200,000 contributed by the Bureau of Land Management, local National Forests, forest industry, and Douglas, Josephine, and Curry Counties. The responsibility of Oregon State University, these phases are designed to adapt existing and new research results relevant to southwest Oregon's forests. Related educational programs for local foresters and designed experiments will focus on reforestation, stand conversion and brushfield reclamation, and improved growth and yield. The adaptive research and information-sharing phases are carried out by four Oregon State University faculty members stationed in Medford but operating in conjunction with Forest Research Laboratory faculty in Corvallis. They are regeneration specialists S. B. Hobbs, silviculture specialist K. A. Wearstler, watershed specialist D. H. McNabb, and harvesting specialist D. H. Lysne.

The fundamental research phase of the program was initiated on schedule in the fall of 1979 with the transfer of a $1.2 million appropriation from the Bureau of Land Management to the Pacific Northwest Forest and Range Experiment Station. Operating under a comprehensive 10-year research plan directed by the Pacific Northwest Station, research projects at both the Station and Oregon State University have been initiated. According to the plan, full federal funding in the fall of 1980 will enable the 10-year program to move forward at full speed and on schedule.

To inform the FIR program directors of local concerns, to provide counsel regarding research priorities, to evaluate progress, and to help implement approved programs, a Program Advisory Council was appointed in 1978 by C. H. Stoltenberg, Forest Research Laboratory Director. The Council is comprised of 15 local citizens who are concerned with the success of forest management in southwestern Oregon. It includes county commissioners, public and private forest managers, and others.

This program has several unique features. Urgently needed research is directed to forest managers in a three-county area. The information-sharing phase is enabling both public and private managers and researchers to share candidly and continuously their successes and their failures, thus capitalizing on each other's experiences. The research is jointly planned and conducted by two research agencies, with close support and consultation of local forest owners, managers, and citizens. The combination of education and research agencies reflects the importance and should assure maximum credibility and acceptance of results, as well as maximum focus of research talent. Because two research agencies and both local and laboratory-based scientists are involved, the program avoids duplication and capitalizes on the best available expertise and research facilities to accomplish the needed research in the prescribed period. Because the two agencies are linked to research under way elsewhere, results from other areas can be quickly adapted to local conditions—and local results can be quickly shared with those outside southwest Oregon. And finally, those who must eventually solve the region's forestry problems are closely involved in conducting and examining the research.

FIR is a promising and innovative program, one appropriate for active participation by the Forest Research Laboratory.

Part of the FIR program involves the collection of cones to assess genetic variation in Douglas-fir.

FRL File Photo

FORESTRY PUBLICATIONS

Because research results are more valuable when shared with others who can apply them, scientists at the Forest Research Laboratory and their cooperators publish their findings. The publications listed here, issued between January 1, 1979, and June 30, 1980, are grouped by subject: forest engineering, forest management, forest products, forest resource recreation management, and forest science.

Many reprints are available from the Forest Research Laboratory or other divisions of Oregon State University. The appropriate source within the University is given in parentheses at the end of most citations, and inquiries should be directed to that source. Where no University source exists, reprints may be requested directly from the journal, publisher, or agency stated in the citation.

Engineering

Beschta, R. L. 1979. DEBRIS REMOVAL AND ITS EFFECT ON SEDIMENTATION IN AN OREGON COAST RANGE STREAM. Northwest Science 53(1):71-77. (For. Res. Lab.)

For foresters, forest engineers, hydrologists, and fisheries biologists. In the first winter after removal of large organic debris obstructing passage of anadromous fish in an Oregon Coast Range stream, downcutting of previously stored sediments was accelerated and more than 5,000 m^3 of sediment along a 250-m^3 reach were eroded. Downstream suspended sediment and turbidity levels increased. Resource managers considering debris-dam removal should consider downstream consequences of increased sediment loads.

Beschta, R. L. 1980. MODIFYING AUTOMATED PUMPING SAMPLERS FOR USE IN SMALL MOUNTAIN STREAMS. American Water Resource Bulletin 16(1):137-138. (For. Res. Lab.)

For hydrologists. Two modifications to automated pumping samplers in small mountain streams have improved data

collection during storm runoff. An intake nozzle mounted on a bent, free-swinging, metal rod supported in midstream allows sampling without buildup of floatable organic debris. Dynamic forces of the stream on the lower end of the rod keep the intake submerged over diverse flow conditions. A magnetic switching device activates the pumping sampler at a preset stage on the rising limb of a storm hydrograph to improve sampling at frequent fixed intervals, with minimal maintenance between runoff events, and to ensure collection during the rising limb of the hydrograph when flow and sediment concentrations change rapidly.

Beschta, R. L., and W. L. Jackson. 1979. THE INTRUSION OF FINE SEDIMENTS INTO A STABLE GRAVEL BED. Journal of Fisheries Research Board of Canada 35(2):204-210. (For. Res. Lab.)

For hydrologists, fisheries biologists, and foresters. A flume study showed that intrusion and deposition of fine sands into initially clean gravels was influenced by flow conditions which thus influence the quality of gravel substrates in mountain streams. Maximum intrusion of sands with median particle diameters of 0.5 and 0.2 mm was 8% and 25%, respectively. Implications of the study for small streams in mountain watersheds are discussed.

Bohren, C. F., and R. L. Beschta. 1979. SNOWPACK ALBEDO AND SNOW DENSITY. Cold Regions Science and Technology 1(1):47-50. (Dep. For. Engr.)

For hydrologists. Snowpack albedo is essentially independent of snow density when grain size remains constant. Inverse correlations between albedo and density probably result from other snowpack changes during the aging process.

Bradshaw, G. 1979. PREPLANNED SKID TRAILS AND WINCHING VERSUS CONVENTIONAL HARVESTING ON A PARTIAL CUT. Forest Research Laboratory, Oregon State University, Research Note 62. 4 p. (For. Res. Lab.)

For loggers and forest engineers. Production rates, skidding costs, and soil disturbance were compared for two partial cuts—the first a unit with preplanned skid trails and winching and the second a conventional unit harvested with a Caterpillar D-7F. Production was 11 percent less and skidding cost per unit volume 29 percent more for the first unit than for the second. However, only 4 percent of the area was in skid trails, compared with 22 percent in the conventionally harvested unit. Total cycle time with winching was a function of skidding distance, skid trail slope, number of logs per turn, volume per turn, number of winching cycles, and average winching distance.

Butler, D. A., and C. B. LeDoux. 1980. SCHEDULING REPLACEMENT OF LOGGING EQUIPMENT: SOME QUANTITATIVE GUIDELINES. Forest Research Laboratory, Oregon State University, Corvallis. Research Bulletin 32. 22 p. (For. Res. Lab.)

For logging managers. The authors describe a new, theoretical methodology for evaluating the replacement of single piece of logging equipment with a predetermined new model. The example is for a specific piece of equipment and gives results unique to the data base analyzed, but the application typifies procedures, required data, and the results of the method. The model is coded in the BASIC programming language and may be adapted to other situations simply by altering the code.

Froehlich, H. A. 1979. SOIL COMPACTION FROM LOGGING EQUIPMENT: EFFECTS ON GROWTH OF YOUNG PONDEROSA PINE. Journal of Soil and Water Conservation 34(6):276-278.

For foresters, land managers, and soil specialists. Compacted soils in tractor skid trails produced by harvesting ponderosa pine proved to be longlasting. Soil densities in skid trails at 7.6 and 15.9 cm (3 and 6 in.) depths and 22.9 and 30.5 cm (9 and 12 in.) depths were 18 and 9 percent greater, respectively, than those in adjacent, undisturbed soils 16 years after logging. Growth of residual young trees related negatively to the area and intensity of soil compaction in the root zone. Growth rate of moderately impacted trees was reduced 6 percent and of heavily impacted trees 12 percent over a 16-year period.

Garland, J. J. 1979. A LOOK AT LOGGER TRAINING. Loggers Handbook XXXIX. Pacific Logging Congress, Portland, Oregon. 6 p. (For. Res. Lab.)

For those interested in logging training. The state of the art is discussed; training models, obstacles to training, job-leaving rates, and research needs are outlined.

Garland, J. J. 1979. TIMBER HARVESTING OPTIONS. Revised. EC 858, Oregon State Extension Service, Corvallis. 2 p. (Ext. Serv.)

For small woodland owners and managers. The general performance of various timber yarding systems is discussed in this circular, which gives the landowner information for making comparisons. It is designed to accompany a slide-tape, "Timber Harvesting Options," available from the Forestry Media Center of the School of Forestry, Oregon State University.

Garland, J. J., and M. L. Rowley. 1979. GATHERING FUELWOOD FOR HOME HEATING. Revised. EC 847, Oregon State University Extension Service, Corvallis. 4 p. (Ext. Serv.)

For homeowners, renters, and others. This discussion of fuelwood sources, necessary tools, and cutting techniques offers some do's and don'ts of fuelwood gathering.

Gay, L. W. 1979. RADIATION BUDGETS OF DESERT, MEADOW, FOREST, AND MARSH SITES. Archiv fuer Meteorologie Geophysik und Bioklimatologie, Series B 27:349-359.

For geophysicists, micrometeorologists, and biologists. Incoming and outgoing fluxes of shortwave, longwave, and allwave radiation were compared for four high-elevation sites (1,250-1,600 m) in the semi-arid plateau region of central Oregon—pumice desert, wet meadow, pine forest, and marsh. Mean radiation budgets (in calories/cm^2/day) over 2 clear summer days were determined. The mean incoming allwave radiation was similar at each site, yet transformation efficiency, expressed by net radiations, differed substantially. The influence of surface characteristics upon radiation fluxes is discussed.

Hobbs, S. D., D. H. McNabb, and K. A. Wearstler, Jr. 1979. ANNUAL REPORT TO COOPERATORS (OCTOBER 1, 1978-SEPTEMBER 30, 1979). Southwest Oregon Forestry Intensified Research Program. Forest Research Laboratory, Oregon State University, Corvallis. 111 p. (Dep. For. Sci.)

For resource managers. The Southwest Oregon Forestry Intensified Research Program (FIR) is uniquely designed to provide professional natural resource managers with current technology through adaptive research and extension education. This report summarizes activities of FIR during its first year of operation in Medford and gives problem analyses for six major topics.

Holbo, H. R., T. C. Corbett, and P. J. Horton. 1980. AEROMECHANICAL BEHAVIOR OF SELECTED DOUGLAS-FIR. Agricultural Meteorology 21:81-91. (For. Res. Lab.)

For forest meteorologists, biometeorologists, and wind engineers. This reports an analytical technique for measuring the degree of coupling between trees and natural winds. The coupling function, experimentally defined directly from wind and tree motion, makes it possible to assess the potential for blowdown or windthrow in the forest.

Johnson, M. G., and R. L. Beschta. 1980. LOGGING, INFILTRATION CAPACITY, AND SURFACE ERODIBILITY IN WESTERN OREGON. Journal of Forestry 78(6):334-337. (For. Res. Lab.)

For foresters, soil scientists, and hydrologists. Infiltration capacity and erodibility were measured 3 to 6 years after portions of forested watersheds in western Oregon had been logged. Overall values on the logged portions did not differ significantly from values on unlogged portions. Heavily disturbed areas—skid trails, cable log paths, and places where slash had been windrowed by tractors and then burned—had reduced infiltration capacity and increased surface erodibility but also had partially recovered to prelogging conditions.

McNabb, D. H. 1979. CORRELATION OF SOIL PLASTICITY WITH AMORPHOUS CLAY CONSTITUENTS. Soil Science Society of America Journal 43:613-616. (For. Res. Lab.)

For soil scientists and engineers. The percentage of amorphous constituents removed from the clay-size fraction of western Oregon soils by kinetic dissolution was significantly correlated with soil plasticity.

McNabb, D. H., and J. M. Geist. 1979. ACETYLENE REDUCTION ASSAY OF SYMBIOTIC N_2 FIXATION UNDER FIELD CONDITIONS. Ecology 60(5):1070-1072. (For. Res. Lab.)

For quantitative ecologists. Acetylene is shown to be a precise and accurate internal standard for estimating N_2 fixation rates at remote field sites.

McNabb, D. H., and J. M. Geist. 1979. NITROGEN FIXATION POTENTIAL OF NATIVE LUPINES IN WESTERN CONIFER ECOSYSTEMS. Agronomy Abstracts 71:217.

For land managers and soil scientists. Nitrogen-fixation rates of native lupines are less than 11 kg/ha annually. Several autecological factors influence nodule biomass, the principle factor affecting the nitrogen fixation rate.

McNabb, D. H., J. M. Geist, and C. T. Youngberg. 1979. NITROGEN FIXATION BY *CEANOTHUS VELUTINUS* IN NORTHEASTERN OREGON. Abstract. P. 481-482 *in* Proceedings, Symbiotic Nitrogen Fixation in the Management of Temperate Forests. Forest Research Laboratory, Oregon State University, Corvallis. (See Gordon et al., Forest Science section)

For land managers and soil scientists. The annual nitrogen fixation rate of *Ceanothus velutinus* on a droughty site in northeastern Oregon was estimated at 32 kg/ha. After midseason, nitrogenase activity was significantly related to predawn xylem pressure potential.

Olsen, E. D., and H. A. Coonfield. 1979. A MANPOWER PLANNING SYSTEM. American Association of State Highway and Transportation Officials 58(1): 18-21. Washington, D.C.

For project personnel managers. A computerized forecasting system was developed to estimate engineering staffing needs on projects. The system has been implemented by the Technical Services Branch of the Oregon Department of Transportation.

Paustian, S. J., and R. L. Beschta. 1979. THE SUSPENDED SEDIMENT REGIME OF AN OREGON COAST RANGE STREAM. Water Resources Bulletin 15(1):144-154. (For. Res. Lab.)

For hydrologists, soil scientists, and fisheries biologists. A seasonal "flushing" of suspended sediments was shown by a progressive decrease in the ratio of suspended sediment to stream discharge during the winter runoff period. During individual storms, suspended sediment concentrations were influenced by stream discharge and hydrograph characteristics.

Sidle, R. C. 1980. IMPACTS OF FOREST PRACTICES ON SURFACE EROSION. Pacific Northwest Extension Publication PNW 195. 16 p. (Ext. Serv.)

For land managers, small woodland owners, and decision makers. This is designed to help the reader understand the negative effects (such as erosion) of various management activities on forest soils.

Management

Adams, D. M., and R. W. Haynes. 1979. CHANGING PATTERNS OF LOCATION AND WOOD USE CHARACTERISTICS IN THE U.S. FOREST PRODUCTS INDUSTRY: PROJECTIONS FOR 1980 THROUGH 2030. P. 52-60 *in* Proceedings, Timber Supply: Issues and Options. Forest Products Research Society Symposium, P-79-24. 2801 Marshall Court, Madison, Wisconsin 53705.

For planners, managers, and policy makers. Projections of industry location and characteristics of wood consumption by forest products firms over the next 5 decades are derived from the 1980 U.S. Forest Service National Timber Assessment.

Adams, D. M., R. W. Haynes, T. J. Mills, D. Shearer, and S. Childress. 1979. PRODUCTION, CONSUMPTION, AND PRICES OF SOFTWOOD PRODUCTS IN NORTH AMERICA—REGIONAL TIME SERIES DATA 1950-1976. Forest Research Laboratory, Oregon State University, Corvallis. Research Bulletin 27. 43 p. (For. Res. Lab.)

For researchers. Compilation of basic data on production, consumption, and prices of softwood forest products is given by region in North America. The series, several heretofore unpublished, were used to develop econometric relations in the 1980 RPA Timber Assessment Softwood Market Model of the USDA Forest Service.

Bare, B. B., and D. W. Hann. 1979. RIDGE REGRESSION: APPLICATION IN FOREST BIOMETRY AND VALUATION. P. 151-166, 169, 173 *in* Proceedings, Forest Resource Inventories. Society of American Foresters and the International Union of Forestry Research Organizations Workshop. Colorado State University, Fort Collins.

For forest researchers. Describes two forestry-related applications of ridge regression for dealing with multicollinearity in multiple linear regression. The first application demonstrates selection of independent variables during the development of a basal area growth model for ponderosa pine. The second uses ridge regression to develop a descriptive mode for estimating bare land values in the Douglas-fir region.

Bentley, W. R., D. M. Adams, and E. Morales. 1979. DEALING WITH BUYERS AND SELLERS. P. 430-446 *in* Forest Resource Management: Decision-making Principles and Cases. W. B. Saunders Co., Philadelphia, Pennsylvania.

For students of forest economics and management. This is a pedagogical discussion of the role of markets and marketing in the management of forest resources.

Beuter, J. H. 1979. FOREST FERTILIZATION AND THE ECONOMICS OF PERPETUAL MOTION MACHINES. P. 4-13 *in* Proceedings, Symbiotic Nitrogen Fixation in the Management of Temperate Forests. Forest Research Laboratory, Oregon State University, Corvallis. (See Gordon et al., Forest Science section)

For forest managers and planners. Although artificial fertilization of forests is feasible technically and economically, its future viability is questionable if energy costs continue to rise. Fertilization from symbiotic nitrogen fixation is an alternative to enhance forest production and likely will result in better energy balance in the long run.

Beuter, J. H. 1979. SOME PROBLEMS WITH THE 1980 RPA TIMBER ASSESSMENT. *In* Proceedings, Timber Supply: Issues and Options. Forest Products Research Society Symposium, P-79-24. 2801 Marshall Court, Madison, Wisconsin 53705.

For timber resource analysts and forest managers. Although the 1980 RPA timber assessment will be the best ever, its strength and greatest innovation are in demand analysis. This paper points out some problems in the supply analysis and makes suggestions for improvement.

Brodie, J. D., D. M. Adams, and C. Kao. 1978. ANALYSIS OF ECONOMIC IMPACTS ON THINNING AND ROTATION FOR DOUGLAS-FIR USING DYNAMIC PROGRAMMING. Forest Science 24(4):513-522. (For. Res. Lab.)

For researchers and managers. Impacts of regeneration cost, initial stocking level, site, quality premiums, and variable logging costs on thinning and rotation are derived with a forward-recursion dynamic programming algorithm. The efficiency and information provided by intermediate solutions is compared with previously used backward recursions. A resolution is offered for controversy regarding the form of the dynamic programming algorithm and the validity of results in studies of thinning and rotation.

Brodie, J. D., H. C. Black, E. J. Dimock II, J. Evans, C. Kao, and J. A. Rochelle. 1979. ANIMAL DAMAGE TO CONIFEROUS PLANTATIONS IN OREGON AND WASHINGTON, PART II. AN ECONOMIC EVALUATION. Forest Research Laboratory, Oregon State University, Corvallis. Research Bulletin 26. 22 p. (For. Res. Lab.)

For managers and silviculturists. Regression models of height growth and survival were fitted to aggregate data for protected and unprotected trees surveyed for animal damage on Douglas-fir and ponderosa pine plantations in Oregon and Washington. Dynamic programming analysis, using soil expectation and allowable-cut-effect indicators, gives management guidelines for optimal economic regimes in stands with full and depressed stocking levels, for protection expenditure and stand replacement, and for physical impacts on volume yield.

Brodie, J. D., and C. Kao. 1979. OPTIMIZING THINNING IN DOUGLAS-FIR WITH THREE-DESCRIPTOR DYNAMIC PROGRAMMING TO ACCOUNT FOR ACCELERATED DIAMETER GROWTH. Forest Science 25(4):665-672. (For. Res. Lab.)

For researchers and managers. Accelerated diameter growth as a result of thinning must be incorporated into dynamic programming analysis to account for reduced logging cost and increased income as the size of harvested material increases. A three-state-descriptor model is necessary, but a three-descriptor formulation encounters problems in rounding, storage, and computational efficiency. Techniques for overcoming the problems are outlined and applied in representative demonstrations of the model.

Busch, W. L., C. McLean, and J. F. Bell. 1979. ESTIMATE AND COMPARE CRUISE PROCEDURE. P. 423-431 *in* Proceedings, Forest Resource Inventories Workshop, Volume I. Colorado State University, Fort Collins.

For forest inventory specialists. A comparison cruising system is being tested for even-aged second growth Douglas-fir at Alsea, Oregon. Data tabulated for 1 year show a

saving of about 25 percent over conventional variable plot cruising.

Gourley, J., P. L. Tedder, and J. S. Schmidt. 1980. TREES, TIMBER RESOURCE ECONOMIC ESTIMATION SYSTEM. VOL. IV: COMPUTER ANALYST'S GUIDE. Forest Research Laboratory, Oregon State University, Corvallis. Research Bulletin 31d. 127 p. (Forestry Accounting, School of Forestry. $6.00)

For computer analysts and experienced users. The FORTRAN code implementing the Timber Resource Economic Estimation System (TREES), a forest management and harvest scheduling model, is given in flowcharts and text. The location and description for each computer variable in COMMON, the interrelationships of subprograms and use of COMMON variables and formal parameters, and input and output operations are referenced. Also given are special features of the Control Data Corporation CYBER 73 version of FORTRAN IV and other features of TREES, including built-in limitations and diagnostic output requests.

Hann, D. W., and B. B. Bare. 1979. UNEVEN-AGED FOREST MANAGEMENT: STATE OF THE ART (OR SCIENCE?). USDA Forest Service General Technical Report INT-50. Intermountain Forest and Range Experiment Station, Ogden, Utah. 18 p.

For forest managers. Some important historical factors are examined that have caused widespread preference of the even-aged management system over the uneven-aged management system. Major decisions facing forest managers interested in applying uneven-aged management are defined, and techniques traditionally used or recently proposed for making these decisions are reviewed. Problem areas needing further research and development are identified.

Haynes, R. W., and D. M. Adams. 1979. IMPACTS OF RAREII WITHDRAWALS ON SOFTWOOD PRICES, CONSUMPTION AND PRODUCTION. Journal of Forestry 78(4):230-233.

For planners, managers, and policy makers. Projections for the next 2 decades suggest that adoption of all Federal RAREII recommendations for land withdrawal will have significant impact on Douglas-fir regions and other western regions, raising stumpage prices and lowering lumber and plywood production. Substitution from the South and Canada, however, reduces national impact.

Haynes, R. W., and D. M. Adams. 1979. POSSIBLE CHANGES IN FOREST PRODUCTS MARKETS DURING THE NEXT 50 YEARS. Forest Products Journal 29(10):75-80.

For planners, managers, and policy makers. Recent projections suggest that the West will continue to lose the market share in lumber and plywood to Canada and the South during the next 2 decades, probably because of rising stumpage costs. After 2000, the South may continue to expand, but Canada's role in lumber markets will decline because of escalating costs.

Kao, C., and J. D. Brodie. 1979. DETERMINATION OF OPTIMAL THINNING ENTRY INTERVAL USING DYNAMIC PROGRAMMING. Forest Science 25(4):672-674. (For. Res. Lab.)

For researchers. Use of the "neighborbood" concept reduced the time interval for dynamic analysis of thinning and rotation to 1 year and permitted analysis of the optimal thinning entry interval, usually a fixed constant. The changes in solution with fixed intervals of 2, 5, and 10 years are provided for comparison.

Kao, C., and J. D. Brodie. 1979. GOAL PROGRAMMING FOR RECONCILING ECONOMIC, EVEN-FLOW, AND REGULATION OBJECTIVES IN FOREST HARVEST SCHEDULING. Canadian Journal of Forest Research 9(4):525-531. (For. Res. Lab.)

For researchers and managers. To resolve the traditionally quantifiable but incommensurate goals of perfect regulation, maximization of present net worth, and even-flow harvest, the three goals were programmed for a sample forest to provide optimal and compromise solutions that considered all three as weighted. Such programming overcame problems of infeasible specification, satisfied alternate criteria in cases with multiple optima, and provided a means of considering each goal and minimizing the appropriately weighed deviations.

Mitchell, B. R., and D. W. Hann. 1979. BREX: A COMPUTER PROGRAM FOR APPLYING RIDGE REGRESSION TECHNIQUES TO MULTIPLE LINEAR REGRESSION. USDA Forest Service General Technical Report INT-51. Intermountain Forest and Range Experiment Station, Ogden, Utah. 25 p.

For forest researchers. An algorithm for ridge regression (BREX) is presented for use in conjunction with Grosenbaugh's REX (1967), a linear regression program with combinatorial screening. The algorithm uses either REX-punched matrix input or raw data with suitable transformations to estimate ridge (biased) regression coefficients.

Schmidt, J. S., and P. L. Tedder. 1980. TREES, TIMBER RESOURCE ECONOMIC ESTIMATION SYSTEM. VOL. II: MATHEMATICAL ANALYSIS AND POLICY GUIDE. Forest Research Laboratory, Oregon State University, Corvallis. Research Bulletin 31b. 71 p. (Forestry Accounting, School of Forestry. $6.00)

For forests economists and forest biometricians. Mathematical foundations are explained for harvest scheduling and growth in the Timber Resource Economic Estimation System (TREES). Detailed steps for seven harvest-scheduling methods—absolute amount, percent of inventory, area control, even-flow of volume, even-flow of a function of volume, present net benefit, present net worth—are given with consequent effects. Solution feasibility and optimality are discussed for several sets of assumptions for the multiple iteration methods. Available growth options and implications are given for even-aged and uneven-aged inventories. Appendices aid computer implementation.

Sutherland, C. F., Jr. 1979. THE FOREST PROPERTY TAX LAW IN WESTERN OREGON. Revised. EC 888, Oregon State University Extension Service, Corvallis. 24 p. (Ext. Serv.)

For small woodland owners and others. Property tax alternatives for small woodland owners in western Oregon and ways to determine tax liability under different options are discussed.

Sutherland, C. F., Jr. 1979. FOREST PROPERTY TAXATION IN EASTERN OREGON. Revised. EC 898, Oregon State University Extension Service, Corvallis. 12 p. (Ext. Serv.)

For small woodland owners and others. Property tax alternatives for small woodland owners in eastern Oregon and ways to determine tax liability under different options are discussed.

Sutherland, C. F., and W. C. Siegel. 1979. HOW GIFTING BETWEEN SPOUSES CAN REDUCE FOREST ESTATE TAXES. Journal of Forestry 77(10):655-657.

For private, nonindustrial forest owners and forest managers. Estate taxes have major impacts on forest management by private, nonindustrial forest owners. Gifting between spouses is shown as a useful estate-planning device to reduce estate taxes. The procedures for gifting between spouses and the changes made in the Tax Reform Act of 1978 are explained.

Sutherland, C. F., and P. L. Tedder. 1979. IMPACTS OF FEDERAL ESTATE TAXATION ON INVESTMENTS IN FORESTRY. Land Economics 55:510-520. (For. Res. Lab.)

For private, nonindustrial forest owners and forest taxation specialists. Three simulated cases determine the amount of timber required to fund the Federal estate tax and the resulting impact on future cash flow and present net value (PNV), which changed substantially as a result of unexpected harvests. Regulated forest property suffered the greatest losses. Increases in the discount rate lessened the impact on PNV but did not affect the estate tax due. As the value of forest property increased, the estate tax increased progressively. Two methods of funding the estate tax are outlined.

Tedder, P. L. 1979. OREGON'S FUTURE TIMBER HARVEST: THE SIZE OF THINGS TO COME. Journal of Forestry 77(11):714-716. (For. Res. Lab.)

For forest economists and planners. Oregon's future timber harvest is predicted and illustrated in terms of timber size and variability. The harvest will decline in the short run and stabilize somewhat below current levels in the long run. Trees harvested may average as small as 14 inches in diameter at breast height and may vary little in size.

Tedder, P. L., J. S. Schmidt, and J. Gourley. 1980. TREES, TIMBER RESOURCE ECONOMIC ESTIMATION SYSTEM. VOL. I: A USER'S MANUAL FOR FOREST MANAGEMENT AND HARVEST SCHEDULING. Forest Research Laboratory, Oregon State University, Corvallis. Research Bulletin 31a. 81 p. (Forestry Accounting, School of Forestry. $6.00)

For forest managers and forestry students. The Timber Resource Economic Estimation System (TREES) is based on resource units of even- or uneven-aged forest inventories entered by age class or size and diameter class, by stocking level, and by management intensity. Management assumptions for grouped resource units specify species; site class; inventory shifts; changes in management intensity, land base, or utilization standard; and options for thinning, regeneration, cultural treatment, and growth. Harvest assumptions for allowable cut units of several grouped resource units comprise information on seven harvest-scheduling methods, on financial accounting options, and on harvest-priority selection. Computer operating instructions are included.

Tedder, P. L., J. S. Schmidt, and J. Gourley. 1980. TREES, TIMBER RESOURCE ECONOMIC ESTIMATION SYSTEM. VOL. III: EXAMPLE PROBLEM GUIDE. Forest Research Laboratory, Oregon State University, Corvallis. Research Bulletin 31c. 87 p. (Forestry Accounting, School of Forestry. $6.00)

For forest managers and forestry students. In seven sample runs of the Timber Resource Economic Estimation System (TREES), the seven harvest scheduling methods—absolute amount, percent of inventory, area control, even-flow of volume, even-flow of a function of volume, present net benefit, and present net worth—are applied to an even-aged inventory. The eighth run shows switching from a fixed to a variable harvest scheduling method for an uneven-aged inventory. Input specifications and portions of reports requested are illustrated via sample output.

Tedder, P. L., and C. F. Sutherland. 1979. THE FEDERAL ESTATE TAX: A POTENTIAL PROBLEM FOR PRIVATE NONINDUSTRIAL FOREST OWNERS IN THE SOUTH. Southern Journal of Applied Forestry 3(3):109-111. (For. Res. Lab.)

For forest managers and consultants. As land and timber prices continue to escalate with inflation and real cost increases, the Federal estate tax may ultimately change forest land ownership patterns in the United States. Sometimes only a fraction of the original tract may be passed to a surviving family member, with the balance sold to pay the estate tax. Sound management of financial and forest resources can offset this problem. Alternatives to harvesting timber to fund the tax are given.

Products

Arganbright, D. G., H. Resch, and J. R. OLSON. 1979. HEAT TRANSFER FROM IMPINGING SLOT JETS OF AIR. PART 2. AVERAGE AND LOCAL HEAT TRANSFER COEFFICIENTS. Wood Science and Technology 13(1):1-20.

For drying engineers. The heat transfer of two-dimensional impinging air jets was examined. Average and local heat transfer coefficients were measured for jet arrays with a variety of vertical and horizontal spacings to obtain predictive equations describing average heat transfer data. Jet exit velocity and the lateral distance between the centerline of adjacent jets had the greatest influence on heat transfer.

Atherton, G. H. 1979. INDUSTRY APPRAISAL OF FOREST PRODUCTS CURRICULUM AT OREGON STATE UNIVERSITY. Wood and Fiber 10(4):264-274. (For. Res. Lab.)

For educators, graduates in the Forest Products curriculum, and industry members. A survey conducted to assess current relevance of the Forest Products curriculum at Oregon State University (OSU) asked respondents to rank the importance of 59 subjects, courses, or disciplines and to indicate their type of manufacturing operation, management level, field of training, length of time with firm, age, level of education, and most helpful sources of education. Analyses were made for responses of OSU graduates and for responses by management level, type of operation within the industry, and age level of respondents.

Atherton, G. H., and S. E. Corder. 1979. HUMAN RESPONSE TO VIBRATION OF FLOORS IN OCCUPIED DWELLINGS. Forest Products Journal 29(7):29-39. (For. Res. Lab.)

For designers and builders. Information for prediction and control of objectionable wood-floor vibration was obtained by surveying occupants of 687 single and multifamily units and mobile homes. Occupants rated their floors on the basis of everyday experience and their reaction to impact vibration. Objectionable floors were tested to determine vibration characteristics, and the results were related to displacement, velocity, acceleration, frequency, and damping.

Brown, T. D. 1979. DETERMINING LUMBER TARGET SIZES AND MONITORING SAWING ACCURACY. Forest Products Journal 29(4):48-55. (For. Res. Lab.)

For lumber quality control supervisors and plant managers. A method is given for size control of lumber by sawmill management and quality-control personnel. The program includes ways to determine lumber target sizes and to monitor sawing accuracy.

Brown, T. D. 1979. LUMBER PROCESS CONTROL CHECKLISTS. Folder. EM 79:1, Oregon State University Extension Service, Corvallis. (Ext. Serv.)

For lumber quality control supervisors and plant managers. Sixteen checklists provide a systematic inspection method that can be used by sawmill maintenance and control personnel to increase lumber board foot and grade recovery.

Brown, T. D. 1980. ARE YOU LOOKING FOR REASONS FOR MILL LOSSES BUT NOT SEEING THEM? Forest Industries March:78-80.

For sawmill managers, superintendents, and quality-control personnel. This article looks at some common but often overlooked areas where lumber value is lost during the manufacturing process. All phases of the manufacturing operation from woods operations to lumber shipping are discussed briefly.

Bublitz, W. J., and J. L. Hull. 1979. KRAFT GREEN LIQUOR PULPING OF RED ALDER FOR CORRUGATING MEDIUM. P. 89-95 *in* Proceedings, 1979 Pulping Conference. Technical Association of the Pulp and Paper Industry, Atlanta Georgia. (For. Res. Lab.)

For pulp-mill managers. Kraft green liquor pulping of red alder produces pulp suitable for commercial corrugating medium but somewhat inferior in crushing strength to alder pulp made by the neutral sulfite process (NSSC pulp).

Bublitz, W. J., and D. P. Knutsen. 1979. THE EFFECTS OF DESHIVE REFINING ON HIGH-YIELD KRAFT LINERBOARD PULP. P. 41-47 *in* Proceedings, 1979 Pulping Conference. Technical Association of the Pulp and Paper Industry, Atlanta, Georgia. Also in TAPPI 63(5):109-113. (For. Res. Lab.)

For pulp and paper technologists. High-yield unbleached kraft linerboard pulp was deshived in a PFI mill and a Bauer 187 double-disk refiner. A regression model was developed for shive count after disk deshive refining in the Bauer refiner. Sodium losses after pulp washing were reduced as much as 33 percent by prior Bauer 187 deshive refining. At 700 ml CSF freeness, deshive refining improved the strength of a low-kappa-number pulp but impaired the strength of a high-kappa-number pulp.

Bublitz, W. J., and D. C. Wade. 1979. THE APPLICATION OF WASTE LIQUOR FLUORESCENCE TO THE CONTROL OF PULP QUALITY. Svensk Papperstidnung 82(18):535-538.

For pulp and paper technologists. Laboratory studies have shown that the progress of both acid sulfite cooks and kraft cooks can be reproducibly traced by fluorescent analysis of liquor samples periodically withdrawn from the digesters during the cooks. Correlations between fluorescent behavior of pulping liquors and various cooking parameters were inconsistent within a typical batch digester from an acid sulfite mill, but better correlations have been seen in a kraft mill with a continuous digester.

Corder, S. E., compiler. 1979. ENERGY FROM WOOD RESIDUES. Proceedings. Forest Research Laboratory, Oregon State University, Corvallis. 112 p. (Forestry Accounting, School of Forestry. $2.00)

For engineers, technologists, manufacturers, and others concerned with energy efficiency. The information is especially intended for those in forest products industries having a wood-fuel supply available as a by-product of their manufacturing process. The authors discuss wood-fuel utilization, energy conversion systems, methods for making boiler systems and emissions-control systems more efficient, and the impact of using wood rather than fossil fuel.

Currier, R. A. 1979. ENERGY FROM FOREST BIOMASS—SOME POTENTIAL BENEFITS AND PROBLEMS. P. 77-83 *in* Proceedings, Western Dry Kiln Clubs, 30th Annual Meeting. School of Forestry, Oregon State University, Corvallis.

For plant managers and logging engineers. The present and potential contribution of forest residues to the supply of energy is reviewed for both industrial and residential use. Also examined are possible problems if forest-land biomass is removed.

Dougal, E. F., R. L. Krahmer, J. D. Wellons, and P. Kanarek. 1980. GLUELINE CHARACTERISTICS AND BOND DURABILITY OF SOUTHEAST ASIAN SPECIES AFTER SOLVENT EXTRACTION AND PLANING OF VENEERS. Forest Products Journal 30(7):48-52. (For. Res. Lab.)

For plywood plant managers and researchers. Bond durability of plywood gluelines made with face veneers of nine species of Southeast Asian wood planed or extracted with a 1-percent caustic solution before gluing to Douglas-fir was compared with gluelines of untreated veneer. Wood failure for untreated veneers of five species averaged below the acceptable level of 85 percent for exterior use, but all species exceeded this level when veneers were planed before gluing. Solvent extraction of the veneer surfaces did not improve bond durability.

Fernandez, V. A., and A. Polensek. 1979. MODEL FOR PREDICTING STRENGTH AND STIFFNESS OF WOOD STUDS. Wood Science 12(2):65-72. (For. Res. Lab.)

For scientists in structural design of wood systems. A theoretical analysis procedure has been developed to simulate random studs and predict their strength and stiffness. The procedure accounts for nonlinearity, local material variability, and defects. Theoretical and experimental results showed reasonable agreement which could be further improved by better defining stud defects. A sensitivity study showed that local stiffness and strength of clear wood, grain angle, and knots greatly influenced deflection-load relations of studs.

Funck, J. W., and D. R. Prestemon. 1979. FRAMING LUMBER FROM IOWA COTTONWOOD. Revised. Forestry Extension Note F 317, Iowa State University Cooperative Extension Service, Ames, Iowa. 4 p. (Dep. For. Prod.)

For forest products technologists. Appropriate techniques for the production of eastern cottonwood wall-framing lumber and the officially approved design values are given. Results of an economic and market analysis indicate it is feasible for sawmills typical of those found in Iowa to produce 2 x 4's.

Funck, J. W., D. R. Prestemon, and D. W. Bensend. 1979. MODULUS OF RUPTURE AND DYNAMIC AND STATIC MODULUS OF ELASTICITY OF EASTERN COTTONWOOD TWO-BY-FOURS. Forest Products Journal 29(11):35-37. (For. Res. Lab.)

For forest products technologists. Static bending strength and dynamic and static stiffness values were obtained for full-size 2 x 4's of eastern cottonwood. Analysis showed a correlation of 0.914 between static and dynamic modulus of elasticity, 0.782 between modulus of rupture and static modulus of elasticity, and 0.675 between modulus of rupture and dynamic modulus of elasticity. Inclusion of specific gravity in the modulus of rupture equations had no effect on correlation coefficients or standard errors of the residuals.

Gibson, M. D., and R. L. Krahmer. 1980. STAINING TO MAKE UREA-FORMALDEHYDE RESIN VISIBLE ON GLUED WOOD SURFACES. Forest Products Journal Technical Note 30(1):46-48. (For. Res. Lab.)

For wood scientists. An easier staining technique to produce contrast between transparent cured urea-formaldehyde resin and wood is needed for use on blended particleboard furnish. The technique should not noticeably damage either the wood surface or the resin droplets. The purpose of this study was to test published procedures and their modifications and to determine which yielded the best contrast.

Gollob, L., and J. D. Wellons. 1980. ANALYTICAL METHODS FOR FORMALDEHYDE—A REVIEW. Forest Products Journal 30(6):27-35. (For. Res. Lab.)

For chemical analysts in the forest products industry. Gas chromatography was found best for analyzing mixtures containing large concentrations of formaldehyde. Colorimetric and titrimetric methods—especially with chromatropic acid, sodium sulfite, and hydroxylamine hydrochloride—are most useful where both sensitivity and simplicity are needed.

Graham, R. D. 1979. CONVERTING 1979 WOOD PRESERVATION PROBLEMS INTO OPPORTUNITIES FOR 1999. Forest Products Journal 30(2):17-20. (For. Res. Lab.)

For the wood-preservation industry and builders. This paper places the art of wood preservation in perspective by reviewing the long duration of the problems and of man's attempts to solve them. Poor design and construction practices of the present and other challenges for wood technologists are enumerated.

Graham, R. D. 1979. IN LARGE TIMBERS FUMIGANTS STOP ROT THAT GOOD DESIGN COULD HAVE PREVENTED. Forest Products Journal 20(9):21-27. (For. Res. Lab.)

For builders. Large timbers rot because of design that fails to shelter wood from the weather or to specify preservative-treated wood. Internal rot can be stopped by placing volatile chemicals in holes drilled in the timbers and then plugging the holes. The vapors diffuse throughout the wood, eliminating decay fungi and insects for 8 years and possibly more.

Graham, R. D. 1980. WOOD PRESERVATION, THEN AND NOW. Concepts 30:20-22.

For wood technologists and the treating industry. The article provides historic perspectives about the wood-preservation industry and shows its progress as well as remaining problems and opportunities.

Graham, R. D., and G. G. Helsing. 1979. WOOD POLE MAINTENANCE MANUAL: INSPECTION AND SUPPLEMENTAL TREATMENT OF DOUGLAS-FIR AND WESTERN REDCEDAR POLES. Forest Research Laboratory, Oregon State University, Corvallis. Research Bulletin 24. 62 p. (For. Res. Lab.)

For utility companies and other users of wood poles. This manual provides basic information to help pole inspectors make wise decisions on the maintenance of these valuable wood products. Included are a description of fumigant treatment, appendices on culturing wood fungi and on computerizing a record-keeping system, and a list of publications for further reference.

Helsing, G. G. 1979. CONTROLLING WOOD DETERIORATION IN WATERFRONT STRUCTURES. Sea Technology Magazine 6:20-21. (For. Res. Lab.)

For those using wood in the marine environment. This article summarizes the performance of Douglas-fir piles and timbers along the West Coast, gives an improved method of pile top protection, and provides information on the use of fumigants to stop decay.

Helsing, G. G. 1979. RECOGNIZING AND CONTROLLING MARINE WOOD BORERS. Pamphlet and poster. Oregon State University Extension Service, Corvallis. Sea Grant Advisory Program Number 49. (Ext. Serv.)

For those using wood in seawater. The principal wood destroyers within salt water and their damage to wood are illustrated, with accompanying information about preventing or stopping their attack.

Helsing, G. G., and R. D. Graham. 1980. PROTECTING CUTOFF TOPS OF DOUGLAS-FIR PILES FROM DECAY. Forest Products Journal 30(2):23-25. (For. Res. Lab.)

For engineers, architects, designers, builders, owners, and maintainers of waterfront structures. In coastal waters of the Pacific Northwest, pressure-creosoted Douglas-fir piles exposed to the weather serve more than 30 years if their cut-off tops are properly protected. Left unprotected or coated with creosote or asphalt, piles rot internally within 4 years. In a pile cut-off test plot, application of a preservative and cap or of certain water-soluble preservatives is promising greatly improved serviceability of piles. An early result of the research is changes in national standards for protection of cut-off tops of piles.

Jenkins, J. L., A. Polensek, and K. M. Bastendorff. 1979. STIFFNESS OF NAILED WALL JOINTS UNDER SHORT AND LONG TERM LATERAL LOADS. Wood Science 11(3):145-154. (For. Res. Lab.)

For engineers and scientists in structural and wood design. For engineers and scientists in structural and wood design. Long-term loads on wood-stud walls induce creep-slip in nailed joints. The creep-dependent joint modulus for any numerically defined time-load function may be estimated from experimental data for creep under constant shear loads. Testing procedures and data reduction for developing the experimental data are demonstrated on nailed joints between Douglas-fir studs and wall coverings of ⅜-inch plywood sheathing and ½-inch gypsum wallboard. Experimental data relating slip to short-term loads and time to creep-slip were closely approximated by exponential functions.

Johnson, J. W. 1979. LATERAL TESTS OF WOOD ROOF SECTIONS SHEATHED WITH LODGEPOLE PINE DECKING. Forest Products Journal 29(1):41-43. (For. Res. Lab.)

For designers and builders. Roof sections (20 ft. by 60 ft.) sheathed with lodgepole pine decking were 2 to 3 times stronger with elastomeric adhesive or metal clips installed between the decking rows to resist wind and earthquake forces than similar roof sections that were nailed only.

Johnson, J. W. 1979. TESTS OF FIRE-RETARDANT TREATED AND UNTREATED LUMBER-PLYWOOD NAILED AND STAPLED JOINTS. Forest Products Journal 29(4):23-30. (For. Res. Lab.)

For designers and builders. Eight types of fasteners—nails or staples—were used to fabricate lumber-plywood joints of fire-retardant Douglas-fir that were then exposed for 0, 2, and 7 years in a standard room (70¼ °F, 65% relative humidity) and a cold room (35¼ °F, 70%-80% relative humidity). Three fire retardants were used. The 6d common nail was the strongest at lower deformations; the 6d common, the 6d hot-dip galvanized, and the 6d monel nail performed equally well and were strongest for overall performance in joints tested to failure.

Johnson, J. W. 1980. BENDING STRENGTH OF LODGEPOLE PINE LUMBER INCREASES AFTER EDGE-GLUING. Forest Products Journal 30(1):35-36. (For. Res. Lab.)

For designers and builders. This paper is the second in a series on improving strength properties by edge-gluing narrow pieces of lumber to make wider pieces. It reports on bending tests of lodgepole pine edge-glued lumber and gives results from specimens without clear edges.

Kozlik, C. J., and J. C. Ward. 1979. CONVENTIONAL AND HIGH-TEMPERATURE KILN DRYING OF SAPWOOD, NORMAL HEARTWOOD, AND SINKER HEARTWOOD OF DIMENSION LUMBER FROM YOUNG-GROWTH WESTERN HEMLOCK. P. 33-53 *in* Proceedings, Western Dry Kiln Clubs, 30th Annual Meeting. School of Forestry, Oregon State University, Corvallis.

For sawmill managers or dry kiln foremen. Normal heartwood dries about 35 percent faster than sapwood or sinker heartwood. High-temperature drying reduces total drying for all classifications by 50 percent. Kiln drying of hemlock may be optimized by segregation of normal heartwood from sapwood and sinker heartwood.

Lei, Y. K., and J. B. Wilson. 1979. A MODEL FOR FRACTURE TOUGHNESS OF ORIENTED FLAKEBOARD. P. 89-99 *in* Proceedings, 1st International Conference on Wood Fracture. Banff, Alberta, Canada. (For. Res. Lab.)

For wood researchers and engineers. A mathematical model is given to predict the fracture toughness of flakeboard based on the fracture toughness and inherent flaws of the original solid wood used to make the flakes and on the length of voids and nonbonded areas in the board. Based on the assumption that voids and nonbonded regions in flakeboard form surfaces for cracks, fracture mechanics were used to analyze flakeboard as a cracked body. Experimental verification is given using oriented flakeboard of differing densities.

Lei, Y. K., and J. B. Wilson. 1979. FRACTURE TOUGHNESS OF PARALLEL-LAMINATED VENEER. Forest Products Journal 29(8):28-32. (For. Res. Lab.)

For researchers and designers. Fracture toughness of parallel-laminated veneer (PLV) loaded normal to the glueline was evaluated in relation to veneer thickness, grain orientation, and loading rate and tested at four orientations (expressed as load direction and expected direction of the crack with respect to the grain). Fracture toughness of the PLV was then compared with that of the original solid wood from which it was made. Fracture toughness generally increased as veneer thickness decreased. PLV with a fracture toughness exceeding that of the original clear wood can be constructed with thin veneers (1/32 in.).

Lei, Y. K., and J. B. Wilson. 1980. FRACTURE TOUGHNESS OF ORIENTED FLAKEBOARD. Wood Science 12(3):154-161. (For. Res. Lab.)

For researchers and designers. Fracture toughness of oriented flakeboard is shown to be affected by the average length of interflake voids within the board and by board density. Fracture is unaffected by flake-grain orientation and the resin spread rate. The internal bond strength of flakeboards can be increased by properly eliminating or reducing the size of the voids and by avoiding high density boards which result in damaged flakes during mat compaction.

Masters, K. R. W. 1979. STEAM-JET HEAT RECOVERY IN A LUMBER DRY KILN. P. 69-76 *in* Proceedings, Western Dry Kiln Clubs, 30th Annual Meeting. School of Forestry, Oregon State University, Corvallis.

For plant engineers and equipment manufacturers. Steam-jet recovery yielded 20 percent of the energy required for a lumber dry kiln. Such a system would be economically feasible when Bunker C oil or natural gas is used to generate steam but not when wood residue is used.

McKimmy, M. D., and J. P. King. 1980. STRENGTH RELATIONSHIPS IN YOUNG PONDEROSA PINE OF KNOWN PARENTAGE. Wood Science 12(3):165-167. (For. Res. Lab.)

For geneticists and forest managers. Wood from a 38-year-old progeny test plantation of ponderosa pine was sampled and analyzed to determine whether variations in mechanical properties were inherited among progeny. Second-growth stands can be intensively managed to produce wood of high density and high mechanical strength. Accelerated growth does not seem to weaken wood. Genetic selection of families with denser juvenile wood or those that produce mature wood earlier should improve wood uniformity and strength.

McMahon, R. O. 1979. FOREST PRODUCTS: ECONOMIC OUTLOOK FOR 1979. P. 18 *in* Pacific Northwest Agricultural Situation and Outlook. Pacific Northwest Extension Publication PNW 161. Oregon State University, Corvallis. (Ext. Serv.)

For sales organizations. The forest products market in 1979 is unpredictable. Elements of weakness and strength are seen on the demand side; increasing tightness in timber available is seen on the supply side. Prices will probably rise moderately into 1979 and are not expected to decline much below prices in late 1978.

Miller, D. J. 1979. DETERIORATION OF LOGS IN COLD DECKS: A SURVEY OF INFORMATION APPLYING TO THE PACIFIC NORTHWEST. Forest Products Journal 29(1):39-40. (For. Res. Lab.)

For logyard managers. Logs decked dry may be damaged by stain, bugs, and checks during a few months of warm weather. Sprinkling provides good protection if logs are kept wet. Environmental restrictions have not stopped most operators from sprinkling. Little information exists on the amount and value of losses to logs stored in dry or wet decks.

Miller, D. J., and S. Swan. 1980. BLUE STAIN IN SPRINKLED LOG DECKS AND LUMBER PILES OF PONDEROSA PINE. Forest Products Journal 30(2):42-48. (For. Res. Lab.)

For mill managers. Ponderosa pine logs decked under various water-spray conditions during summer in central Oregon were evaluated for alternatives to continuous sprinkling with a regulated supply of fresh, cool, river water. Log staining was controlled as effectively (1% downgrade) by intermittent as by continuous sprays, though when spray was off more than 10 minutes, the amount of staining increased. Recycled pond water was as effective as service water but sometimes created a slimy deck. Lumber staining seems unrelated to log-sprinkling practices.

Oswald, K. D., and D. C. Junge. 1980. DRYING WOOD AND BARK FUELS WITH BOILER EXHAUST GASES. Cosponsors: Energy Research and Development Institute and Forest Research Laboratory, Oregon State University, Corvallis. (Eng. Exp. Stn.)

For combustion engineers and plant managers. Heat energy in boiler exhaust gases may have a significant potential for use in fuel drying, particularly if stack temperatures are near 600° F (588.7° K). The reduction in fuel use due to coupling fuel dryer facilities to a boiler exhaust stack has been calculated for a wide range of operating conditions. However, the cost analysis for the example of a complete new fuel dryer system installed on a 100,000 pph boiler indicates a doubtful cost-benefit ratio.

Polensek, A., and K. M. Bastendorff. 1979. DAMPING OF ROOF DIAPHRAGMS: TONGUE AND GROOVE DECKING CONSTRUCTED WITH GLUED LUMBER PANELS. Wood Science 11(3):155-158. (For. Res. Lab.)

For engineers in earthquake design of wood systems. Horizontal free vibration was induced on four 20- by 60-foot diaphragms constructed with tongue and groove panel decking. The average intradiaphragm damping ratio ranged between 0.028 and 0.094 with corresponding maximum double amplitudes between 0.019 and 0.058 inch. These results and those of 11 similar diaphragms tested previously were combined to produce a regression equation useful for designing wood buildings in earthquake-prone regions.

Polensek, A., and D. S. Gromala. 1979. WOOD-STUD WALL SYSTEM: PERFORMANCES AND PROBABILISTIC DESIGN FOR COMPRESSION-BENDING LOADS. P. 177-194 *in* Proceedings, International Symposium on Behavior of Building Systems and Building Components. Vanderbilt University, Nashville, Tennessee. (For. Res. Lab.)

For engineers and scientists in structural wood design. Wall panels were tested to identify mechanisms neglected by the current design method that are associated with the structural behavior of wood-stud wall systems: partial composite action, load sharing, stud variability, and nonlinearity. A theoretical procedure accounting for these mechanisms has been developed and experimentally verified. Monte-Carlo type simulation of samples representing specific wall types, combined with the theoretical procedure, allows computation of the probability distribution of their strength and stiffness.

Polensek, A., and J. R. Loferski. 1979. MEASURED AND ACTUAL STRENGTH RATIO OF UTILITY GRADE STUDS. Forest Products Journal 29(9):50-51. (For. Res. Lab.)

For engineers and scientists in structural wood design. To determine how well strength ratio (SR) predicts stud strength, samples of Douglas-fir and Engelmann spruce studs of Utility grade were measured for defects and then destructively tested. Measured SR determined according to ASTM Standard D 245 was statistically compared to actual SR based on testing. Results showed that the two types of SR came from different populations and were unrelated.

Polensek, A., and R. H. White. 1979. ANALYSIS OF SUPPORT RESTRAINT OF WOOD-STUD WALLS. American Society of Civil Engineers, Preprint 3642. 17 p. (For. Res. Lab.)

For engineers and scientists in structural design of wood systems. Finite element and linear step-by-step methods that account for variability and inelastic behavior of component materials and nailed joints were combined to evaluate stiffness and strength of wood-stud wall supports and their connections to floors and foundations. Application to systems with known theoretical and experimental solutions shows the potential for accurately estimating the coefficient of support restraint. A sensitivity study showed that nailing sheathing into floor headers substantially increased the degree of support restraint.

Resch, H. 1979. ENERGY RECOVERY FROM WOOD RESIDUES. Holzforschung und Holzverwertung 31(4):79-82. (For. Res. Lab.)

For wood technologists and engineers. Forest products industries have the potential to generate most of their energy from their own wood and bark residues. Depending on composition and site, forests produce as much as 80 dry metric tons of wood and bark per hectare annually with heat content between 4,500 and 5,200 kcal/kg. Residues from sawmilling and plywood manufacture are about 60 percent of the tonnage converted into forest products. To convert energy, boilers incorporating a furnace and heat exchangers—spreader stokers, Dutch ovens, fuel cells, multichamber combusters, and suspension-burning systems—are commonly used.

Resch, H. 1979. INDUSTRIAL USES AND UTILIZATION POTENTIAL FOR RED ALDER. P. 444-454 *in* Proceedings, Symbiotic Nitrogen Fixation in Management of Temperate Forests. Forest Research Laboratory, Oregon State University, Corvallis. (See Gordon et al., Forest Science section)

For foresters. Red alder, the most utilized hardwood in the Pacific Northwest, covers slightly more than 3 million acres of commercial forest land along the Washington and Oregon coast. Net annual growth of sawtimber averages about 170 fbm/acre. Logging is relatively expensive because of small log size. Primary industries annually convert about 260 million fbm to lumber, veneer, pulp chips, fuel, and bark products. Secondary conversion is to furniture, cabinets, case goods, pallets, novelties, pulp, and minor products. Value added by manufacturers of solid wood products alone is approximately $1,180/1,000 fbm.

Resch, H. 1980. UTILIZATION OF RED ALDER IN THE PACIFIC NORTHWEST. Forest Products Journal 30(4):21-26. (For. Res. Lab.)

For forest and plant managers. Changing silvicultural practices warrant an intensive look at the utilization potential of red alder, which depends mainly on the cost of obtaining and converting the raw material and on the demand and price for the manufactured products. Resources, current utilization and conversion, and potential uses for the hardwood are examined.

Resch, H. 1980. WOOD SCIENCE AND TECHNOLOGY IN A UNIVERSITY SETTING. Wood and Fiber 11(4):244-251. (For. Res. Lab.)

For wood technologists. During the last several decades, Wood Sciences and Technology has become recognized as an interdisciplinary segment of forestry or engineering schools. Wood Science is founded on botany, chemistry, physics, and engineering; Wood Technology applies science to convert wood into useful products. This paper reviews the place of the discipline in teaching and research and discusses the need to improve communication between the sheltered university core and professionals who face industrial and commercial problems.

Resch, H., and K. Bastendorff. 1978. SOME WOOD PROPERTIES OF PLANTATION PINES, *PINUS CARIBAEA* AND *PINUS* OOCARPA. Wood and Fiber 10(3):210-217. (For. Res. Lab.)

For foresters. *Pinus caribaea* and *Pinus* oocarpa plantations in Brazil provided test trees from 4 to 17 years old. *Pinus oocarpa* showed slightly higher strength in stiffness and bending and compression than *Pinus caribaea*. Increasing age correlated with increase in mechanical properties, and, in many cases, in specific gravity. Patterns of wood density within tree cross sections from different heights were determined by X-ray and water-displacement methods. In both species, tracheid length increased steadily with age and was greater in latewood than in earlywood.

Resch, H., and R. Parker. 1979. HEAT CONDITIONING OF VENEER BLOCKS. Forest Research Laboratory, Oregon State University, Corvallis. Bulletin 29. 33 p. (For. Res. Lab.)

For foresters. The softwood plywood industry conventionally conditions blocks by steaming or deluging them with hot water in drive-in chambers, or by submerging them in feed-through vats of hot water. About 450 to 1,000 pounds of steam are required to heat blocks with a veneer volume of 1,000 square feet, ⅜-inch basis. The best wood temperature for peeling is 120°F to 140°F, but because blocks are not segregated into diameter classes, heating periods often are too short to reach the target temperature. An infrared sensor system, reported here, gives industry a tool to monitor block temperature.

Scheffer, T. C. 1979. DECAY RESISTANCE OF ANGELIQUE *(DICORYNIA GUIANENSIS)*. Forest Products Journal 29(6):33-34. (For. Res. Lab.)

For builders. Standard ASTM soil-block testing corroborated Angelique's reputation for superior decay resistance and corresponding suitability for long service both in ground contact and in hazardous decay situations above ground.

Short, P. H., and J. D. Wellons. 1980. THERMAL CHARACTERISTICS OF DOUGLAS-FIR BARK FIBER -25°C to 250°C. Wood and Fiber 12(2):88-97. (For. Res. Lab.)

For wood scientists. Extractives are shown to control the thermal properties of Douglas-fir bark fiber and limit its utility for reinforcing plastics. When bark fiber is heated to 250°C, water and carbon dioxide are produced in proportion to the amount of extractives present. Bark fiber recovered by pressurized

refining contained fewer extractives and produced fewer volatiles than fiber recovered by atmospheric refining or alkali extraction.

Szymani, R., and C. D. Mote, Jr. 1979. THEORETICAL AND EXPERIMENTAL ANALYSIS OF CIRCULAR SAW TENSIONING. Wood Science and Technology 13:211-237. (For. Res. Lab.)

For saw machinists. Tensioning, the saw-prestressing procedure most commonly used in the forest products industry to increase the stability of thin circular saws, stiffens the saw blade by introducing favorable in-plane residual stresses. This paper discusses a method of evaluating tension and analyzing the relationship between the rolling load and the resulting tensioning stress. The theory developed can be useful in predicting tensioning stresses for a given rolling load and roller geometry.

Vital, B. R., and J. B. Wilson. 1979. FACTORS AFFECTING THE WATER ADSORPTION OF PARTICLEBOARD AND FLAKEBOARD. P. 97-101 *in* Proceedings, Symposium on Wood Moisture Content—Temperature and Humidity Relationships. Virginia Polytechnic Institute and State University, Blacksburg, Virginia. (For. Res. Lab.)

For quality-control supervisors and wood technologists. The amount of water adsorption determines the dimensional stability of particleboard and flakeboard. Statistical regression models showed that water adsorption is a function of exposure condition, resin type, and board specific gravity, as well as of the thickness and slenderness ratio of the wood furnish. These factors explained 95 percent of all water-adsorption variation.

Wellons, J. D. 1980. WETTABILITY AND GLUABILITY OF DOUGLAS-FIR VENEER. Forest Products Journal 30(7):53-55. (For. Res. Lab.)

For plywood manufacturers and adhesive specialists. This study examines the relationship between wetting contact angle of water (pH-11) and bond performance with a phenolic adhesive. To avoid surface inactivation, green veneers of Douglas-fir were conditioned to desired moisture contents at ambient temperatures. Their wetting contact angles were then compared with their gluebond quality. Veneers dried to moisture contents as low as 3 percent were difficult to wet at ambient temperatures but wetted excessively during gluing, causing the adhesive to dry out, even at assembly times as short as 1 minute.

Wilson, J. B., G. L. Jay, and R. L. Krahmer. 1979. USING RESIN PROPERTIES TO PREDICT BOND STRENGTH OF OAK PARTICLEBOARD. Adhesives Age 6:26-30. (For. Res. Lab.)

For wood and resin chemists. This study characterizes the bonding strength of resins in terms of wetting ability and molecular weight distribution. A commercial phenolic resin and a series of six ammonia-lignosulfonate phenolics as possible replacements for the commercial phenolic were selected to reduce resin cost. A randomly oriented oak flakeboard intended as core stock for plywood was made. Resin wetting properties and molecular weight distribution were then correlated with internal bond strength and modulus of rupture strength of the board.

Wilson, J. B., R. P. McEvoy, and R. W. Perkins. 1979. ON COMPRESSION FAILURE IN WOOD MATERIALS: A MATHEMATICAL AND EXPERIMENTAL SIMULATION. P. 289-301 *in* Proceedings, 1st International Conference on Wood Fracture. Banff, Alberta, Canada.

For wood technologists and wood engineers. A mathematical model is given for the high uniaxial compression loads that cause localized failure in woody materials. In other materials, such as metals, these compression failures are referred to as slip bands, occurring as a result of a local material instability. Experimental evidence shows that the model can be used to predict the critical compression load based on the anisotropy of the material.

Wisherd, K. D., and J. B. Wilson. 1979. BARK AS A SUPPLEMENT TO WOOD FURNISH FOR PARTICLEBOARD. Forest Products Journal 29(2):35-40. (For. Res. Lab.)

For managers of particleboard plants. Strength properties of laboratory-fabricated homogeneous particleboard of medium density were evaluated to determine the effects of substituting different percentages of Douglas-fir, ponderosa pine, and red alder bark for standard wood furnish. Boards bonded with urea-formaldehyde and phenol-formaldehyde (PF) resins were compared with each other and with control boards. Red alder bark with PF resin improved internal bond strength from 6 to 15 percent. Ponderosa pine bark with PF resin improved linear expansion and thickness swelling. Five percent Douglas-fir bark with PF resin did not affect strength properties.

Resource Recreation

Brown, P. J. 1979. THE OPPORTUNITY SPECTRUM: TECHNIQUES AND IMPLICATIONS FOR RESOURCE PLANNING AND COORDINATION. P. 82-87 *in* Proceedings, Dispersed Recreation Symposium, Utah State University, Logan.

For land management and recreation planners. This paper explains how planning for recreation opportunities fits into land management systems. Each step of the process for developing the recreation component and integrating recreation is described.

Brown, P. J., B. L. Driver, D. H. Bruns, and C. McConnell. 1979. THE OUTDOOR RECREATION OPPORTUNITY SPECTRUM IN WILDLAND RECREATION PLANNING: DEVELOPMENT AND APPLICATION. P. 527-538 *in* Proceedings, 1st Annual Conference on Recreation Planning and Development, Volume II. American Society of Civil Engineers, New York.

For land management and recreation planners. The system of planning for recreation opportunities being developed by the Forest Service and Bureau of Land Management for required land-management planning is described.

Gibbs, K. C., L. Queirolo, and C. Lomnicki. 1979. THE VALUATION OF OUTDOOR RECREATION IN A MULTIPLE-USE FOREST. Forest Research Laboratory, Oregon State University, Corvallis. Research Bulletin 28. 18 p. (For. Res. Lab.)

For resource planners, forestry researchers, and managers of private forest lands. An analytical methodology is presented for evaluating nonmarket uses of forest resources, particularly those associated with recreation, and is applied to a forest management unit to typify procedures, types of data, and kinds of answers. Planners and managers may adapt the method to other particular conditions by changing the model assumptions. Though relating uses such as recreation or wildlife habitat to market uses such as timber production is complex and not yet resolved, the methodology will help managers get the best available information before allocating forest resources.

Gibbs, K. C., and W. W. S. van Hees. 1980. A COST ANALYSIS OF U.S. FOREST SERVICE CAMPGROUNDS IN THE PACIFIC NORTHWEST. Forest Research Laboratory, Oregon State University, Corvallis. Research Bulletin 30. 14 p. (For. Res. Lab.)

For resource and recreation planners and administrators. A detailed cost analysis was performed on 111 U.S. Forest Service campgrounds in the Pacific Northwest (Region 6) to estimate facility, operation and maintenance, and opportunity costs for five experience levels. Cost functions, estimated by multiple linear regression analysis to predict the effect of size, number of sites, and use, should help predict average costs of existing and new campgrounds at each level. Total annual costs per campground ranged from $800 (level 1) to $65,000 (level 5) at a 10 percent interest rate. Costs averaged $1.53 per recreation visitor-day and $886 per site across all levels.

Haas, G. E., D. J. Allen, and M. J. Manfredo. 1979. SOME DISPERSED RECREATION EXPERIENCES AND THE RESOURCE SETTINGS IN WHICH THEY OCCUR. P. 21-26 *in* Assessing Amenity Resource Values. USDA Forest Service, General Technical Report RM-68.

For recreation behavior researchers and recreation planners. Results are given from a research program quantifying the reasons wilderness and background recreationists in Colorado engage in different outdoor recreation activities. To experience nature and to escape pressures were the most important reasons identified. Environmental attributes of meadows and forests and of water were considered most important in the experiences.

Haas, G. E., B. L. Driver, and P. J. Brown. 1980. A STUDY OF SKI TOURING EXPERIENCES ON THE WHITE RIVER NATIONAL FOREST. P. 25-30 *in* Proceedings, North American Symposium on Dispersed Winter Recreation. Office of Special Programs, Educational Services, 2-3, University of Minnesota, St. Paul.

For recreation behavior researchers and winter sports managers. Different types of experiences desired by ski tourers are identified and the experience preferences related to recreation and resource management issues.

Hautaluoma, J. E., and P. J. Brown. 1978. ATTRIBUTES OF THE DEER HUNTING EXPERIENCE—A CLUSTER ANALYTIC STUDY. Journal of Leisure Research 10(4):271-287.

For behavioral researchers and wildlife agency administrators. Five types of deer hunters in Washington State and their preferred kinds of hunting experiences are identified. The findings have implications for hunting management.

Shelby, B. 1980. CONTRASTING RECREATIONAL EXPERIENCES: MOTORS AND OARS IN THE GRAND CANYON. Journal of Soil and Water Conservation 35(3):129-131. (For. Res. Lab.)

For resource managers. In a field experiment, a group of river runners in the Grand Canyon traveled half the distance in oar-powered boats and half in motorized rafts. Oar travel was preferred because of the slower, more relaxed pace and the smaller social groupings. The study also shows how user perceptions were tied to structural differences between the two travel modes.

Shelby, B. 1980. CROWDING MODELS FOR BACKCOUNTRY RECREATION. Land Economics 56(1):43-55. (For. Res. Lab.)

For resource managers. Findings on the effect of crowding in outdoor recreation, particularly in wild areas, are reported from a study on the Colorado River in the Grand Canyon. The effect of density and interaction on perceived crowding is examined and other variables are given for consideration. Though crowding may be managed by controlling signs of overuse and by making public expectations more realistic, management must carefully specify low-density experiences and define an appropriate range of encounters if such experiences are to be maintained.

Shelby, B., and R. B. Colvin. 1979. DETERMINING USE LEVELS FOR THE ROGUE RIVER. WRRI-63, Water Resources Research Institute, Oregon State University, Corvallis. 65 p. (Water Resour. Res. Inst.)

For resource managers. This reports results of a study to determine social carrying capacity on the wild section of the Rogue River in Oregon. A discussion of possible management alternatives is included.

Science

Adams, W. T., and G. T. Duncan. 1979. A MAXIMUM LIKELIHOOD STATISTICAL METHOD FOR ANALYZING FREQUENCY-DEPENDENT FITNESS EXPERIMENTS. Behavior Genetics 9(1):7-21. (For. Res. Lab.)

For population biologists. In experiments on frequency-dependent fitness, pairwise mixtures of distinguishable types are often formed at several frequency combinations, the mixtures allowed to undergo competition, and the performance of each type enumerated. This paper offers a superior statistical method for analyzing such experiments. It involves the maximum likelihood estimation of parameters for two logistic regression models: one assuming that fitness is frequency dependent, the other that it is constant over changing frequency. Application is illustrated with published data from experiments on differential mating success in *Drosophila*.

Adams, W. T., and R. J. Joly. 1980. GENETICS OF ALLOZYME VARIANTS IN LOBLOLLY PINE. Journal of Heredity 71:33-40. (For. Res. Lab.)

For forest geneticists. Evidence based on wind-pollinated and control-crossed families of loblolly pine seed indicates that allozymes in 10 enzyme systems are encoded by at least 17 loci. In eight loci where embryo band patterns could be interpreted, the same locus was found to code allozymes in embryos and megagametophytes. However, embryo expression of two enzymes demonstrates that a gene may not necessarily be detectable in both seed tissues. Progeny of three heterozygous combinations did not segregate in expected Mendelian ratios, and in each case the deficiency of a particular allele was consistent over several parents.

Adams, W. T., and R. J. Joly. 1980. LINKAGE RELATIONSHIPS AMONG TWELVE ALLOZYME LOCI IN LOBLOLLY PINE. Journal of Heredity 71:199-202.

For forest geneticists. Linkage relationships among 12 allozyme loci were investigated by testing the independence of single-locus segregations in megagametophyte tissue of seeds from trees heterozygous at two or more loci. Of the 49 two-locus combinations available for testing, 45 segregated independently. Three of the remaining pairs were weakly linked, with recombination fractions (P) greater than 0.4; the fourth pair (PGI2:GOT1) was tightly linked ($P = 0.024$). Loci coding

allozymes with band patterns similar to PGI2 and GOT1 have also been found to be tightly linked in at least two other conifer species.

Aho, P. E., K. Cromack, Jr., C. Y. Li, and A. Hutchins. 1979. OCCURRENCE OF CALCIUM OXALATE AND OXALATE-UTILIZING BACTERIA IN *ECHINODONTIUM TINCTORIUM* DECAY ZONES IN *ABIES CONCOLOR*. USDA Forest Service, Pacific Northwest Forest and Range Experiment Station, Portland, Oregon. Research Note PNW-328. 8 p.

For forest pathologists, microbiologists, and forest ecologists. Production of oxalate by wood-rotting fungi, known for several years, was found in decay zones of Indian paint fungus in white fir. A new discovery was oxalate-utilizing bacteria in fungal decay zones. Implications of calcium cycling by wood-rot fungi and associated bacteria are discussed.

Askren, C. A., and R. K. Hermann. 1979. IS THE OSCILLOSCOPE TECHNIQUE SUITABLE FOR PREDICTING SURVIVAL OF PLANTING STOCK? Tree Planters' Notes 30(4):7-11. (For. Res. Lab.)

For nurserymen and field foresters. The oscilloscope technique offers little promise as a tool for predicting survival potential of bare-rooted seedlings of Douglas-fir and, probably, of other western coniferous species. Trace patterns and subsequent seedling performance were poorly correlated.

Berg, A. B., and J. F. Bell. 1979. LEVELS-OF-GROWING-STOCK COOPERATIVE STUDY ON DOUGLAS-FIR. REPORT 5—THE HOSKINS STUDY 1963-1975. USDA Forest Service, Pacific Northwest Forest and Range Experiment Station, Portland, Oregon. Research Paper PNW-257. 29 p. (For. Res. Lab.)

For forest managers. Growth data are given for the first 12 years of a young Douglas-fir stand in the Oregon Coast Range manipulated to include eight levels of growing stock. The study describes the second and third treatment periods and gives summary data from the calibration and first treatment period. The capability of young Douglas-fir stands to transfer the growth from many trees to few trees and the potential of some treatments to equal or surpass the gross cubic-foot volume of the controls in the next periods are shown.

Black, H. C., E. J. Dimock II, J. Evans, and J. A. Rochelle. 1979. ANIMAL DAMAGE TO CONIFEROUS PLANTATIONS IN OREGON AND WASHINGTON, PART I. A SURVEY 1963-1975. Forest Research Laboratory, Oregon State University, Corvallis. Research Bulletin 25. 45 p. (For. Res. Lab.)

For regeneration foresters. Mammal and bird damage was recorded on Douglas-fir and ponderosa pine plots in Oregon and Washington. Ten of 110 seedlings on each of 194 sampling plots were caged, then all trees were examined after planting and bud burst each year for 5 years. A sample of 45 Douglas-fir plots was observed for 10 years for long-term patterns. Survival and growth of caged trees were compared with that of uncaged trees, and the agents, kind, amount, and distribution of damage were evaluated by state, subregion, and site.

Blake, J., J. Zaerr, and S. Hee. 1979. CONTROLLED MOISTURE STRESS TO IMPROVE COLD HARDINESS AND MORPHOLOGY OF DOUGLAS-FIR SEEDLINGS. Forest Science 25(4):576-582. (For. Res. Lab.)

For nurserymen and foresters. October and December measurements of nursery-grown Douglas-fir seedlings subjected to three levels of moisture stress between July and August showed that mild stress of -5 to -10 bars significantly improved cold hardiness. Effectiveness of the mild stress treatment decreased when stress was delayed from mid-July until September 1. Earlier stress decreased height and shoot:root ratios but increased root weight and nitrogen content of the needles. Mild stress also decreased mortality from cold storage of seedlings lifted in October.

Bormann, B. T., J. C. Gordon, and D. S. DeBell. 1979. THE EFFECT OF DENSITY ON CANOPY CHARACTERISTICS OF YOUNG *ALNUS RUBRA* STANDS. Abstract. P. 473 *in* Proceedings, Symbiotic Nitrogen Fixation in Management of Temperate Forests. Forest Research Laboratory, Oregon State University, Corvallis. (See Gordon et al.)

For silviculturists. Dense stands (2 ft. by 4 ft.) of 6-year-old planted alders have a lower leaf area than medium-density (4 ft. by 6 ft.) or low-density (9 ft. by 9 ft.) stands. Also, dense

stands have most leaves far from the root in the upper crown. These characteristics lead to lower nitrogen fixation per unit area in dense stands.

Borrecco, J. E., H. C. Black, and E. F. Hooven. 1979. RESPONSE OF SMALL MAMMALS TO HERBICIDE-INDUCED HABITAT CHANGES. Northwest Science 53(2):97-106. (For. Res. Lab.)

For forest managers and mammalogists. Vegetation and small-mammal communities were sampled before and after western Oregon clearcuttings were treated with herbicides, principally atrazine and 2,4-D. The number of plant species on treated areas was less than on control areas, but survival and growth of Douglas-fir and shrubs were greater. Mark-recapture data showed that species composition of small-mammal communities altered with herbaceous vegetation.

Campbell, A., and K. K. Ching. 1980. GENETIC DIFFERENCES IN RED ALDER POPULATIONS ALONG AN ELEVATIONAL TRANSECT. Forest Research Laboratory, Oregon State University, Corvallis. Research Note 64. 4 p. (For. Res. Lab.)

For forest managers and geneticists. Basic information is given about variation in conelets, seed characteristics, and early growth of red alder studied along an elevational transect in the Oregon Coast Range. Early growth differed among elevations, though no strong genotype x environment interaction was detected. The results open avenues for study of ecological preconditioning.

Ching, T. M., R. H. Berg, P. A. Monaco, and K. K. Ching. 1979. ISOLATION OF ENDOPHYTIC VESICLE-CLUSTERS FROM RED ALDER ROOT NODULES. Poster. International Symposium on Nitrogen Fixation. Phytochemical Society of Europe, University of Sussex, England.

For physiologists, biochemists, and geneticists. Because of the high amounts of polyphenolic compounds that exist in red alder nodules, isolation of large amounts of active vesicle clusters (VCs) is quite difficult. Comparison of several methods indicates that the best combination of purity and nitrogenase activity results from isolation of VCs on Percoll density gradients.

Ching, K. K., and P. Hinz. 1978. COOPERATIVE PROVENANCE STUDY OF DOUGLAS-FIR IN THE PACIFIC NORTHWEST. P. 229-240 *in* Volume I, Proceedings, IUFRO Joint Meeting of Working Parties: Douglas-Fir Provenances, Lodgepole Pine Provenances, Sitka Spruce Provenances, Abies Provenances. Ministry of Forestry, Province of British Columbia, Vancouver, Canada. (For. Res. Lab.)

For foresters and geneticists. Examination of data for height, diameter breast height, and survival shows that trees of diverse provenances differ in all traits measured, but that the interaction between provenance and planting location is not of practical importance at age 20. The correlation between mean heights for ages 5 and 20 years is 0.69, which is sufficiently large to warrant its use as an index for selecting superior genetic stock for a particular site and for predicting performance.

Conard, S. G., and S. R. Radosevich. 1979. COMPARATIVE PHYSIOLOGICAL ECOLOGY OF THE THREE MONTANE CHAPARRAL SPECIES. P. 23 *in* Abstracts, Botanical Society of America. Miscellaneous Series Publication 157.

For silviculturists, forest ecologists, and tree physiologists. Seasonal patterns of xylem sap tension, $^{14}CO_2$ uptake and leaf conductance of white fir, snowbrush ceanothus, and greenleaf manzanita were compared on a montane chaparral site in the Sierra Nevada.

Conard, S. G., and S. R. Radosevich. 1979. THE EFFECT OF MONTANE CHAPARRAL SHRUBS ON GROWTH OF WHITE FIR [*ABIES CONCOLOR* (GORD. & GLEND.) LINDL.]. P. 87 *in* Abstracts, Weed Science Society of America.

For silviculturists and forest ecologists. A 200 percent increase in leader growth was observed in artifically shaded white fir saplings after removal of shrub competition. These data and studies of comparative physiological ecology of dominant species and of microclimate suggest that soil moisture stress inhibits growth of white fir more than shading in montane chaparral in the northern Sierra Nevada.

Cromack, K., Jr., C. C. Delwiche, and D. H. McNabb. 1979. PROSPECTS AND PROBLEMS OF NITROGEN MANAGEMENT USING NITROGEN FIXERS. P. 210-223 *in* Proceedings, Symbiotic Nitrogen Fixation in the Management of Temperate Forests. Forest Research Laboratory, Oregon State University, Corvallis. (See Gordon et al.)

For forest ecologists, soil scientists, forest land managers, and silviculturists. Data are summarized for nitrogen fixation by several species widely distributed in the Pacific Northwest. Snowbrush and red alder generally fix the largest amounts, 70 kg/ha to 320 kg/ha annually. Woody and nonwoody litter fractions produced by nitrogen fixers decompose faster than corresponding fractions produced by conifers. The authors recommend the acetylene reduction method of estimating N fixation, which may be complemented by measurement of soil nitrogen accretion and fractionation of N isotopes in plant components and in the soil profile.

Cromack, K., Jr., P. Sollins, W. C. Graunstein, K. Speidel, A. W. Todd, G. Spycher, C. Y. Li, and R. L. Todd. 1979. CALCIUM OXALATE ACCUMULATION AND SOIL WEATHERING IN MATS OF THE HYPOGEOUS FUNGUS *HYSTERANGIUM CRASSUM*. Soil Biology and Biochemistry 11:463-468. (For. Res. Lab.)

For forest ecologists, forest soil scientists, mycologists, and physiologists. A commonly occurring truffle fungus growing on the roots of young Douglas-fir stands was studied near Corvallis, Oregon. Considered an ectomycorrhizal symbiont, it forms dense mats in the upper soil horizon and can strongly weather the soil profile by releasing oxalic acid into the soil solution. Such weathering of soils is important for release of essential tree nutrients such as phosphorus, potassium, magnesium, and trace metal elements.

Cromack, K., Jr., F. J. Swanson, and C. C. Grier. 1979. A COMPARISON OF HARVESTING METHODS AND THEIR IMPACT ON SOILS AND ENVIRONMENT IN THE PACIFIC NORTHWEST. P. 449-476 *in* Proceedings, Forest Soils and Land Use. 5th North American Forest Soils Conference, Colorado State University, Fort Collins.

For forest soil scientists, forest ecologists, geomorphologists, and forest land managers. Forest harvest techniques in use in Pacific Northwest forests are evaluated for their relation to loss of forest nutrients and to watershed erosion. The authors discuss management alternatives, such as nitrogen fixers for fertilization and ways to minimize soil compaction and erosion in harvesting and roading activities. First- and second-order streams are considered as integrated forest units important in future landscape management.

Dawson, J. O., and J. C. Gordon. 1979. NITROGEN FIXATION IN RELATION TO PHOTOSYNTHESIS IN *ALNUS GLUTINOSA*. Botanical Gazette 140(1):S70-S75. (For. Res. Lab.)

For plant physiologists and ecologists. Clonal lines of *Alnus glutinosa* (L.) Gaertn., grown with a spore-negative North American endophyte, were studied for relationships between nitrogen fixation and photosynthesis in nitrogen-free culture and for the effect of host-plant genotype on symbiotic growth. Genetic variation in the host, as well as the source of the endophyte, seems to condition the related rates of nitrogenase activity and photosynthesis in black alder.

Dawson, J. O., and J. C. Gordon. 1979. PHOTOASSIMILATE SUPPLY AND NITROGEN FIXATION IN *ALNUS*. P. 187-195 *in* Proceedings, Symbiotic Nitrogen Fixation in the Management of Temperate Forests. Oregon State University, Forest Research Laboratory, Corvallis. (See Gordon et al.)

For forestry researchers and silviculturists. Host-plant photoassimilate supply is shown to be important for regulating nitrogen fixation in *Alnus/Frankia* symbioses in this review of current knowledge and theories. The use of alder hosts that can efficiently produce and distribute photosynthate for nitrogen fixation and wood growth seems to promise increased productivity for nitrogen-deficient sites.

Dawson, J. O., J. C. Gordon, and C. T. Wheeler. 1979. PHOTOSYNTHESIS AND NITROGENASE ACTIVITY IN BLACK ALDER. P. 48-51 *in* Proceedings, 5th North American Forest Biology Workshop. Gainesville, Florida.

For tree physiologists. Black alder shows great promise as a land reclamation species, but to improve soil nitrogen content, genetic variants capable of high photosynthetic rates

in harsh environments must be selected. There are some indications that this can be done when trees are quite young.

de Calesta, D. S. 1979. SPRING AND SUMMER FOODS OF AUDUBON'S COTTONTAIL IN NORTH CENTRAL COLORADO. Southwestern Naturalist 24(3):549-553.

For mammalogists and ecologists. Foods identified from stomach contents of cottontail rabbits in Colorado in the spring and summer are described. A microhistological technique was used.

de Calesta, D. S., and J. P. Hayes. 1979. RESPONSE OF BIRDS TO FRIGHTENING STIMULI IN BLUEBERRY FIELDS. Pest Control 47(9):18, 20.

For growers, county agents, and pest controllers. The potential effectiveness and operational constraints of scaring devices (alarm calls, shell-crackers, fireworks) designed to keep birds out of blueberry fields are evaluated.

Del Rio, E., and A. B. Berg. 1979. GROWTH OF DOUGLAS-FIR REPRODUCTION IN THE SHADE OF A MANAGED FOREST. Forest Research Laboratory, Oregon State University, Corvallis. Research Paper 40. 14 p. (For. Res. Lab.)

For forest managers. Natural Douglas-fir reproduction in the understory of a Douglas-fir forest in the Oregon Coast Range was thinned to maintain three basal-area intensities. Growth increments increased with light and tree height. Average growth increased linearly as thinning intensity increased. Leader growth and production of new needles and stems correlated highly with leader growth and tree height of previous years.

Del Rio, E., and A. B. Berg. 1979. SPECIFIC LEAF AREA OF DOUGLAS-FIR REPRODUCTION AS AFFECTED BY LIGHT AND NEEDLE AGE. Forest Science 25(1):183-186. (For. Res. Lab.)

For forest ecologists. Measurements of leaf area on young Douglas-fir growing in the shade of a managed Douglas-fir forest suggest that specific leaf area (cm^2/g) is negatively linear to a logarithmic transformation of daily sunlight received at the crown. Specific leaf area is also influenced by needle age. Results show that leaf morphology of Douglas-fir is sensitive to the light regime, that all degrees of shade leaves exist, and that survival strategies change with environment.

DeYoe, D. R., and G. N. Brown. 1979. GLYCEROLIPID AND FATTY ACID CHANGES IN EASTERN WHITE PINE CHLOROPLAST LAMELLAE DURING THE ONSET OF WINTER. Plant Physiology 64:924-929. (For. Res. Lab.)

For tree physiologists. Chloroplast lamellae of eastern white pine were analyzed to determine changes in total glycerolipids, component glycerolipids, and glycerolipid fatty acids during the onset of winter hardiness. Results suggest that eastern white pine chloroplasts maintain lamellar viscosity by increasing lamellar unsaturation and tolerate freeze desiccation by increasing the interfacial water-binding capacity of the lamellae.

Dilworth, J. R. 1979. LOG SCALING AND TIMBER CRUISING. Revised. OSU Book Stores, Inc., Corvallis, Oregon. 468 p.

For foresters, mensurationists, scalers, and timber cruisers. Current log grading and scaling practices of the U.S. Forest Service and log scaling and grading bureaus in the Pacific Northwest and Alaska are covered in detail. Timber inventory procedures are given with guidelines for approved methods of forest cruising.

Dilworth, J. R., and J. F. Bell. 1979. VARIABLE PROBABILITY SAMPLING. Revised. OSU Book Stores, Inc., Corvallis, Oregon. 130 p.

For foresters, mensurationists, and timber cruisers. This revision gives detailed coverage of variable plot cruising, with procedures and appropriate tables, and a brief overview of 3-P sampling.

Drew, A. P., and W. K. Ferrell. 1979. SEASONAL CHANGES IN THE WATER BALANCE OF DOUGLAS-FIR (*PSEUDOTSUGA MENZIESII*) SEEDLINGS GROWN UNDER DIFFERENT LIGHT INTENSITIES. Canadian Journal of Botany 57:666-674. (For. Res. Lab.)

For regeneration foresters, plant physiologists, ecologists. Seedlings grown under low light intensity are less drought resistant and are under greater water stress than those grown under fall light, regardless of soil moisture status.

Fogel, R., and G. Hunt. 1979. FUNGAL AND ARBOREAL BIOMASS IN A WESTERN OREGON DOUGLAS-FIR ECOSYSTEM: DISTRIBUTION PATTERNS AND TURN OVER. Canadian Journal of Forest Research 9(2):245-256. (For. Res. Lab.)

For forest ecologists and silviculturists. Allocation and turnover of various biomass components were measured from August 1976 to August 1977 in a young, second-growth, Douglas-fir stand in the Oregon Coast Range. Total annual cycling through the stand, excluding soil organic matter, was 30,324 kg: 50.5% was fungal matter, 39.5% was tree matter, and 10.0% was matter in the forest floor.

Gholz, H. L. 1980. STRUCTURE AND PRODUCTIVITY OF *JUNIPERUS OCCIDENTALIS* IN CENTRAL OREGON. The American Midland Naturalist 103(2):251-261. (For. Res. Lab.)

For forest tree physiologists. In a western juniper stand in the arid environment of central Oregon, uniformly spaced trees rarely exceeded 8 m tall. Leaf area per unit of water-conducting tissue in the stem of the individual trees examined was less than that of fir species on more mesic sites but similar to that of two western pine species. Double sampling provided reliable estimates of means and confidence intervals for juniper biomass and leaf area.

Gholz, H. L., C. C. Grier, A. G. Campbell, and A. T. Brown. 1979. EQUATIONS FOR ESTIMATING BIOMASS AND LEAF AREA OF PLANTS IN THE PACIFIC NORTHWEST. Forest Research Laboratory, Oregon State University, Corvallis. Research Paper 41. 39 p. (For. Res. Lab.)

For silviculturists and mensurationists. Sets of equations, with instructions and cautions about their use, are given for 43 major sjecies of trees, shrubs, and herbs in the Pacific Northwest. The fully documented equations relate foliage biomass and area, stem biomass, branch biomass, and other component sizes to diameter at breast height, basal diameter, and other dimensions easily measured in the field.

Gordon, J. C., and J. O. Dawson. 1979. POTENTIAL USES OF NITROGEN-FIXING TREES AND SHRUBS IN COMMERCIAL FORESTRY. Botanical Gazette 140 (Supplement):S88-S90.

For foresters and forestry researchers. The potential for commercial utilization of tree and shrub species that can fix molecular nitrogen symbiotically is examined. Recommendations are made for research to speed the practical use in forestry of woody plants that fix nitrogen in combination with specific soilborne microorganisms.

Gordon, J. C., C. T. Wheeler, and D. A. Perry, eds. 1979. SYMBIOTIC NITROGEN FIXATION IN THE MANAGEMENT OF TEMPERATE FORESTS. Proceedings. Forest Research Laboratory, Oregon State University, Corvallis. 501 p. (Forestry Accounting, School of Forestry. $5.00)

For researchers and silviculturists. This is a state-of-the-art compendium of microbiological, physiological, ecological, and silvicultural knowledge of symbiotic nitrogen fixation in forestry, with emphasis on actinorhizal species in North America and Europe.

Grier, C. C., R. L. Edmonds, R. H. Waring, and D. W. Cole. 1979. FOREST MANAGEMENT IMPLICATIONS OF PRODUCTIVITY, NUTRIENT CYCLING, AND WATER RELATIONS RESEARCH IN WESTERN CONIFERS. P. 96-106 *in* Proceedings, North America's Forests: Gateway to Opportunity. Society of American Foresters and Canadian Institute of Foresters, Washington, D.C. 496 p.

For silviculturists and foresters. Research, focused on determining how productivity of coniferous forests is related to their structure and internal biological processes, was directed by systems analysis methods. Conceptual models of forest ecosystems were used to structure and coordinate the research. The discussion emphasizes results having potential use in forest management.

Hawk, G. M. 1979. VEGETATION MAPPING AND COMMUNITY DESCRIPTION OF A SMALL WESTERN CASCADE WATERSHED. Northwest Science 53(3):200-212. (For. Res. Lab.)

For forest botanists and ecologists. Using an established trail and grid system and a stem map of all trees greater than 15 cm diameter breast height, 414 map units of plant communities were delimited for Watershed 10 in the west central Cascade Mountains. Structural vegetation

characteristics of seven plant communities and four habitat types are described.

Hermann, R. K. 1980. DIE DOUGLASIE EINST UND HEUTE (DOUGLAS-FIR IN PAST AND PRESENT). Allgemeine Forst Zeitschrift 35(9/10):215-219.

For European silviculturists. This paper describes the past history of Douglas-fir, differentiation into various ecotypes, and current status of classification based on chemotaxonomic and ecophysiological characteristics.

Hermann, R. K. 1980. DIE WALDVERJUNGUNG IM WESTLICHEN NORDAMERIKA (FOREST REGENERATION IN WESTERN NORTH AMERICA). Forstarchiv 51(4):68-72. (For. Res. Lab.)

For European silviculturists. The development of forest regeneration practices is traced for the Douglas-fir and ponderosa pine regions of western North America.

Hermann, R. K. 1980. ZUR WALDBAULICHEN BEHANDLUNG SUBALPINER WALDUNGEN IM WESTEN DER VEREINIGTEN STAATEN (ON THE SILVICULTURAL TREATMENT OF SUBALPINE FORESTS IN THE WESTERN UNITED STATES). Schweizerische Zeitschrift fuer Forstwesen 131(5):415-422.

For European silviculturists. This paper reviews silvicultural practices in subalpine forests of western North America.

Hermann, R. K., and Y. Birot. 1980. GEOGRAPHIC VARIATION OF MORPHOLOGICAL AND ANATOMIC CHARACTERISTICS OF GRAND FIR. P. 367-386 *in* Volume 2, Proceedings, IUFRO Joint Meeting of Working Parties: Douglas-Fir Provenances, Lodgepole Pine Provenances, Sitka Spruce Provenances, Abies Provenances. Ministry of Forests, Province of British Columbia, Vancouver, Canada.

For forest scientists. The 15-year results of the first provenance trial with *Abies grandis* in France indicate that needle length and length of stomatal bands on upper needle surface are useful for identification of grand fir provenances on a regional scale.

Hermann, R. K., and D. P. Lavender. 1979. TESTING THE VIGOR OF CONIFEROUS PLANTING STOCK. Forest Research Laboratory, Oregon State University, Corvallis. Research Note 63. 3 p. (For. Res. Lab.)

For silviculturists and nurserymen. Successful establishment of plantations depends largely upon vigorous seedlings and sound outplanting practices. To prevent costly losses, the physiological quality of seedlings should be tested before outplanting in order to pinpoint nursery or field practices that result in subsequent unsatisfactory growth. During growth room and field trials with hundreds of test lots of seedlings, mainly Douglas-fir and ponderosa pine, a test was developed that closely estimates the physiological vigor of planting stock.

Hobbs, S. D., and A. D. Partridge. 1979. WOOD DECAYS, ROOT ROTS, AND STAND COMPOSITION ALONG AN ELEVATION GRADIENT. Forest Science 25(1):31-42.

For silviculturists and pathologists. Randomly selected stands of mixed conifers were examined for wood-decaying fungi in northern Idaho during 1974 and 1975. Fungi distributions and stand composition changed with elevation. *Armillariella mellea* and *Echinodontium tinctorium* were found throughout the sample area, the latter more frequently in stands dominated by grand fir. *Phaeolus schweinitzii, Inonotus tomentosus,* and *Perenniporia subacida* were found more often in stands above 1,500 m; *Polyporus sericeomollis* and *Phellinus weirii,* restricted to stands below 1,500 m, were primarily found on western redcedar.

Hooven, E. F., H. C. Black, and J. C. Lowrie. 1979. DISTURBANCE OF SMALL MAMMAL LIVE TRAPS BY SPOTTED SKUNKS. Northwest Science 53(2):79-81. (For. Res. Lab.)

For mammalogists. Unusual predation of live traps occurring during a study of the effects of controlled slash burning on small-mammal communities in the Coast Range of western Oregon was attributed to spotted skunks (*Spilogale putorius*).

Hunt, G. A. 1980. BIOMASS AND TURNOVER OF THE FUNGAL COMPONENTS IN A WESTERN OREGON DOUGLAS-FIR ECOSYSTEM. P. 19, Abstract 13. *In* 53rd Annual Meeting, Northwest Scientific Association. Western Washington University, Bellingham, Washington.

For forest ecologists and silviculturists. Biomass allocation and turnover time of four fungal components were measured in a young Douglas-fir stand in the Oregon Coast Range. Fungal turnover was 5 times faster than that of the forest floor.

Iverson, R. D., and M. Newton. 1980. LARGE DOUGLAS-FIR SEEDLINGS PERFORM BEST ON OREGON COASTAL SITES. International Paper Co., Western Forest Research Center, Lebanon, Oregon. Technical Note 55.

For foresters, land managers, and nurserymen. Seedling performance was positively related to size at the time of planting in a variety of environments. Growth was greatest and mortality from various causes was least for large transplants. The ratio of benefit to cost was greatest for largest stock despite its highest absolute cost. The benefits of the large trees are expressed in terms of survival and years required to reach a height of 4.5 feet.

Kraemer, J. F., and R. K. Hermann. 1979. BROADCAST BURNING: 25-YEAR EFFECTS ON FOREST SOILS IN THE WESTERN FLANKS OF THE CASCADE MOUNTAINS. Forest Science 25(3):427-439. (For. Res. Lab.)

For forest soil scientists and forest managers. This assessment of the long-term consequences of broadcast burning after clearcutting showed that broadcast burning does not have a lasting effect on chemical and physical properties of forest soils.

Kuser, J. E., and K. K. Ching. 1979. PROVENANCE VARIATION IN WESTERN HEMLOCK (*TSUGA HETEROPHYLLA*). P. 27, Abstract 60. *In* 52nd Annual Meeting, Northwest Scientific Association. Western Washington University, Bellingham, Washington. (For. Res. Lab.)

For geneticists and silviculturists. Bud-set dates and degree of injury to first-year western hemlock seedlings caused by freezing weather at Corvallis in November 1978 varied clinally with latitude and elevation of provenance. Cone size, seed weight, and cotyledon number did not show the same pattern. Cotyledon number varied significantly between families within provenance.

Lavender, D. P., R. K. Hermann, and P. Hinz. 1979. CONTROLLED ENVIRONMENT FACILITIES FOR PREDICTING VIGOR IN OUTPLANTED DOUGLAS-FIR SEEDLINGS. P. 242-244 *in* Proceedings, 5th North American Forest Biology Workshop. Gainesville, Florida.

For regeneration foresters. Growth responses of seedlings maintained under control conditions may be valuable to predict survival potential of seedlings used in reforestation projects.

Lovejoy, B. P., and H. C. Black. 1979. MOVEMENTS AND HOME RANGE OF THE PACIFIC MOUNTAIN BEAVER, *APLODONTIA RUFA PACIFICA*. The American Midland Naturalist 101(2):394-402. (For. Res. Lab.)

For forest managers and mammalogists. The home range and movements of the mountain beaver were studied from 1956 to 1967 in the Coast Range of western Oregon. Movements were analyzed for average and maximum distance between captures and for home-range area. Average home range of adult males (0.32 ± 0.05 ha) was nearly twice that of adult females and larger than previously reported.

Lovejoy, B. P., and H. C. Black. 1979. POPULATION ANALYSIS OF THE MOUNTAIN BEAVER, *APLODONTIA RUFA PACIFICA*, IN WESTERN OREGON. Northwest Science 53(2):82-89. (For. Res. Lab.)

For forest managers and mammalogists. In a rotational live-trapping study of mountain beaver conducted weekly from 1965 to 1967 in western Oregon, the male-female ratio of adults was 1.62:1 and of juveniles 1:1. Population estimates ranged from 41 to 54 for a 5.5-ha grid. Survival rate was 64 percent after 1 year, 24 percent after 2 years. Some animals were at least 4.5 years old when taken.

Maser, C., R. Anderson, K. Cromack, Jr., J. T. Williams, and R. E. Martin. 1979. DEAD AND DOWN WOODY MATERIAL. P. 78-95 *in* Wildlife Habitats in Managed Forests: the Blue Mountains of Washington and Oregon. USDA Agricultural Handbook 553. U.S. Government Printing Office, Washington, D.C.

For wildlife biologists, forest ecologists, forest land managers, stream ecologists, and the general public. This paper discusses the diverse functions of down logs on land and in streams as habitats for wildlife, as storage mechanisms for organic matter and nutrients, and as links between plant communities in different stages of succession. Guidelines for maintenance of essential numbers of down logs in managed forests are suggested.

McBrayer, J. F., and K. Cromack, Jr. 1980. EFFECT OF SNOWPACK ON OAK LITTER BREAKDOWN AND NUTRIENT RELEASE IN A MINNESOTA FOREST. Pedobiologia 20:47-54.

For forest ecologists. Data are given for decomposition, nutrient cycling, and soil animal activity beneath the snowpack in a Minnesota forest. Implications of decomposer activity and nutrient release beneath snowpacks are discussed.

McNabb, D. H., and J. M. Geist. 1979. ACETYLENE REDUCTION ASSAY OF SYMBIOTIC N_2 FIXATION UNDER FIELD CONDITIONS. Ecology 60:1070-1072. (For. Res. Lab.)

For forest ecologists and physiologists. A quantitative field method for estimating N_2 fixation utilizing the acetylene reduction assay method is presented.

Monaco, P. A., T. M. Ching, and K. K. Ching. 1979. CLONING RED ALDER GENOTYPES BY VEGETATIVE CUTTINGS. Abstract. P. 483 *in* Proceedings, Symbiotic Nitrogen Fixation in the Management of Temperate Forests. Forest Research Laboratory, Oregon State University, Corvallis. (See Gordon et al.)

For physiologists, geneticists, and nurserymen. Greenwood stem cuttings from red alder were rooted in 5 weeks when treated with 4,000 to 8,000 ppm indole-3-butyric acid and dusted with 10 percent benlate. Treated cuttings were set in a horticultural growth medium and placed in a warm, humid environment with a daily photoperiod.

Monaco, P. A., T. M. Ching, and K. K. Ching. 1979. IN VIVO AND IN VITRO NITROGENASE ACTIVITY OF ROOT NODULES OF RED ALDER (*ALNUS RUBRA* BONG.) SEEDLINGS. Abstract. Plant Physiology Supplement 63(5):86.

For physiologists. Greenhouse-grown red alder seedlings were tested for nitrogenase activity by the acetylene reduction method 5 weeks after inoculation. Activity was assayed in vivo with whole root-soil systems of intact seedlings and in vitro with detached nodules. Activity was 70 percent greater when measured on intact plants. The nondestructive in vivo assay will facilitate studies on nodule development and host-endophyte interactions.

Monaco, P. A., T. M. Ching, and K. K. Ching. 1980. ROOTING OF *ALNUS RUBRA* CUTTINGS. Tree Planters' Notes 31(3):22-24. (For. Res. Lab.)

For foresters, geneticists, and physiologists. Greenwood cuttings from red alder were readily rooted when treated with high concentrations of indolebutyric acid (IBA) (4,000-8,000 ppm) with 10 percent benonyl and then set in a warm, humid environment. More than 50 percent were rooted 6 weeks after treatment. Rooting response to the environmental conditions depended on the concentrations of IBA.

Muren, R. C., T. M. Ching, and K. K. Ching. 1979. METABOLIC STUDY OF DOUGLAS-FIR POLLEN GERMINATED IN VITRO. Physiologia Plantarum 46:287-292. (For. Res. Lab.)

For physiologists and geneticists. Douglas-fir pollen was germinated and grown in mass in a mineral medium. During a 4-day germination period, a metabolic study detected quantitative changes in sugar, starch, amino acids, proteins, nucleic acids, and energy charge. Respiration and carbon allocation was monitored using ^{14}C-glucose.

Nelson, E. A., and D. P. Lavender. 1979. THE CHILLING REQUIREMENT OF WESTERN HEMLOCK SEEDLINGS. Forest Science 25(3):485-490. (For. Res. Lab.)

For nurserymen and tree physiologists. Seedings of western hemlock preconditioned with 6 weeks of mild, short days required constant chilling for 4 weeks at 5°C to break bud. Those not receiving pretreatment generally required 6 to 8 weeks, still less than required by Douglas-fir. Pretreatment effects and chilling requirements have implications for improving nursery production of western hemlock seedlings.

Newton, M. 1979. ENVIRONMENTAL EFFECTS OF PHENOXY HERBICIDES IN FORESTS. Weeds Today. Winter 1979. (For. Res. Lab.)

For foresters, woodland owners, county agents, and regulatory personnel. Effects of phenoxy herbicides in forests are limited to changes in plant composition and abundance. The principal effect is that conifer forests emerge as the dominant cover—with minimum physical disturbance. Health risks to animals and humans are low. Exposures are low level and transient—even applicators enjoy large safety factors. Overall, the phenoxy herbicides are safe, effective management tools.

Newton, M., and L. A. Norris. 1980. POTENTIAL EXPOSURE OF HUMANS TO 2,4,5-T AND TCDD IN THE OREGON COAST RANGE. *In* Abstracts, Weed Science Society of America. (For. Res. Lab.)

For toxicologists, environmental biologists, land managers, and regulatory personnel. Residents living near major aerial applications of 2,4,5-T in forests are, at worst, exposed briefly to extremely low levels of 2,4,5-T and TCDD. Based on the most conservative published estimates of toxicity, more than 20,000 worst-case exposures would have to occur in a single day to induce the first detectable sign of intoxication. Applicators are exposed much more heavily but still have dosage safety factors of more than 300:1. The overall risk from TCDD appears to be even lower than from 2,4,5-T.

Newton, M., and C. A. Roberts. 1979. BRUSH CONTROL ALTERNATIVES FOR FOREST SITE PREPARATION. P. 1-10 *in* Proceedings, 28th Annual Oregon Weed Control Conference. Salem, Oregon. (For. Res. Lab.)

For foresters, land managers, regulatory personnel, and county agents. Various chemical and nonchemical methods for controlling brush are compared. Favorable and unfavorable effects of each course of action under comparable conditions are discussed. Each method has unique effects. The overall risk is least with the least physical disturbance, but some disturbance occurs with the methods having the most positive results.

Newville, E. G., and W. K. Ferrell. 1980. ABSCISIC ACID LEVELS AND STOMATAL BEHAVIOUR DURING DROUGHT AND RECOVERY IN DOUGLAS-FIR (*PSEUDOTSUGA MENZIESII*). Canadian Journal of Botany 58:1370-1375.

For ecologists, plant physiologists, foresters. Transpiration rates of seedlings of xeric sources were less sensitive to drought cycles than those of mesic sources (the former keep stomates open under higher water stress). Levels of abscisic acid increase sharply to coincide with stomatal closure during initial drought but show no relationship to stomatal closure during subsequent drought.

Perry, D. A. 1979. VARIATION WITHIN AND BETWEEN TREE SPECIES. P. 71-97 *in* Proceedings, The Ecology of Even-Aged Plantations. Institute of Terrestrial Ecology, Edinburgh, Scotland.

For geneticists, ecologists, and silviculturists. Genetic variation within forest trees occurs among populations, among individuals within populations, and among species. Variation among populations, widely studied, usually correlates with an environmental gradient. Variation within populations is apparently large, but its adaptive significance is not yet clear. Variation within and among species in a given forest may be important silviculturally, and selection for the ideotypic community rather than the ideotypic individuals should be considered.

Perry, D. A., and J. E. Lotan. 1979. A MODEL OF FIRE SELECTION FOR SEROTINY IN LODGEPOLE PINE. Evolution 33(3):958-968. (For. Res. Lab.)

For geneticists and silviculturists. Lodgepole pine in the Rocky Mountains persists because of periodic fire. However, cone serotiny, a fire-selected trait, occurs at lower than expected levels. Simulations suggest that variation in fire frequency and severity may result in a polymorphism maintained by temporal environmental diversity.

Perry, D. A., M. Meyer, and D. Egeland. 1979. LONG-TERM EFFECTS OF COMPLETE BIOMASS REMOVAL ON LOGGED SITES IN SOUTHWEST MONTANA. Abstract. P. 142 *in* Impact of Intensive Harvesting on Forest Nutrient Cycling. State University of New York, Syracuse, New York.

For forest ecologists and silviculturists. Decreased seedling growth 13 years after timber harvest and broadcast burning or severe site scarification could be rectified by nitrogen fertilization. Numbers of mycorrhizal root tips were lower in soils from harvested areas than in soils from adjacent undisturbed forest.

Perry, D. A., and G. Pitman. 1979. THE ROLE OF GENETICS AND ENVIRONMENT IN RESISTANCE OF TREES TO INSECTS. Abstract. *In* 30th Annual Proceedings, Western Forest Insect Work Conference. Boise, Idaho.

For geneticists, silviculturists, and forest protection specialists. The genetic-environmental matrix for host-pest relations may be altered by silvicultural activities. Plant defense strategies, both biochemical and phenologic, are usually genetically based; but environment may modify phenotypic expression and thus affect susceptibility. Frequently, genetic uniformity has been shown to increase the susceptibility of plant populations to pests. The intensively managed forest may be more or less susceptible but almost certainly different in this respect from the natural forest.

Perry, D. A., C. T. Wheeler, and O. T. Helgerson. 1979. NITROGEN-FIXING PLANTS FOR SILVICULTURE: SOME GENECOLOGICAL CONSIDERATIONS. P. 243-252 *in* Proceedings, Symbiotic Nitrogen Fixation in the Management of Temperate Forests. Forest Research Laboratory, Oregon State University, Corvallis. (See Gordon et al.)

For silviculturists and foresters. Nitrogen-fixing plants may be used within forest stands to supplement fertilization. The genetic-environmental matrix within which the nitrogen-fixing plant and its symbiont exist must be better understood to pave the way for site-specific genetic selection of both host and symbiont.

Radosevich, S. R., E. J. Roncoroni, S. G. Conard, and W. B. McHenry. 1980. SEASONAL TOLERANCE OF SIX CONIFEROUS SPECIES TO EIGHT FOLIAGE-ACTIVE HERBICIDES. Forest Science 26(1):3-9.

For foresters, silviculturists, and others concerned with forest weed control. The selectivity of 2,4-D; 2,4,5-T; silvex; dichlorprop, triclopyr-fosamine; glyphosate, and asulam applied at different phenological stages was compared for ponderosa pine, Jeffrey pine, sugar pine, Douglas-fir, white fir, and red fir. Applications after fall dormancy generally resulted in the highest conifer tolerance.

Seyer, S. C. 1979. NEW MOSSES FROM CRATER LAKE NATIONAL PARK, OREGON. The Bryologist 82(1):82-83. (For. Res. Lab.)

For naturalists and botanists. Three species are reported new to Oregon: *Bryum weigelii* Spreng., *Helodium blandowii* (Web. & Mohr.) Warnst. var. *blandowii*, and *Drepanocladus vernicosus* (Lindb. ex C. Hartm.) Warnst.

Shields, W. J., Jr., and S. D. Hobbs. 1979. SOIL NUTRIENT LEVELS AND pH ASSOCIATED WITH *ARMILLARIELLA MELLEA* ON CONIFERS IN NORTHERN IDAHO. Canadian Journal of Forest Research 9(1):45-48.

For silviculturists and forest managers. A stepwise discriminant function analysis, based on soil chemical properties at the growing site, was used to differentiate conifers with root decay caused by *Armillariella mellea* (Vahl. ex Fr.) Karst. from conifers without *A. mellea* decay. Discriminant functions developed for Douglas-fir and grand fir were significant. Low soil nitrogen and pH were associated with decayed Douglas-fir; low soil calcium and phosphorus and high potassium were associated with decayed grand fir.

Spycher, G., and J. L. Young. 1979. WATER-DISPERSIBLE SOIL ORGANIC-MINERAL PARTICLES: II. AMORPHOUS AND CRYSTALLINE PHASES IN DENSITY FRACTIONS OF CLAY-SIZE PARTICLES. Soil Science Society of America 43:323-332.

For soil scientists. Clay-organic particles were fractionated by density, and the amorphous particle phase was removed and analyzed for silicon, aluminum, and iron. The crystalline matrices were studied using XRD. A continuum of particle composition and properties was observed and explained in terms of the model proposed in Part I of the study.

Waring, R. H. 1979. SEEKING SYMPTOMS AND PRESCRIBING CURES. Abstract. P. 104-105 *in* Forest Ecosystem Approach to Tree Pest Interactions. 30th Annual Western Forest Insect Work Conference. Boise, Idaho.

For entomologists and foresters. Ecosystems are complex, but they function similarly. Key places within the system

indicate the chain of processes operating. By measuring such variables as sapwood area growth, relative water content of wood, and leaf nutrient stress, trees susceptible to insect attack can be identified.

Waring, R. H. 1980. OPPORTUNITIES AND CONSTRAINTS ON FORESTS IMPOSED BY THEIR NATURE AS ECOLOGICAL SYSTEMS. P. 30-48 *in* Forest Land Use Symposium 1. The Conservation Foundation, 1717 Massachusetts Avenue, Washington, D.C.

For the general public. A key to management is recognizing that forests have similar design and function, though they vary considerably in productivity. This paper describes the working of forest ecosystems and the practices that are detrimental or helpful to nature and man.

Waring, R. H., and J. F. Franklin. 1979. EVERGREEN CONIFEROUS FORESTS OF THE PACIFIC NORTHWEST. Science 204:1380-1386. (For. Res. Lab.)

For the general public. The unique history and composition of the coniferous forests of the Pacific Northwest, now dominated by a few broadly distributed and well-adapted conifers, are surveyed. The conifers have the advantage of winter photosynthesis, nutrient uptake, and storage; deciduous hardwoods are limited to photosynthesis at a time when evaporative demand is high, water is limiting, and most nutrients are less available.

Waring, R. H., and G. B. Pitman. 1980. A SIMPLE MODEL OF HOST RESISTANCE TO BARK BEETLE ATTACK. Forest Research Laboratory, Oregon State University, Corvallis. Research Note 65. 2 p. (For. Res. Lab.)

For foresters and entomologists. The mortality of lodgepole pine is shown in relation to a tree vigor index and intensity of beetle attack.

Waring, R. H., W. G. Thies, and D. Muscato. 1980. STEM GROWTH PER UNIT OF LEAF AREA: A MEASURE OF TREE VIGOR. Forest Science 26(1):112-117. (For. Res. Lab.)

For silviculturists. The ratio of basal area growth to sapwood basal area is shown to correspond with the stemwood-volume production per unit of leaf area. Analysis of 122 healthy Douglas-fir trees in one stand showed this ratio to be consistent among all but suppressed trees. Evaluation of other stands suggests that the ratio may be sensitive to environment and may reflect competition. This assessment of tree vigor will help silviculturists determine optimum stocking and maintain a selected level of vigor.

Waring, R. H., D. Whitehead, and P. G. Jarvis. 1979. THE CONTRIBUTION OF STORED WATER TO TRANSPIRATION IN SCOTS PINE. Plant, Cell and Environment 2(4):309-317.

For plant physiologists, ecologists, and hydrologists. The amount of water available diurnally and annually from storage tissues was measured in plots of Scots pine trees with four different population densities in a 40-year-old plantation in northeastern Scotland. The water storage capacity of stems, branches, and foliage was estimated from equations derived from harvested trees and measurements of relative water content. Trees on the lowest-density plot occasionally had slightly higher relative water contents and diurnal fluctuations than those on the highest-density plot, possibly because of differences in wood density. Sapwood water content was generally lower at times of high transpiration rate and in winter during freezing.

Webber, J. E., M. L. Laver, J. B. Zaerr, and D. P. Lavender. 1979. SEASONAL VARIATION OF ABSCISIC ACID IN THE DORMANT SHOOTS OF DOUGLAS-FIR. Canadian Journal of Botany 57(5):534-538.

For wood chemists and plant physiologists. Abscisic acid (ABA) in dormant shoots of Douglas-fir was confirmed by bioassay, thin-layer chromatography and gas-liquid chromatography/mass chromatography spectrometry. Seasonal variation was then determined with *2-trans*-ABA as an internal standard. ABA concentrations were highest for buds and needles in autumn and highest for stems in January. All tissues had lowest concentrations in February and March before bud burst. Close correlation of ABA levels with other evidence of growth and metabolic activity suggests a possible role in the dormancy cycle of Douglas-fir.

Wheeler, C. T., J. C. Gordon, and T. M. Ching. 1979. OXYGEN RELATIONS OF THE ROOT NODULES OF *ALNUS RUBRA* BONG. The New Phytologist 82:449-457. (For. Res. Lab.)

For tree physiologists. Acetylene reducing activity of *Alnus rubra* nodules is maximum in 15 to 30 percent oxygen.

Within the nodule, frequent large spaces between uninfected cells in the outer cortex facilitate air diffusion through the lenticels to infected cells in the mid-cortex. Access of air to these cells that run at an angle from the stele towards the nodule apex is restricted by fewer and smaller air spaces. High peroxidase and o-diphenol oxidase activity in the cytoplasm of infected cells does not correlate with nitrogenase activity, which suggests the enzyme activity does not affect access of oxygen to the endophyte.

Wheeler, C. T., D. A. Perry, O. Helgerson, and J. C. Gordon. 1979. WINTER FIXATION OF NITROGEN IN SCOTCH BROOM (*CYTISUS SCOPARIUS* L.). The New Phytologist 82:697-701. (For. Res. Lab.)

For silviculturists and forest ecologists. The retention of green lateral branches by Scotch broom allows nitrogen fixation to continue during mild winters. Tolerance of low soil temperatures may be a major factor contributing to winter nitrogen fixation.

White, T. L., K. K. Ching, and J. Walters. 1979. EFFECTS OF PROVENANCE, YEARS, AND PLANTING LOCATION ON BUD BURST OF DOUGLAS-FIR. Forest Science 25(1):161-167. (For. Res. Lab.)

For geneticists and physiologists. Date of bud burst was monitored on Douglas-fir saplings from 16 Pacific Northwest provenances. Those from areas with low summer rainfall tended to have early bud burst. The field results and results of recent growth-room studies indicated that summer drought in some Pacific Northwest areas may have resulted in natural selection of seedlings with early bud burst.

Forestry-Related Publications

Other published materials pertinent to forestry readers are listed here. Publication inquiries should be directed to the author's department (indicated in parentheses), Oregon State University, or to the address given.

Anderson, J. B., R. C. Ullrich, L. F. Roth, and G. M. Filip. 1979. GENETIC IDENTIFICATION OF CLONES OF *ARMILLARIA MELLEA* IN CONIFEROUS FORESTS IN WASHINGTON. Phytopathology 69:1109-1111. (Dep. Bot. Plant Pathol.)

Bowers, W., B. Hosford, A. Oakley, and C. Bond. 1979. WILDLIFE HABITATS IN MANAGED RANGELANDS—THE GREAT BASIN OF SOUTHEASTERN OREGON. NATIVE TROUT. USDA Forest Service, Pacific Northwest Forest and Range Experiment Station, Portland, Oregon. General Technical Report PNW-84. 16 p. (Dep. Fish. Wildl.)

Brown, K. N. 1979. CALIBRATING A KNAPSACK SPRAYER FOR REFORESTATION AND CHRISTMAS TREE WEED CONTROL. EC 962. Oregon State University Extension Service, Corvallis. (Ext. Serv.)

Crabtree, G., and L. H. Fuchigami. 1979. VEGETATIVE MATURITY OF RED-OSIER DOGWOOD AND RESPONSE TO HERBICIDES. HortScience 14:753-755. (Dep. Hortic.)

Dost, F. N. 1978. TOXICOLOGY OF PHENOXY HERBICIDES AND HAZARD ASSESSMENT OF THEIR USE IN REFORESTATION. USDA Forest Service, Region 5. 630 Sansome Street, San Francisco, California 94111. (Dep. Agric. Chem.)

Fuchigami, L. H., and F. W. Moeller. 1978. ROOT REGENERATION OF EVERGREEN PLANTS. Proceedings, International Plant Propagation Society 28:39-49. (Dep. Hortic.)

Hansen, E. M. 1979. NUCLEAR CONDITION AND VEGETATIVE CHARACTERISTICS OF HOMOKARYOTIC AND HETEROKARYOTIC ISOLATES OF *PHELLINUS WEIRII*. Canadian Journal of Botany 57:1579-1582. (Dep. Bot. Plant Pathol.)

Hansen, E. M. 1979. SEXUAL AND VEGETATIVE INCOMPATIBILITY REACTION IN *PHELLINUS WEIRII*. Canadian Journal of Botany 57:1573-1578. (Dep. Bot. Plant Pathol.)

Hansen, E. M. 1979. SURVIVAL OF *PHELLINUS WEIRII IN* DOUGLAS-FIR STUMPS AFTER LOGGING. Canadian Journal of Forest Research 9:484-488. (Dep. Bot. Plant Pathol.)

Hansen, E. M., P. B., Hamm, A. J. Julis, and L. F. Roth. 1979. ISOLATION, INCIDENCE, AND MANAGEMENT OF PHYTOPHTHORA IN FOREST TREE NURSERIES IN THE PACIFIC NORTHWEST. Plant Disease Reporter 63:607-611. (Dep. Bot. Plant Pathol.)

Hansen, E. M., L. F. Roth, P. B. Hamm, and A. J. Julis. 1980. SURVIVAL SPREAD AND PATHOGENICITY OF PHYTOPHTHORA SPP. ON DOUGLAS-FIR SEEDLINGS PLANTED ON FOREST SITES. Phytopathology 70:422-425. (Dep. Bot. Plant Pathol.)

Kehr, R., and R. D. Layton. 1979. A PROCEDURE TO IDENTIFY AND EVALUATE FOREST ARTERIAL AND COLLECTOR ROAD NETWORKS. Transportation Research Report 79-1. Oregon State University, Corvallis. 331 p. (Dep. Civil Engr.)

Oliveira, R. A., and G. W. Whittaker. 1978. MULTIVARIATE TIME SERIES ANALYSIS OF RELATIONSHIPS BETWEEN U.S. LUMBER PRICES, HOUSING STARTS, AND LOG EXPORTS OF JAPAN. Agricultural Experiment Station Technical Paper 5047. Oregon State University, Corvallis. 16 p. (Dep. Agric. Resour. Econ.)

Oliveira, R. A., and G. W. Whittaker. 1979. AN EXAMINATION OF DYNAMIC RELATIONSHIPS—AND THE LACK THEREOF—AMONG U.S. LUMBER PRICES, U.S. HOUSING STARTS, U.S. LOG EXPORTS TO JAPAN, AND JAPANESE HOUSING STARTS. Agricultural Experiment Station Special Report 565. Oregon State University, Corvallis. 34 p. (Dep. Agric. Resour. Econ.)

Roberts, A. N. 1979. PROGRESS IN PROPAGATING DOUGLAS-FIR CHRISTMAS TREES FROM CUTTINGS. Northwest Lookout 12(3):20,22-24. (Dep. Hortic.)

Roberts, A. N., and F. W. Moeller. 1978. PHASIC DEVELOPMENT AND PHYSIOLOGICAL CONDITIONING IN THE ROOTING OF DOUGLAS-FIR SHOOTS. Proceedings, International Plant Propagation Society 28:32-39. (Dep. Hortic.)

Rose, S., B. A. Daniels, and J. M. Trappe. 1979. *GLOMUS GERDEMANNII* SP. Mycotaxon 8:297-301. (Dep. Bot. Plant Pathol).

Rose, S. L., C. Y. Li, and A. S. Hutchins. 1980. A STREPTOMYCETE ANTAGONIST *PHELLINUS WEIRII, FOMES ANNOSUS,* and *PHYTOPHTHORA CINNAMOMI*. Canadian Journal of Microbiology 26:583-587. (Forestry Sciences Laboratory, 3200 Jefferson Way, Corvallis, Oregon 97330)

Rose, S. L., and J. M. Trappe. 1980. THREE NEW ENDOMYCORRHIZAL *GLOMUS* SPP. ASSOCIATED WITH ACTINORRHIZAL SHRUBS. Mycotaxon 10:413-420. (Forestry Sciences Laboratory, 3200 Jefferson Way, Corvallis, Oregon 97330)

Roth, L. F. 1979. FOREST PATHOLOGY IN THE WEST—PAST, PRESENT AND FUTURE. P. 3-11 *in* Proceedings, Western International Forest Disease Work Conference 27. Salem, Oregon. (Dep. Bot. Plant Pathol.)

Roth, L. F. 1979. FOREST PEST MANAGEMENT AND INTENSIVE FORESTRY CONFLICTS AND OPPORTUNITIES—"DISEASE MANAGEMENT." Abstract. P. 59 *in* Proceedings 49, Western Forestry and Conservation Association. Sacramento, California. (Dep. Bot. Plant Pathol.)

Roth, L. F., and L. Rolph.1979. MARKING GUIDES TO REDUCE ARMILLARIA ROOT ROT IN PONDEROSA PINE ARE EFFECTIVE. Forest Science 24:451-454. (Dep. Bot. Plant Pathol.)

Roth, L. F., L. Rolph, and S. Cooley. 1980. IDENTIFYING INFECTED PONDEROSA PINE STUMPS TO REDUCE COSTS OF CONTROLLING *ARMILLARIA* ROOT ROT. Journal of Forestry 78:145-151. (Dep. Bot. Plant Pathol.)

Rudinsky, J. A. 1979. CHEMOACOUSTICALLY-INDUCED BEHAVIOR OF *IPS TYPOGRAPHUS*. Zeitschrift fuer Angewandte Entomologie 8:537-541. (Dep. Entomol.)

Rudinsky, J. A. (ed.). 1979. FOREST INSECT SURVEY AND CONTROL. OSU Book Stores. Inc.. Corvallis, Oregon. 472 p. (Dep. Entomol.)

Rudinsky, J. A. 1979. INHIBITORY OR ANTIATTRACTANT PHEROMONES IN BARK BEETLE CONTROL. P. 405-415 *in* Forest Insect Survey and Control. OSU Book Stores. Inc., Corvallis, Oregon. 472 p. (Dep. Entomol.)

Rudinsky, J. A., and L. C. Ryker. 1979. FIELD BIOASSAY OF MALE DOUGLAS-FIR BEETLE PHEROMONE 3-METHYLCYCLOHEX-3-EN-1-ONE. Experientia 35:1302. (Dep. Entomol.)

Rudinsky, J. A., and L. C. Ryker. 1980. MULTIFUNCTIONALITY OF DOUGLAS-FIR BEETLE PHEROMONE 3,2-MCH CONFIRMED WITH SOLVENT DIBUTYL PHTHALATE. Journal of Chemical Ecology 6:193-201. (Dep. Entomol.)

Rudinsky, J. A., and S. Vernoff. 1979. EVIDENCE OF FEMALE-PRODUCED AGGREGATIVE PHEROMONE IN *LEPERISINUS CALIFORNICUS*. Pan-Pacific Entomologist 55:299-303. (Dep. Entomol.)

Ryker, L. C., L. M. Libbey, and J. A. Rudinsky. 1979. COMPARISON OF VOLATILE COMPOUNDS AND STRIDULATION EMITTED BY THE DOUGLAS-FIR BEETLE FROM IDAHO AND WESTERN OREGON POPULATIONS. Environmental Entomology 8:789-798. (Dep. Entomol.)

Shirazi, M. A., D. H. Lewis, and W. K. Seim. 1979. MONITORING SPAWNING GRAVEL IN MANAGED FORESTED WATERSHEDS—A PROPOSED PROCEDURE. U.S. Environmental Protection Agency, Ecological Research Series, EPA-600/3-79-014. (Dep. Fish. Wildl.)

Sorenson, G. W., P. Bible, and J. J. Garland. 1979. A DOCUMENTATION OF THE LABOR MARKET, TRAINING, AND APPRENTICESHIP DIMENSIONS OF A WOODWORKING TRAINING PROGRAM. Final Report to Employment and Training Administration, U.S. Department of Labor. National Technical Information Service, Springfield, Virginia 22151. 227 p. (Dep. Econ.)

Stevens, J. B. 1978. THE OREGON WOOD PRODUCTS LABOR FORCE: JOB RATIONING AND WORKER ADAPTIONS IN A DECLINING INDUSTRY. Oregon Agricultural Experiment Station, Corvallis. 183 p. (Dep. Agric. Resour. Econ.)

Taskey, R. D., M. E. Harward, and C. T Youngberg. 1979. RELATIONSHIPS OF CLAY MINERALOGY AND LANDSCAPE STABILITY. P. 140-173 *in* Forest Soils and Land Use. (Dep. Soil Sci.)

Warren, C. E. 1979. TOWARD CLASSIFICATION AND RATIONALE FOR WATERSHED MANAGEMENT AND STREAM PROTECTION. U.S. Environmental Protection Agency, Ecological Research Series, EPA-600/3-79-059. (Dep. Fish. Wildl.)

Will, G. M., and C. T. Youngberg. 1979. SOME FOLIAGE NUTRIENT LEVELS IN TREES AND BRUSH SPECIES GROWING ON PUMICE SOILS IN CENTRAL OREGON. Northwest Science 4:274-276. (Dep. Soil Sci.)

Youngberg, C. T., A. G. Wollum, and W. Scott. 1979. *CEANOTHUS* IN DOUGLAS-FIR CLEARCUTS: NITROGEN ACCRETION AND IMPACT ON REGENERATION. P. 224-233 *in* Symbiotic Nitrogen Fixation in the Management of Temperate Forests. (Dep. Soil Sci.)

Audio-Visual Packages

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By J. Garland, Timber Harvesting Extension Specialist.

For forest engineers, forest managers, forestry students, and others interested in logging. Discusses the important dimensions of skyline logging in the Pacific Northwest. Current research and innovations and a variety of skyline systems are shown.

GLUELINE MOISTURE PROBLEMS
24 minutes, 69 slides, $80 **S-T 700.6**
By J. D. Wellons and T. Brown, Department of Forest Products.

For plywood-production supervisors, gluing foreman, quality-control personnel, and university students. Describes interactions between wood and water in plywood production: moisture content of veneer, moisture movements during storing and processing. Shows how to detect and prevent gluing problems due to moisture.

WOODEN BOAT INSPECTION AND MAINTENANCE
29 minutes, 110 slides, $90 **S-T 716.4**
By G. Helsing, D. Wagner, and R. D. Graham, Department of Forest Products.

For owners and builders of boats. Describes common organisms and processes causing decay in wooden boats. Shows how to prevent decay, how to inspect boats for decay, and how to make durable repairs. Focuses on the West Coast of the United States, but the principles are widely applicable.

ESTIMATING BUFFER STRIP SURVIVAL
12 minutes, 67 slides, $80 S-T 779
By G. Wingate, Forest Watershed Extension Specialist, and T. Mooster, Forestry Media Center.

For forest managers. Describes seven factors influencing the amount of wind damage and a way to predict survival in streamside buffer strips. Based on research conducted from 1975 to 1977 by Steinblums and Froehlich of the School of Forestry on 40 buffer strips in the western Cascade Mountains of Oregon.

FOREST PRACTICES AND SURFACE EROSION
20 minutes, 137 slides, $95 S-T 795
By R. Sidle, Forest Watershed Extension Specialist.

For forest managers, forest practice officers, and forestry students. Describes basic soil erosion process caused by disturbance and compaction during timber harvesting, roadbuilding, and site preparation. Gives many techniques to help minimize surface erosion in forests of the Pacific Northwest.

FOREST PRACTICES AND MASS SOIL MOVEMENT
20 minutes, 107 slides, $90 S-T 813
By R. Sidle, Forest Watershed Extension Specialist, and T. Luba, Forestry Media Center.

For forest managers, engineers, students, and forest practice officers. Describes basic mass erosion processes on steep forested slopes caused by roadbuilding, timber harvesting, and site preparation. Gives general principles and specific techniques to help minimize mass soil movement in the Pacific Northwest.

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BUDGET SUMMARY

July 1, 1979 - June 30, 1980

Income	$ Thousands
State General Fund	1,087
Forest Products Harvest Tax	978
McIntire-Stennis funds	350
Gift, fee, other	290
	2,705

Expenses	
Forest Regeneration	456
Forest Ecology, Culture, and Productivity	367
Integrating Protection of Forests and Watersheds	219
Evaluating Forest Uses, Practices, and Policies	252
Efficiencies in Wood and Energy Use	368
Assuring Product and Structure Performance	322
Program Support	721
	2,705

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